



**HAL**  
open science

# The Opportunity Cost of Time in the History of Economic Thought

Anil Alpman

► **To cite this version:**

| Anil Alpman. The Opportunity Cost of Time in the History of Economic Thought. 2025. <hal-04996265>

**HAL Id: hal-04996265**

**<https://hal.science/hal-04996265v1>**

Preprint submitted on 18 Mar 2025

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Copyright - All rights reserved

**UCO Cahiers de recherche en économie-gestion**

*N° 2024-eco-10*

**UCO Working Paper Series in Economics and Business Administration**

*N° 2024-eco-10*

**Decembre  
2024**

# **The Opportunity Cost of Time in the History of Economic Thought**

---

**Anil Alpman**

UCO Angers



**UCO**

UNIVERSITÉ  
CATHOLIQUE DE L'OUEST

**EGEI**

Éthique et Gouvernance  
de l'Entreprise et des Institutions

Université catholique de l'Ouest  
Faculté de Droit, Économie, Gestion et Science politique

3 place André Leroy, 49008 Angers, France

Responsable : Karl-F. ISRAEL, [kisrael@uco.fr](mailto:kisrael@uco.fr)

<https://recherche.uco.fr/equipe/egei>

# The Opportunity Cost of Time in the History of Economic Thought

Anil Alpman\*

UCO

February 2024

## Abstract

This paper traces the historical development of the opportunity cost of time, beginning with Stanley Jevons. It is only in the recent past that the various factors influencing the opportunity cost of non-market time have been elucidated. However, the literature that highlights the discrepancy between the wage rate and the opportunity cost of time has been largely overlooked by economists, who have instead relied on the leisure-income model for empirical applications. The forgotten literature, which is recovered in this paper, calls for a closer examination of those empirical applications, and it offers a new perspective on labor supply paradigms.

**Keywords:** Opportunity cost of time; labour; leisure; time allocation; history of economic thought.

**JEL:** B13; B21; D11; J22.

## 1 Introduction

Economists have adopted the practice of equating the opportunity cost of time spent outside the labour market to forgone wages, rarely questioning the validity of the equality. After all, this notorious equality is stated in all textbooks presenting the leisure-income model. Yet, a forgotten literature shows that forgone wages rarely reflect the opportunity cost of non-market time. In the rare occasions where economists have mentioned this point (e.g., Gronau, 1986), they have not referred to the original authors who have unveiled the inequality between the wage rate and the opportunity cost time spent outside the labour

---

\*aalpman@uco.fr

market, which has created a gap in the literature. This paper brings back to light the lost literature by tracing the historical development of the opportunity cost of time.

The investigation carried out in this paper shows that much of the difficulty in defining accurately the opportunity cost of non-market time came from a failure to describe properly the articulation between the alternative uses of time and the joint products of time spent in the labour market. For instance, by defining labour as “any painful exertion of body or mind undergone with the view to future good”, Jevons (1871) considers that each unit of time allocated to labour yields simultaneously two products: a commodity that enhances the utility of the individual, and a commonly painful experience that generates disutility. However, Jevons (1871) does not take into account the utility of alternative uses of time. In contrast, the leisure-income model takes into account the alternative uses of time but omits the disutility of labour, considering income as the sole output of time spent in the labour market. Hence, the literature (Derobert, 2001; Spencer, 2003a; Spencer 2008) has noticed ‘the disappearance of labour’ in the transition from Jevons’ (1871) model to the leisure-income model.

Exploring those two models through the lens of opportunity costs reveals some unnoticed aspects, especially regarding implicit assumptions that may not have been intended by the authors. For instance, we will see that Jevons (1871) determines the optimal duration of labour in a way that is not consistent with the utility maximisation rule he had established previously in his book, which led him to set, inadvertently, the opportunity cost of leisure to zero. Furthermore, the literature that is brought back to light in this paper shows that Jevons’ (1871) model and the leisure-income model are both particular cases of a general time allocation model that was formally derived by Johnson (1966).

The general model of Johnson (1966) considers the joint products of labour, as described in Jevons (1871), together with the alternative uses of time, yielding therefore an opportunity cost of non-market time which is lower than the wage rate. Johnson (1966) arrives at this conclusion simply by adding the disutility of labour to the canonical leisure-income model. With this information in hand, we may wonder why economists still rely on the leisure-income model and equate the opportunity cost of non-market time to forgone wages. In fact, we may ask ourselves why the leisure-income model received any acceptance in the first place, since Clark (1893) had already described, as we shall see, the opportunity cost of non-market time that results from a model that considers the disutility of labour and the alternative uses of time. What makes the equality between the wage rate and the opportunity cost of time so compelling that it displaced the general model from the literature not just once, but twice? The clues gathered in this paper suggest that economists have overlooked the disutility of labour and choose to equate the value of time spent in non-market activities to forgone wages because this equality opens a wide range of empirical applications, given the relative ease of obtaining data on wages.

Finally, we will see that the disutility of labour is not the only factor overlooked when one assumes that the opportunity cost of non-market time is equal to forgone wages: shortly after Johnson (1966), economists have shown that expenditures associated with

labour and constraints on the duration of labour also generate a discrepancy between the wage rate and the opportunity cost of time. By overlooking all the factors that affect the opportunity cost of time allocated to non-market activities, little attention was given to the information conveyed by the discrepancy between the wage rate and opportunity cost of time allocated to non-market activities.

The next section presents the formal derivation of the opportunity cost of time. Section 3 explores the labour supply model of Jevons (1871). Section 4 discusses the leisure-income model. Section 5 presents the discoveries that invalidate the equality between forgone wages and the opportunity cost of time allocated to non-market inequalities.

## 2 Formal Derivation of the Opportunity Cost of Time

The leisure-income model, which is also referred to as the labor-leisure choice model in some textbooks (e.g., Borjas, 2015), provides a framework for analysing the partition of time between the labour market and leisure.<sup>1</sup> The model posits that the utility of an individual, which I denote  $U$ , depends on the amount of leisure time (denoted  $t_L$ ) and on the consumption quantity of a representative good (denoted  $x$ ).<sup>2</sup> The utility function writes  $U = u(t_L, x)$ .

The individual faces two constraints: an income constraint and a time constraint. The former is given by  $px \leq wt_M + V$  where  $p$  is the price of the good,  $w$  is the wage rate,  $t_M$  is the amount of time spent on the labour market, and  $V$  denotes non-labour income. The time constraint is  $t_L + t_M \leq T$  where  $T$  is the amount of time available (e.g., 24 hours).

The typical presentation of the leisure-income model would, at this stage, combine the two constraints. However, the studies that we will review in this paper show that there are cases where the two constraints cannot be combined. To facilitate the discussion of those papers, I will solve the consumer problem by keeping the constraints separate. The consumer problem consists in maximising the utility function given the income and time constraints. The Lagrange function associated with this problem is

$$\mathcal{L} = u(t_L, x) + \lambda (wt_L + V - px) + \mu (T - t_L - t_w) \quad (1)$$

and the first order conditions are:

$$\left\{ \begin{array}{l} \frac{\partial \mathcal{L}}{\partial t_L} = \frac{\partial u}{\partial t_L} - \mu = 0 \\ \frac{\partial \mathcal{L}}{\partial x} = \frac{\partial u}{\partial x} - \lambda p = 0 \\ \frac{\partial \mathcal{L}}{\partial t_M} = \lambda w - \mu = 0 \end{array} \right. \Rightarrow \frac{\partial u}{\partial t_L} = \mu \quad (2a)$$

$$\Rightarrow \left( \frac{\partial u}{\partial x} \right) / p = \lambda \quad (2b)$$

$$\Rightarrow w = \frac{\mu}{\lambda} \quad (2c)$$

<sup>1</sup>In the leisure-income model, *leisure* corresponds to the amount of time allocated to all non-market activities; however the model does not address the alternative uses of time among non-market activities.

<sup>2</sup>Extending the number of goods consumed by the individual does not alter the predictions regarding opportunity costs associated with the allocation of time.

$\lambda$  is the marginal utility of income (equation [2b]).  $\mu$  appears in equation (2a) and (2c): in the former, it is equal to the marginal utility of leisure time; in equation (2c), it is equal to the marginal utility of the wage rate ( $\mu = \lambda w$ ). Since  $\lambda$  is the marginal utility of income and  $w$  is the income received for each additional unit of work time, the product of both, which is equal to  $\mu$ , reflects the marginal indirect utility of time allocated to the labour market. Therefore, the first order conditions tell us that utility is maximised when the marginal utility of time allocated to leisure is equal to the marginal indirect utility of time allocated to the labour market:

$$\lambda w = \left( \frac{\partial u}{\partial t_L} \right) = \mu \quad (3)$$

Since both marginal utilities are equalised, we can refer to  $\mu$  simply as the marginal utility of time (without having to mention whether it is the marginal utility of time allocated to the labour market or to leisure). We can also interpret equation (3) in terms of opportunity costs: in equilibrium, the opportunity cost of a unit of leisure time is the utility that one would get by allocating that unit of time to the labour market, which corresponds to the utility of the wage rate.

Since  $\mu$  is the marginal utility of time and  $\lambda$  is the marginal utility of income, dividing all the terms of equation (3) by  $\lambda$  expresses the terms of equation (3) in monetary unit, thus yielding the opportunity cost of time in monetary unit (DeSerpa, 1971; Gronau, 1986):

$$w = \left( \frac{\partial u}{\partial t_L} \right) / \lambda = \frac{\mu}{\lambda} \quad (4)$$

The first term, that is, the wage rate ( $w$ ), is the monetary value of a unit of time spent in the labour market. The second term,  $(\partial u / \partial t_L) / \lambda$ , is the monetary value that individuals attribute to a unit of leisure time. The third term,  $\mu / \lambda$ , is the opportunity cost of time expressed in monetary unit. As long as individuals attribute to their leisure time a monetary value that is lower than the wage rate, they will allocate their time to the labour market. Utility is eventually maximised when the monetary value that individuals attribute to their last unit of leisure time is equal to the wage rate. Equation (4) thus shows the notorious equality between the opportunity cost of a unit of leisure time, *expressed in monetary terms*, and the wage rate.

We will now make a modification by assuming, as Johnson (1966), that time spent in the labour market generates direct disutility. Mathematically speaking, fitting this assumption to the standard leisure-income model requires just a minor modification: the utility function now writes  $U = u(t_L, x, t_M)$ , the constraints remain the same, and, of the first order conditions in (2a), (2b), and (2c), only the last one changes to become

$$\frac{\partial \mathcal{L}}{\partial t_M} = \frac{\partial u}{\partial t_M} + \lambda w - \mu = 0 \quad \Rightarrow \quad w + \left( \frac{\partial u}{\partial t_L} \right) / \lambda = \frac{\mu}{\lambda} \quad (5)$$

With the new assumption, equation (3) becomes

$$\underbrace{\lambda w}_{\text{marginal utility of time allocated to the labour market}} + \underbrace{\left(\frac{\partial u}{\partial t_M}\right)}_{\text{marginal direct disutility of time allocated to the labour market,}} = \left(\frac{\partial u}{\partial t_L}\right) = \mu \quad (6)$$

*overall marginal utility of time allocated to the labour market*

and equation (4) becomes

$$\underbrace{w}_{\text{marginal utility of time allocated to the labour market, expressed in monetary terms}} + \underbrace{\left(\frac{\partial u}{\partial t_M}\right)/\lambda}_{\text{marginal direct disutility of time allocated to the labour market, expressed in monetary terms}} = \left(\frac{\partial u}{\partial t_L}\right)/\lambda = \frac{\mu}{\lambda} \quad (7)$$

*overall marginal utility of time allocated to the labour market, expressed in monetary terms*

Compared to equations (3) and (4), only the terms in the left hand side have changed in equations (6) and (7), and their interpretations are directly noted in the equations. Given the specification of the utility function, each unit of time allocated to the labour market affects the utility in two ways: (i) a unit of time allocated to the labour market affects utility *indirectly* as it provides the individual with the necessary income to buy the representative good, (ii) a unit of time allocated to the labour market generates *direct disutility* ( $\partial u/\partial t_M < 0$ ) based on the emotions felt during labour. The partial derivative of  $u$  with respect to  $t_M$  would be positive if labour generates more pleasure than pain. Yet, we will use the term *disutility* to avoid confusing it with the *indirect utility* of labour. We will use the term *overall* utility of labour to refer to the sum of the indirect utility and the direct disutility.

If time allocated to the labour market generates direct disutility (e.g., boredom, fatigue, stress), equation (7) shows that the monetary value of the opportunity cost of leisure would be lower than the wage rate. However, the monetary value of the opportunity cost of leisure would be higher than the wage rate if  $\partial u/\partial t_M > 0$ , which means that labour generates direct utility.

### 3 The Absence of the Opportunity Cost of Time in Jevons' Theory

Jevons (1871) considers labour as an instance of joint production. On the one hand, it is through labour that individuals produce utility-generating commodities. On the other hand, labour is associated with psychical and physical states that also affect utility. While labour can trigger simultaneously positive and negative emotions, Jevons (1879, p. 178) argues that the general experience is negative: “we might in fact treat labour as simply one case of disutility or negative utility, that is as pain, or at any rate as a generally painful balance of pleasure and pain, endured in the action of acquiring commodity”.

In this framework, Jevons (1871, p.169) explains that individuals will continue to work

as long as the marginal indirect utility of labour (i.e., the additional utility provided by the increase in the quantity of commodity that results from one additional unit of work time) is greater than the marginal disutility of labour. Therefore, Jevons (1871, p. 173) determines the optimal work duration with the following equation:  $\partial l/\partial t = (\partial u/\partial x)(\partial x/\partial t)$ . In Jevons' (1871, p. 170) notation,  $l$  is the aggregate balance of pain accompanying labour,  $t$  is the duration of labour,  $u$  is total utility of the commodity, and  $x$  is the quantity of commodity.

According to Jevons (1879, p. 65 and 178), the dimension of  $l$  is identical with that of utility such that  $\partial l/\partial t \equiv -\partial u/\partial t$  (with  $\partial u/\partial t < 0$ ): "pleasure and pain must be regarded as measured upon the same scale, and as having, therefore, the same dimensions, being quantities of the same kind, which can be added and subtracted". We can thus rewrite the equation of Jevons (1871) as

$$\frac{\partial u}{\partial x} \frac{\partial x}{\partial t} + \frac{\partial u}{\partial t} = 0 \quad (8)$$

The left hand side (LHS) of the equation above is completely identical to the LHS of equation (3),  $\lambda w + \partial u/\partial t_M$ , since, in the leisure-income model,  $(\partial u/\partial x)(\partial x/\partial t) = \lambda w$ .<sup>3</sup> We see that the analytical framework of labour supply in neoclassical economics is not incompatible with Jevons' concept of the disutility of labour: we recover, in the same way as he does, the joint products of labour when we add to the basic leisure-income model the assumption that labour time generates direct disutility. Therefore, the "disappearance of work" (Spencer, 2003a) and the "labor-less labor supply model" (Derobert, 2001), which refers to the canonical leisure-income model, appears to be the result of the choice of economists not to include the disutility of labour in their models.

If we were to refer to the leisure-income model as the labor-less labor supply model (Derobert, 2001), we may equally refer to Jevons' (1871) labour supply model as the *leisure-less labour supply model*: according to Jevons (1871), individuals maximise their utility when the marginal indirect utility of time allocated to labour is equal to its marginal disutility, which implies that the *overall* marginal utility of labour time is equal to 0 (equation 8). Conceptually, this prediction fits the neoclassical framework under one condition: the marginal utility of leisure must be zero, which is the only difference between equation (3) and (8): the right hand side of the former is equal to  $\partial u/\partial t_L$  while that of Jevons' equation (i.e., equation [8]) is 0. Therefore, in Jevons' (1871) perspective, when individuals stop working and do leisure, the opportunity cost of leisure is nil, which implies that the value of leisure is nil. This point reveals a weakness in Jevons' (1871) theory: if individuals stop to work at one point and allocate their time for their physiological needs, this means that they derive some utility from them in the same way individuals derive utility from necessity goods. Jevons (1871), who recognises that labour causes 'exhaustion', would have probably not denied that moments of rest (and other uses of

<sup>3</sup>Equation (2b) shows that  $\partial u/\partial x = \lambda p$ . On the other hand, isolating  $x$  in the budget constraint gives  $x = (wt_M + V)/p$ . Deriving this expression with respect to  $t_M$  gives:  $\partial x/\partial t_M = w/p$ . Therefore,  $(\partial u/\partial x)(\partial x/\partial t_M) = \lambda p(w/p) = \lambda w$ .

time such as the time spent with family and friends) provide utility. Johnson (1966) comments on this issue as follows: “nor is there any indication that individuals who do find their work disagreeable do not attach subjective utility to leisure above and beyond its opportunity cost.” Similarly, Oort (1969), commenting equation (6), remarks that setting the marginal utility of leisure to 0, as in equation (8), leads to a “well-known but equally misleading conclusion”. Indeed, equation (6) seems to provide a more accurate prediction regarding the duration of labour than equation (8): individuals work as long as the *overall* marginal utility of time allocated to work, which includes the direct disutility of labour ( $[\partial u/\partial x][\partial x/\partial t_M] + [\partial u/\partial t_M]$ ) is greater than the marginal utility of time allocated to leisure.

Curiously, Jevons (1871, 69), while speaking about the allocation of income earlier in his book, had established that utility is maximised when the marginal utilities derived from alternative uses of a resource are equalised across those uses. However, it seems that Jevons (1871) was entangled between the alternative uses of time and its joint products, as he failed to apply his optimisation rule to the allocation of time: instead of equalising the overall marginal utilities of the alternative uses of time to determine the duration of labour, he equalised the marginal utilities of the joint products of labour, which prevented him to unveil the opportunity costs associated with the allocation of time. This point constitutes the source of the weakness in Jevons’ (1871) approach, as explained by Knight (1921): “if there is no alternative there is no sacrifice, nor any motivation, valuation, or ‘problem’ of any kind”.

The existence of joint products should not alter the way the optimal allocation of resources are determined. Consider, for instance, that I have some income that I want to allocate between candies and fruits. Economists, including Jevons (1871, 69), would say that I would maximise my utility if I spend my money such that the marginal utility per dollar of candies is equal to that of fruits. Now, take also into account the disutility of candies caused by the deterioration of the dental hygiene (candies are now considered as generating joint products). How will I allocate my income? Will my demand for candies be based on the equality between the marginal utility of candies and its marginal disutility, without any consideration for the marginal utility of fruits? No, I will rather consider the marginal disutility of a candy together with its marginal utility, and I will equate the *overall* marginal utility of candies to the marginal utility of fruits.

The articulation between the disutility of labour and the alternative uses of time has sparked heated debates among economists toward the late 1890s and early 1900s. As we shall explore in the next section, those who criticised Jevons’ (1871) approach may have swung too far to the opposite extreme, completely disregarding the disutility of labour. Yet, correcting the flaw in Jevons’ model did not require to fully omit the disutility of labour.

## 4 Defining the Wage Rate as the Opportunity Cost of a Unit of Time

Derobert (2001) identifies Wicksteed (1910) as the first economist who lay down the foundation of the canonical leisure-income model, which was later completed by Black (1939) and Scitovsky (1951). Spencer (2003b), on the other hand, notes that Wicksteed (1910) simply placed “a formal gloss” on concepts developed prior to him. Indeed, within the two decades preceding Wicksteed (1910), economists started to account for the utility that individuals derive from alternative uses of time in the determination of labour supply. For instance, Green (1894) notes that “the laborer stops work at a certain hour, not simply because he is tired, but because he wants some opportunity for pleasure and recreation. [...] By devoting our efforts to any one task, we necessarily give up the opportunity of doing certain other things which would yield us some return”.

While Green (1894) clearly applies the concept of opportunity cost to the allocation of time, he does not omit the direct disutility of labour. Neither does Böhm-Bawerk (1894): “the Austrian school, for instance, has never denied that in certain cases disutility acts together with utility as an ultimate standard of value. [...] I expressly recognised the disutility of labour”. Wicksteed (1910), on the other hand, ditches completely the disutility of labour. First, he simply neglects it: “we neglect the consideration of any irksomeness or any pleasure that the work itself may give me, and look upon the hour simply as subtracted from other occupations”. Later in the text, Wicksteed (1910) mentions that the direct disutility of labour “is not really the only thing that enters into consideration in the determination of work time”. At this point, it seems that Wicksteed (1910) will introduce an additional factor affecting the tradeoff between work time and time allocated to other activities. However, instead of *adding* another factor alongside the direct disutility of labour, he *substitutes* it by the utility of leisure: the direct (dis)utility of labour “is only a negative expression of one element in the desirability of rest or leisure”. By taking the disutility of work out of the equation, the utility of the wage becomes the sole source of utility resulting from labour: the marginal utility of work time is reduced to the marginal utility of the wage rate, which amounts to the equality in equation (2c).

If the wage is the only source of utility derived from work, and if the marginal utility of income remains positive despite being decreasing, individuals would spend all their time at work in the absence of alternative uses of time providing utility. However, Wicksteed (1910), having substituted the disutility of work by the utility of leisure, concludes that individuals will work as long as the marginal utility of income obtained from an additional unit of work time is greater than the marginal utility of leisure, which describes literally the optimality condition shown in equation (3).

We can reformulate equation (3) in terms of opportunity costs: the opportunity cost of a unit of work time is the utility an individual would get by allocating that unit of time to non-market activities. Conversely, the opportunity cost of a unit of non-market time is the utility an individual would get from allocating that unit of time to labour, which corresponds to the utility of the wage rate. Therefore, an individual will increase the duration of labour as long as the opportunity cost of non-market time is greater than

the opportunity cost of work. Ultimately, optimality is reached when both opportunity costs are equalised. We can also express the optimality condition in monetary terms as in equation (4): in equilibrium, the monetary value of the last unit of leisure time is equal to the wage rate.

Wicksteed (1910) may have taken a questionable shortcut when he switched from his initial position, where he noted that the disutility of labour is not the only thing affecting work hours, to his last statement, where he affirms that the disutility of labour is simply a negative expression of leisure's utility. While we may never know with certainty why Wicksteed (1910) took that shortcut, it is interesting to note that he was giving a numerical example during the discussion of the topic. Why is this important? Without the disutility of labour, one can value leisure by the wage rate because the opportunity cost of leisure, measured in monetary unit, reduces to the wage rate in the absence of the disutility of labour (equation [4]). This may also explain why the vast majority of economists followed in the footsteps of Wicksteed (1910). The wage rate is still being used as the monetary value of the opportunity cost of time to value the production of households that takes place in the non-market sector (see for instance UNECE, 2017). Even before the availability of relevant data, Knight (1921, p.64) noted that "we can come nearer a satisfactory quantitative determination of time and effort than we can of the indeterminate uses that would have been made of them if the labour of producing the (measurable quantity of) goods had not been performed". Considering as an example a boy who can spend his time picking up berries for his own consumption or do any other activity, Knight (1921, p72-73) uses the quantitative character of the alternatives to minimise the role of the disutility of labour:

there is none the less a practical difference between two kinds of alternatives in an ordinary situation. This difference is perhaps connected with the distinction between our feelings of painfulness and pleasantness, but in its essence it relates to the quantitative character of the alternatives (in their physical aspects, not the psychic states involved). [...] The "trouble," "exertion," or what-not is not quantitative on its own account, it is measured by the berries.

The highly influential paper of Becker (1965), *A Theory of the Allocation of Time*, may have further rooted the belief according to which the opportunity cost of time allocated to non-market activities is, in monetary terms, the wage rate. Becker's (1965) approach to the topic was quite different from anything that preceded him: he argued that individuals are combining their time with goods purchased on the market to produce commodities that are the ultimate objects of utility. Therefore, in Becker's (1965) framework, time becomes an input used to produce utility-generating commodities, and no direct (dis)utility is associated with the allocation of time. While Becker (1965) mentions that the opportunity cost of time during activities such as sleep or eating is relatively low ("because these commodities indirectly contribute to earnings"), such points are not reflected in his model, which values a unit of time by the wage rate (Becker, 1965, equation [9]-[11]).

Following the paper of Becker (1965), the topic of time allocation received a consid-

erable amount of attention. As we shall see in the next section, economists not only rediscovered the disutility of labour, but they also discovered new elements that invalidate the equality between the wage rate and the monetary value of the opportunity cost of time (measured in monetary unit). However, those (re)discoveries did not receive as much interest as one could have expected: most likely, the awareness among new generations of economists regarding the disutility of labour faded away as the concept itself gradually disappeared from economic literature. In addition, economists may have willingly sacrificed some realism by overlooking the disutility of labour in favour of the wide range of empirical applications opened by equating the monetary value of the opportunity cost of non-market time to the wage rate. However, the validity of the results obtained in such applications can be questioned as soon as the variables that lead to a discrepancy between the monetary value of the opportunity cost of non-market time and the wage rate are not explicitly accounted for, which is often the case since the direct disutility of labour is unobservable.

We can now sketch precisely the extent to which labour has disappeared in the canonical leisure-income model: the indirect impact of labour on utility remained in the model, which appears implicitly through the utility of the wage rate (as explained in Section 2, the marginal utility of the wage rate corresponds to the marginal indirect utility of time allocated to the labour market). The direct disutility of labour, on the other hand, has entirely disappeared from the canonical leisure-income model. Beside leading to questionable empirical results, the disappearance of the disutility of labour also diverted the attention away from many issues related with labour, such as the impact of work conditions on labour supply.

Despite its misspecification due to the omission of the disutility of labour, the mechanisms through which the canonical leisure-income model determines the allocation of time is consistent with the economic theory: as mentioned in the previous section, economists have shown, since the marginal revolution, that utility is maximised when the marginal utilities derived from alternative uses of a resource are equalised across all its uses. While Jevons (1871) had failed to apply this concept to the allocation of time, the leisure-income model determines the allocation of time by equalising the marginal utilities of the alternative uses of time.

## **5 (Re)discoveries Invalidating the Equality Between Wage Rate and the Opportunity Cost of Time**

The economic literature regarding the allocation of time expanded significantly during the late 1960s and the 1970s, especially after the publication of Becker's (1965) paper. An important contributor to this literature was Reuben Gronau, who received his PhD in 1967 for his thesis *The effect of traveling time on the demand for passenger airline transportation*, written under the supervision of Gary Becker and Jacob Mincer. Starting this section by exploring the work of Gronau thus appears as a sensible choice.

In his most cited paper, Gronau (1977) revisits Becker's (1965) theory while maintaining the assumption that time does not generate direct (dis)utility. However, Gronau (1977) notes, in his concluding remarks, "I expect major criticism to be launched against the assumption that work at home involves the same marginal utility as work in the market. Child care, cooking, gardening, etc., clearly create direct utilities (positive or negative)". If Gronau (1977) expects *major* criticism for omitting the direct (dis)utility of time allocation, it must have been reintegrated into the literature at some point between his article and Becker (1965). Gronau (1977) reviews several papers, among which one from Sirageldin (1969) and one from himself (Gronau, 1973), that attempted to estimate the size of the non-market sector. Since the valuation of time spent in housework necessarily involves a discussion on the opportunity cost of non-market time, we now explore those two papers.

Sirageldin (1969) uses a model where the monetary value of the opportunity cost of non-market time corresponds to the wage rate: "our discussion of the opportunity cost approach thus far assumes that the value - to the family - of a unit of its time used at home instead of sold in the labor market equals its opportunity cost which is equal to the marginal real wage rate net of taxes". Sirageldin (1969) does not include the direct disutility of labour in his model, but he mentions that its omission is "a rather unrealistic assumption". While he does not elaborate more on the disutility of labour, he explains that the monetary value of the opportunity cost of non-market time deviates from the wage rate if there are constraints on the duration of labour: "hourly earnings for those who were unemployed or who desired more hours of work are clearly an overestimate of the marginal value of unpaid work". For those who work more than they desire, Sirageldin (1969) notes that "the same argument, in reverse will show that reported hourly earnings would underestimate the marginal value of unpaid work for those who desire to work less hours".

Sirageldin (1969) thus points out a new element that prevents the equality between the monetary value of the opportunity cost of non-market time and the wage rate: the two will differ from each other for people who do not work as much as (or as little as) they desire. This result can be seen from equation (4): when people work less than they desire, they have relatively too little income and too much leisure time such that the RHS of equation (4) will be lower than the wage rate (i.e., the opportunity cost of work time, which gives leisure its value, is lower than the wage rate). Conversely, when people work more than they desire, the RHS of equation (4) will be higher than the wage rate (i.e., the monetary value of the opportunity cost of work time is higher than the wage rate). A formal demonstration of this inequality has been presented by DeSerpa (1971).

We now look at Gronau (1973). He also uncovers a new factor that invalidates the equality between the wage rate and the monetary value of the opportunity cost of non-market time: expenditures associated with work time (e.g., transport and childcare services). Indeed, such expenditures must be subtracted from the income individuals receive in exchange for their labour to determine the disposable income, which reflects more accu-

rately the monetary value of the opportunity cost of non-market time. Having integrated the remark of Siragelding in his own approach, Gronau (1973) notes: “for those units of time which are freely substitutable for work in the market”, their unit value is the remuneration one receives for “selling the marginal unit of time in the market minus any money costs involved”. Finally, he explains that his argument is true “to the extent that work does not yield any direct marginal utility or disutility”. Yet, Gronau (1973) does not include the disutility of labour in his model.

We already knew that the disutility of labour invalidates the equality between the monetary measure of the opportunity cost of non-market and the wage. We now know that there are two additional factors that causes the discrepancy between the two variables. Yet, we still have to find who were the first authors who reintegrated the disutility of labour into the standard leisure-labour model. Taking a closer look at DeSerpa (1971), whom we have already mentioned, provides an important clue on this matter. Since DeSerpa (1971) introduces constraints on work hours, he finds that  $\mu/\lambda$  (the opportunity cost of non-market time expressed in monetary unit) is not equal to the wage rate. As mentioned in Section 2, economists usually combine the income and time constraints into a single constraint. However, having assumed that there are constraints on work hours, DeSerpa (1971) cannot combine the two constraints, which leads him to the ratio  $\mu/\lambda$ . He seems to find this ‘new’ expression quite informative: “the ratio,  $\mu/\lambda$ , the marginal rate of substitution between time and money, may be interpreted as the value of time. The generation of this value as an equilibrium condition is an important feature of the model”. His sentence ends with a footnote where he says “Johnson [1966] and Oort [1969] drew the same conclusion from their respective models”. Therefore, we must now carefully analyse the papers of these two authors.<sup>4</sup>

Oort (1969) uses the canonical leisure-income model as presented in Derobert (2001), that is, the utility depends on leisure time and income, and he simply assumes that labour generates direct (dis)utility.<sup>5</sup> As a result, Oort (1969) finds the same optimality condition as the one in equation (6). His remarks that come immediately after the optimality condition are noteworthy: “It may be noted in passing that economic textbooks often arrive at the conclusion that the utility function is maximised if the marginal utility of leisure is equal to the wage rate”. Oort (1969) notes that this is true if  $\lambda = 1$  and the marginal disutility of labour is equal to 0. It seems that Oort (1969) did not noticed that  $\lambda = 1$  is not a necessary condition for the opportunity cost of leisure to be equal to the wage rate if the opportunity cost is defined in monetary terms (i.e., equation [6] is divided by  $\lambda$ , which yields equation [7]). He then mentions that we may, alternatively, set the marginal utility of leisure to 0 and  $\lambda = 1$ , which “leads to another well-known but

---

<sup>4</sup>DeSerpa (1971) knew Professor M. Bruce Johnson, as he writes, in his acknowledgment section: “this paper is adapted from the author’s doctoral dissertation submitted to the University of California, Santa Barbara. The author is indebted to Professor M. Bruce Johnson, W. Douglas Morgan, [...] for their many valuable comments”.

<sup>5</sup>His model differs ever so slightly from the one I presented in Section 2, where I defined the utility as a function of a representative good instead of income, which adds an intermediate layer to the model, but it does not affect the results: both approaches yield the same results.

equally misleading conclusion, namely that the individual maximises his utility by working up to the point where the marginal (dis)utility of work equals the wage rate". Therefore, Oort (1969) criticise not only the standard leisure-income model, but also the approach of Jevons (1871).

We now turn our attention to Johnson (1966), whose article was published only 6 months after Becker (1965). It is likely that Johnson (1966) and Becker (1965) were not aware of each other's work prior to their publication. Had Johnson (1966) been aware of Becker's (1965) paper, he probably would not have written "a theory must explicitly consider time as a scarce resource if it is to capture the essence of decisions pertaining to trips, work, leisure, and other competing uses of time. No existing theory does this." On the other hand, if Becker (1965) were aware of Johnson's work (1966) prior to its publication, he might have addressed the disutility of labour in his paper. Indeed, Johnson (1966) is quite critical regarding the approach taken not only by Jevons (1871), but also by Wicksteed (1910):

Why should either the marginal utility of leisure or the marginal disutility of work be arbitrarily set equal to zero? There is no evidence to suggest that the typical individual attaches no subjective disutility to his work apart from the opportunity cost of the desirable leisure foregone. Nor is there any indication that individuals who do find their work disagreeable do not attach subjective utility to leisure above and beyond its opportunity cost, i.e., odious work. What evidence we have suggests that a worker demands a wage rate as a compensation for sacrificing desirable leisure and for performing a disagreeable task. Thus work and leisure should both be included in the utility function so that a distinction between the marginal utility of leisure and the marginal disutility of work is made at the level of individual preferences.

Based on this critique, Johnson (1966) includes leisure time as well as work time directly into the utility function. He notices that

the equilibrium condition for money income and work illustrates that the decision to supply an additional hour of work at the margin involves balancing the utility of the increment to money income against the sum of two factors: the marginal disutility of sacrificing an additional hour of desirable leisure plus the marginal disutility of providing an extra hour of odious work.

Since labour generates direct disutility in Johnson's (1966) model, he sees that his result is

unambiguously contrary to the standard neoclassical result that the value of travel time (and leisure) is *equal* to the wage rate. However, we conclude here that, so long as work *and* leisure enter the utility function as separate variables, the value of leisure, travel time, or any use of time will be less than the money wage rate.

Finally, he explains that previous models fail to reach his results because either the theory excludes work as a variable in the utility function or it omits leisure.

In the post-Wicksteed (1910) era, Johnson (1966) may well be the first economist who included the disutility of labour into the leisure-income model. While Becker (1965) was not really concerned by the direct (dis)utility of time, we have noticed that most of the articles published after Johnson (1966) recognised that the omission of the disutility of labour is unrealistic (even if those articles did not take into account the disutility of labour in their empirical or theoretical applications).

Johnson (1966) notes that his result is quite different from previous models, which might be correct if he refers to economic models presented in mathematical form. However a couple of economists had already described literally the result obtained by Johnson (1966), one of them being Sidney Chapman. Chapman (1909) explains that the choice regarding the duration of labour depends on the income level, the direct value of leisure, and the balance of dissatisfaction that work yields itself. Chapman (1909) first describes the case where the labour does not generate direct disutility: “if the utility derived from an incremental addition to leisure is greater than the utility of the increment of wage sacrificed by transferring an increment of time from production to consumption, the operative would gain from a contraction of the working day, other things being equal.” Chapman (1909) then adds the disutility of labour to his description and comes to the same conclusion as Johnson (1966):

After the working day has exceeded a certain length, any further addition to it diminishes the satisfaction directly derived from working or adds to the balance of dissatisfaction. If a balance of dissatisfaction were associated in the long run with the efforts of the last minute in the working day which the operative would otherwise choose, as would ordinarily be the case, he would elect, other things being equal, to work an even shorter day, the duration of which would be determined at the point at which the gains and the losses came to equivalence when everything was taken into account, that is to say, at the point at which his satisfaction was maximised.

It is interesting to note that Chapman (1909) starts his presentation with the leisure-income model (which has not been established as such at that time) and then adds the disutility of labour to obtain a model that Derobert (2001) refers to as the “labor-leisure-income” model.

Chapman (1909) might have been inspired by Green (1894), which we already mentioned in the previous section, and who explained that labourers stop work not only due to the disutility of labour but also because they want some opportunities for pleasure outside the labour market. If we were to nitpick, we could say that Green (1894) did not describe exactly the equilibrium condition, as he did not formulate his sentence in terms of marginal utilities. However, we would be unfair to him, since he was no stranger to marginal reasoning. In addition, we do not have to dwell too much on Green (1894) because, before him, Clark (1893) had already described accurately what the opportu-

nity cost of non-market time would be under the assumption that labour generates direct disutility in a model that takes into account the alternative uses of time:

In considering whether there is a surplus of benefit realized from working through the last fifteen-minute period of the day one must take account of one plus quantity and of two minus quantities. The whole benefit comes from the articles bought with the wages of the final period; while the injury is the sum of two sacrifices, of which one is caused by weariness and the other by confinement. If the plus quantity exceeds the sum of the two minus quantities there is a surplus gain realized; if it falls short of equaling this sum, there is a loss, and if it just equals it, there is neither a gain nor a loss from the work of the terminal period

In Clark's (1893) terminology, the direct disutility of labour is "weariness", which he defines as the deprivation of "nervous and muscular tissue, which is a physical loss". "Confinement", on the other hand, refers to the forgone utility of leisure: it is the deprivation of "so much pleasure that he might otherwise have had from walking, conversing with friends, playing games, fishing, gardening, reading, etc."

## 6 Conclusion

Clark (1893) appears as the first economist who accurately described the opportunity cost of non-market time taking into account both, the direct disutility of labour and the alternative uses of time. It took almost another century for economists to identify all factors that induce a discrepancy between the wage rate and the monetary value of the opportunity cost of a unit of non-market time:

- the direct disutility of labour (Clark, 1893; Johnson, 1966),
- constraints on work hours, which may be due to constraints in the non-market sector (Sirageldin, 1969, DeSerpa, 1971),
- the existence of expenditures associated with labour (Gronau, 1973).

For each item of the list above, the first reference shows the first economist who accurately described the impact of the listed factor on the opportunity cost of non-market time while the second reference cites the first economist who adapted the mathematical form of the canonical leisure-income model to incorporate the listed factor (for the third item, Gronau [1973] did both). We may also mention that the monetary value of the opportunity cost of a unit of leisure time differs from the average wage rate when the average wage rate differs from the marginal wage (Sirageldin, 1969; Gronau, 1986).

The monetary value of the opportunity cost of time is equal to the wage rate if the items listed above are non-existent, which is unlikely to be the case. The current state of the literature shows that the monetary value of the opportunity cost of time decreases, relative to the wage rate, as the direct disutility of labour increases, the duration of

labour is increasingly constrained, and expenditures associated with labour increase. The discrepancy between the monetary value of the opportunity cost of time and the wage rate, which is determined by the items listed above, provides therefore an important well-being indicator: as soon as the monetary value of the opportunity cost of non-market time is lower than the wage rate, the distance between the two measures the loss of utility induced by the factors listed above.

This paper has shown that an accurate description of opportunity costs associated with the allocation of time raised some challenges due to the difficulty in articulating properly the alternative uses of time and its joint products. Jevons (1871) implicitly set the opportunity cost of non-market time to zero when he determined the optimal duration of labour by equalising the marginal utilities of the joint products of labour instead of equalising the marginal utilities of alternative uses of time. The canonical leisure-income model, on the other hand, determines the optimal duration of labour by equalising the marginal utilities of alternative uses of time but it omits the joint products of labour, which takes out of the equation important considerations regarding labour and well-being (e.g., the trade-off between the wage rate and work conditions, evolution of labor supply with work conditions, etc.). Ultimately, the literature recovered in this paper shows that the “labor-income” model of Jevons, the canonical “leisure-income” model, and the “labour-income-leisure” model are not three separate models: the first two are simply special cases of the labour-income-leisure model. Therefore, we raised the question why the labor-income or leisure-income models exist (or have existed). Two answers are possible: the historical context and a practical reason.

In Jevons’ days, duration of labour was significantly longer, work conditions were significantly worse, and the average income level was lower. In this context, one may naturally focus more on the disutility of labour than the utility of leisure. In contrast, the 1950s, 1960s, and 1970s were characterised by sharp changes in the alternative of uses of time (the duration of labour was decreasing while the labour force participation rate of women was quickly increasing). This context calls for a greater attention on alternative uses of time than on the disutility of labour.

Economists may also have disregarded the factors listed above to impute a monetary value (i.e., forgone wages) to non-market time, which enables a variety of empirical applications that ranges from the estimation of leisure demand functions (Abbott and Ashenfelter, 1973) to the estimation of the value of non-market commodities produced during housework (Sirageldin, 1969; Gronau, 1973; UNECE, 2017). Yet, the assumption that rendered those application possible is also the reason why one may be skeptical regarding the validity of their results.

## References

- Becker, Gary. 1965. “A Theory of the Allocation of Time.” *Economic Journal* 75: 493–517.
- Black, Duncan. 1939. *The Incidence of Income Taxes*. London, UK: Macmillan.
- Böhm-Bawerk, von Eugen. 1894. “One Word More on the Ultimate Standard of Value.” *Economic Journal*

4: 719–24.

- Chapman, Sidney. 1909. “Hours of Labour.” *Economic Journal* 19: 355–73.
- Clark, John Bates. 1893. “The Surplus Gains of Labor.” *Annals of the American Academy of Political and Social Science* 3: 79–89.
- Derobert, Laurent. 2001. “The Genesis of the Canonical Labor Supply Model.” *Journal of the History of Economic Thought* 23: 197–215.
- DeSerpa, Alan. 1971. “A Theory of the Economics of Time.” *The Economic Journal* 81: 828–846
- Green, David I. 1894. “Pain-Cost and Opportunity-Cost.” *Quarterly Journal of Economics* 8: 218–29.
- Gronau, Reuben. 1973. “The Measurement of Output of the Nonmarket Sector: The Evaluation of Housewives’ Time.” In *The Measurement of Economic and Social Performance*, edited by Milton Moss, 163–192, NBER Books.
- Gronau, Reuben. 1977. “Leisure, Home Production, and Work—the Theory of the Allocation of Time Revisited.” *The Journal of Political Economy* 85: 1099–1123.
- Gronau, Reuben. 1980. “Home Production—A Forgotten Industry.” *The Review of Economics and Statistics* 62: 408–416.
- Gronau, Reuben. 1986. “Home production – A survey.” *Handbook of Labor Economics* 1: 273–304.
- Jevons, William Stanley. 1871. *The Theory of Political Economy*. 1st ed. London, UK: Macmillan.
- Jevons, William Stanley. 1879. *The Theory of Political Economy*. 2nd ed. London, UK: Macmillan.
- Johnson, M.B. 1966. “Travel Time and the Price of Leisure.” *Economic Inquiry*, 4: 135–145
- Knight, Frank. 1921. *Risk, Uncertainty and Profit*. Boston, MA: Houghton Mifflin Company.
- Oort, C. J. 1969. “The Evaluation of Travelling Time.” *Journal of Transport Economics and Policy* 3: 279–86.
- Scitovsky, Tibor. 1951. *Welfare and Competition*. Chicago: Richard D. Irwin.
- Sirageldin, Ismail A. 1969. *Non-Market Components of National Income*. Ann Arbor: Univ. Michigan Press.
- Spencer, David A. 2003a. “Love’s Labour’s Lost? The Disutility of Work and Work Avoidance in the Economic Analysis of Labour Supply.” *Review of Social Economy* 61: 235–60.
- Spencer, David A. 2003b. “The Labor-Less Labor Supply Model” in the Era Before Philip Wicksteed.” *Journal of the History of Economic Thought* 25: 505–513.
- Spencer, David A. 2008. “From Pain Cost to Opportunity Cost: The Eclipse of Work in Economic Theory.” In *The Political Economy of Work*, edited by David A. Spencer, 69–93, Abington, UK: Routledge
- UNECE. 2017. *Guide on Valuing Unpaid Household Service Work*, Geneva: United Nations.
- Wicksteed, Philip. 1910. *The Common Sense of Political Economy: including a Study of the Human Basis of Economic Law*. London, UK: Macmillan.