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WASTE: WHY ECONOMICS GOT IS SO WRONG, AND WHAT COULD BE THE REMEDY?

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ABSTRACT

A paradigm shift occurred in economics in the middle of the 20th century. According to the old paradigm, economics studies the determinants of wealth. The new paradigm, called neoclassical economics, posits that economics studies behaviour under scarcity of resources. A corollary of the new view is that people and organisations can be assumed to make optimal, best possible, decisions regarding the scarce resources.

The old paradigm of economics recognized waste as a factor influencing wealth. The new paradigm, focusing on optimal allocation of resources, did not apply the notion of waste. The Nobel laureate economist Stigler went in 1976 even further and claimed that waste is not a useful concept in economic theory, though he admitted the occurrence of waste, which he narrowly defined as a foregone product that can be obtained for less than its cost.

The 1976 paper of Stigler is critically assessed. Three major shortcomings are found. First, waste is ubiquitous in economic activities, whereas Stigler downplayed its significance. Second, waste can occur irrespective of the context, whereas Stigler insisted that waste occurs in the context of market exchange. Third, decision usually needs to be implemented in the material world, and waste often emerges in this implementation. Stigler considered decisions without taking implementation into account.

To rectify the shortcomings in the economic conception of behaviour under scarcity, a new conception is offered. It is based on the recognition of three different types of waste in relation to a decision: background waste, non-optimality of the decision, and foreground waste. There should be an attempt to reduce or to eliminate all three types of waste. The new conception implies that the starting point of neoclassical economics has been seriously wrong.

KEYWORDS

Economics, waste, optimum, scarcity, Stigler

INTRODUCTION

The neoclassical economic theory assumes that firms make optimal decisions under scarcity. Thus, in their production, the maximum possible output from given amounts of inputs is gained. Firms are thus operating on their production frontier, determined by their production function and representing the maximal production opportunities. Obviously, firms differ regarding their efficiency; this is explained by assuming each firm to have its own production frontier.

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However, firms can move their production frontier by deciding to invest into new technology (this concept includes also knowledge). (Stigler 1976).

In the discipline of production management, there has been another conceptualisation of production, where the concept of waste is used. Waste refers here to avoidable costs of production (or any other activity in the firm), for example costs which can be attributed to poor quality. The efficiency differences between firms using the same technology may be explained by different levels of waste. These waste costs can be avoided or at least reduced by appropriate training, management, etc. However, first the root causes of waste need to be investigated, for selecting appropriate countermeasures. Thus, problem-solving is emphasised as a key activity. All in all, the key significance of waste is that it represents unexploited potential for improvement.

These two conceptions of production are starkly contradictory: one assumes that firms continuously make optimal decisions and gain maximal output, the other views that there always exists, more or less, waste in operations, representing avoidable costs. This contradiction has attracted surprisingly little scholarly attention. However, in a recent call for economics of climate change and related change in economics (Stern 2022), a new research area for economics is proposed: "There are all kinds of inefficiencies that exist in our economies and we must try to to understand their nature and origins and how to overcome them."

This paper endeavours to respond to Stern's call. The treatment of inefficiency, waste, in economics is critically reviewed and its serious errors and weaknesses are pinpointed. Based on this, a new conception of behaviour under scarcity is proposed. This conception deals with decisions and waste in the same framework, and in so doing, offers itself as one new starting point for economics for understanding inefficiencies. This may sound recklessly and unrealistically ambitious. However, as Attenborough states (2021): "Economics is a discipline that shapes decisions of the utmost consequence, and so matters to us all."

The paper is structured as follows. The following section gives a historical account on the understanding of waste in economics. Then, the most influential, and also most detailed theoretical concept of waste in economics, originated by Stigler, is critically evaluated. Next, the current understanding of the notion of waste in the context of economic practice is explored. To rectify the found shortcomings of the concept of waste of neoclassical economics, and to remove the current confusion around this notion, a new conception of behaviour under scarcity is then devised.

WASTE IN ECONOMICS

WASTE IN ECONOMICS UP TO MID 20TH CENTURY

Up to the 1930's, the common definition of economics stated that it deals with the causes of material welfare, especially production and distribution (Robbins 1932). In this framework, waste was acknowledged as a worthy topic of the economic science, but there was little theoretical work on it.

A new paradigm of economics, now called neoclassical economics, did a breakthrough in the period 1935 – 1950. One leading idea was that economics is a science addressing behaviour under scarcity – production was excluded from the subject-matter of economics. In an influential essay, Robbins (1932) states: "But when time and the means for achieving ends are limited and capable of being distinguished in order of importance, then behaviour necessarily assumes the form of choice." It is of course prudent to assume that economic agents try to make the best decisions (choices) they can, given their circumstances. However, another branch of the economic theory gave even further support to the idea of optimal decisions. In analyses of perfect competition, assumptions closely related to optimal decisions were made from early on. Such assumptions included the following (Knight 1921):

Economic agents act with complete rationality

They know what they want

They know absolutely the consequences of their acts when they are performed, and perform them in the light of the consequences

The mathematization of the neoclassical economic theory gave a further boost to the idea of optimal decisions. Especially, Samuelson's (1947) influential synthesis of the neoclassical theory contained the axiomatic assumption of economic agents making optimal decisions, for maximizing profit or utility under the ubiquitous scarcity. The concept of waste does not fit into this conception; waste implies that decision-making has not necessarily been optimal.

The production management-based conception was dominant in the first part of the 20th century: waste was discussed in writings on economics, management, production and policies. However, the neoclassical economic theory started to be propagated in the 1930s and diffused in the next decades. Along with this, the usage of the notion of waste diminished; it was simply not needed in discussions focusing on optimal production. Along with the proliferation of neoclassical economics, the usage of the term waste declined both in economic literature and economic policy. It is illustrative that when President Johnson in 1964 launched a war against waste in administration, the Time magazine commented that he felt "folksy pride" when describing efforts to eliminate waste (Time 1964). The term of waste started to be positioned as a word used only in colloquial contexts.

COMPETING VIEWS IN ECONOMICS ON OPTIMAL DECISIONS AND WASTE

Nevertheless, the everyday observations on less than optimal decisions and inefficiencies of course continued in the context of business, households, etc., and there were attempts to incorporate such findings into economic theory.

An early example is provided by Simon (1955), who argued that people do not search for the absolute optimum, but rather satisfice, that is, stop the search when a sufficient and satisfactory option has been found. Especially, Simon pinpointed that the concept of rational behaviour should be compatible with the access to information and the computational capacities actually possessed by the "economic man". Based on this seminal contribution, a new branch of economics, namely behavioural economics, emerged. However, behavioural economics has not been able shake the dominance of the neoclassical theory.

Among the many modes of behavioural economics, one has been directly focused on waste, namely Leibenstein's (1966) theory of X-efficiency, which explains the formation of waste mainly through motivational factors. According to Leibenstein, "where the motivation is weak, firm managements will permit a considerable degree of slack in their operations and will not seek cost-improving methods".

Triggered by Leibenstein's theory, which challenged the neoclassical orthodoxy, the noted economist and Nobel laureate Stigler published an article that defined waste from the neoclassical viewpoint as error, and then claimed, in essence, that waste is not a useful economic concept (Stigler 1976). Next Kirzner (1978) presented his concept of waste, also based on the idea of waste as error in decision; however he rejected Stigler's view that the amount of waste is negligible. Somewhat later, Williamson (1991) forwarded the claim that failures of alignment of transactions and their governance structures create waste.

These competing conceptions of waste in economics are summarised in Table 1. Out of the four conceptions, only Stigler's contribution, which closely relates to the dominant neoclassical doctrine, has had long term influence. Therefore, it is focused on in the remainder of the paper.

Table 1: Competing conceptions of waste in economics

Originator	Cause of waste	Prevalence of waste	Reduction/elimination	Conceptual framework
Leibenstein, 1966	Lacking motivation or incentives (and a variety of factors influencing these)	Considerable: "…people and organizations normally work neither as hard nor as effectively as they could."	Competitive pressure, adversity, force of example	Neoclassical economics, psychology
Stigler, 1976	Error in decision; non-optimal behaviour	Negligible: can be abstracted away	Costs and prices incite to correct decisions	Neoclassical economics
Kirzner, 1978	Error in decision	Very common: "enormous scope for improvement exists"	Through entrepreneurship	Austrian economics
Williamson, 1991	Failures of alignment of transactions with governance structures	The assumption of firms working on their production function and maximizing profits is an egregious oversimplification.	"…better organizational form; better internal incentives and controls; better alignment of the contractual (interfirm and intrafirm) interfaces"	Institutional economics, especially transaction cost economics

STIGLER'S ATTACK ON WASTE IN 1976

In his much cited and influential[4] paper, Stigler (1976) seems to want to explicitly push waste out of economics. In doing so, he comes to define waste from the economic viewpoint in a useful detail. In the following, this attack on waste is presented and critically analysed.

DEFINITION OF WASTE

According to Stigler (1976), "waste is a foregone product that could be obtained for less than its cost". This definition is somewhat cryptic[5] as well as vague and deserves to be clarified through an example.

The grocery shop that is frequently used by the first author has an oven where bread, rolls, etc., are daily baked from frozen dough. For example, a multigrain roll has the price of 85 pence. However, if there are rolls still available after 19.00 o'clock or so, the price is reduced to 5 pence. Most probably this is below the cost of the roll. Thus, the question is about waste, in Stigler's sense.

It can be observed that Stigler wants to define waste in connection to a possible or realised market exchange. However, in doing so, he excludes waste that occurs in organisations not offering products for market, such as governmental organisations or households. Also, because

[4] Perelman (2011) writes: "Realizing that Leibenstein's idea of X-efficiency represented a serious threat to abstract price theory, Stigler (1976) rose to the occasion, pulling out all the stops. In terms of rhetorical success, Stigler's combination of brilliance and bluster mostly carried the day."

[5] The word "foregone" requires interpretation. The probably most common meaning of a "foregone product" refers to a product that was not purchased although seriously considered. However, here the question is about another meaning of "foregone", namely previous or past. Thus "foregone product" refers to a product that has been (previously) produced, and is available after a time lag for less than its cost. Namely, a producer will not knowingly create a wasteful product; time is needed after the act of production for realising that a reduced price is appropriate.

waste, as defined by Stigler, must be visible in a product, wastes (in the generic sense of the word) occurring inside the productive processes may not get visible[6].

Moreover, alone from our example, questions that challenge the logic of Stigler's definition of waste arise: Is it waste if the shop would not reduce the price in the evening, and a roll does not get sold? If a customer buys a roll, but just forgets to eat it in time, and has to put it into the garbage can or feed to birds, is that waste[7]?

Stigler does not explain why he has selected this definition for waste. However, a possible inspiration is the purpose given to production in the economic theory. According to Frisch (1965), production in the economic sense means an attempt to create a product which is more highly valued than the original input elements. Obviously, this purpose is not fulfilled if a foregone product could be obtained for less than its cost.

CAUSES OF WASTE

Stigler recognises two causes of waste: (1) Plans rested upon erroneous predictions; (2) The economic agent is not engaged in maximizing behavior.

Even if the word is missing in these two causes, the question is about decisions; regarding the first cause, assumptions of a decision that turn out to be wrong, and regarding the second cause, decisions that are not made in an optimal manner.

In our illustrative example, waste arises if the predicted daily demand for rolls turns out to be wrong (erroneous prediction), or if the number of rolls produced is not based on empirical patterns of demand (that is, the behaviour is not optimising).

The second cause, of course, represents the ideas of Simon (1955), Leibenstein (1966) and others who have claimed that economic agents are not making optimal decisions.

In critical analysis, a significant oversight is that Stigler sees waste causation only in terms of decisions, belonging to the world of ideas. Waste will emerge when a decision is implemented in the material world – this is not covered by Stigler at all. An implication is that Stigler fails to see a number of important causes of waste in the material world, such as variability of productive processes (as studied in Hopp & Spearman's Factory Physics (2011)).

AMOUNT OF WASTE

Stigler comments the amount of waste regarding the first cause above, decisions being based on erroneous assumptions. According to him, "its magnitude is subject to control". He does not justify this claim. He does not present empirical evidence on the amount of waste. Nevertheless, he seems to conclude that the amount of waste is negligible and can be abstracted away.

PLACE OF WASTE IN THE ECONOMIC THEORY

Regarding the first cause of waste, Stigler states: "Waste is error within the framework of modern economic analysis, and it will not become a useful concept until we have a theory of error".

Regarding his second cause, he says: "Until one is prepared to take the mighty methodological leap into the unknown that a nonmaximizing theory requires, waste is not a useful economic concept."

Thus, in either case, "waste is not a useful economic concept". The message is clear: the occupation with waste should thus stop in economics.

[6] An analogous situation has been noted by Koskela and Tommelein (2009), who claim that opportunities for sustainability improvements may be invisible when production is looked at from the economic viewpoint, as a black box transformation.

[7] This example also illustrates that "waste" is an abstract man made construct rather than a phenomenon. What is waste depends on the subject observing the setting.

REDUCING OR ELIMINATING WASTE

Nevertheless, Stigler gives, in passing, one direction that, besides solving the original problem of Leibenstein, namely productivity differences between firms, could be used for reducing or eliminating waste. He writes: "No attention has been paid by economists to the analysis of the optimal amount of technological knowledge that a firm should possess." He illustrates this through a dense sketch concerning two farmers with different productivity: "In neoclassical economics, the producer is always at a production frontier, but his frontier may be above or below that of other producers. The procedure allocates the foregone product to some factor, so in turn the owner of that factor will be incited to allocate it correctly".

The procedure outlined by Stigler seems to be based on three principles. Firstly, the starting point here is the "foregone product", which for whatever reason has been observed as problematic. For example, the company can get the products sold only by having a lower price than the main competitor, or there is waste (in Stigler's sense) associated to the product. Either way, for the particular foregone product, the problematic feature is identified.

Secondly, then, that problematic feature is "allocated" to some factor of production. These include, manpower, land (raw materials), capital (machinery) and technology. In neoclassical economics, production is a black box, meaning that only inputs (factors) and outputs (foregone products) are visible. Thus, remarkably, the problematic feature of a product is associated, through the black box, to a factor. Obviously, some kind of an inference backwards (regression) is carried out.

Thirdly, the owner of that factor will then make a "correct" decision. It can be assumed that this is the optimal decision.

This Stigler's procedure is closely based on the doctrine of neoclassical economics: production gets managed, through optimal decisions, by prices and costs. However, there is one exception: as far as we know, regressive inferences from outcome to cause are not part of the conceptual framework of economics. Looking at the proposed framework from a practical viewpoint, the central question is how the right factor can be identified when production is seen as a black box. Say, quality problems are identified in the products: it may be impossible to determine whether the cause lies with materials, manpower, equipment or knowledge without opening the black box and investigating the process (flow) of production.

OVERALL ASSESSMENT OF STIGLER'S CONCEPT OF WASTE

Above, features of Stigler's conception of waste have already been critically assessed; here the conception is assessed as a whole.

Stigler, as a leading proponent of the neoclassical economic theory, defines and discusses the notion of waste and finds that is is not a useful concept for economic theory. Unfortunately, Stigler's conception of waste is distorted and biased, and his conclusions are wrong. Three major shortcomings in his conception can be identified:

- Stigler's narrowly defined waste is unavoidable, however it's magnitude can be subject to control so that it can be abstracted away; we argue that waste is ubiquitous and of such magnitude that it cannot be abstracted away.
- Stigler defines waste in the context of decisions and market exchange; we argue that waste can occur irrespective whether the context is decisions and market exchange or not.
- Stigler does not take into consideration that decisions often, if not usually, need to be implemented in the material world; we claim that it is also here that waste can occur.

These arguments lead us to contend that waste, inefficiency, should be fully incorporated into economic theory.

CURRENT PRACTICAL IMPACT OF ECONOMIC TREATMENTS OF WASTE

Above, the treatment of waste in the neoclassical economic theory has been discussed. It is also of interest how waste is currently dealt with. In the following, three cases of current treatment of waste in the practice (or practice-oriented teaching) of economics are discussed. Although the sample is small, the cases give a cogent picture of the situation.

WASTE IN HEALTHCARE

In 2017, the the Organisation for Economic Co-operation and Development (OECD) published a report on healthcare waste. In that report, two principles for reducing waste are highlighted:

"• Stop spending on things that do not improve health – for example, unnecessary surgeries and clinical procedures.

• Swap inputs and change approaches when less pricy alternatives of equal value exist."

The first principle would seem to suggest deciding to eliminate waste. In turn, the second principle interestingly recommends making optimal decisions.

The suggested implementation of waste reduction is summarised as follows: "…recognizing the existence of the problem, developing tools to assess its scale, convincing and incentivizing stakeholders to change their behaviour are all part of the solution."

Thus, waste is seen to be caused by stakeholders' decisions and behaviour, in compliance with economic theory. However, in contradiction to that theory, it is implicitly admitted that decisions are not necessarily optimal, causing waste.

FOOD WASTE

The attention given to food waste has triggered recent research in economics, given that "there exists no foundational economic model of food loss and waste for consumers, processors, intermediaries and farmers based on first principles" (Drabik, de Gorter and Reynolds 2019). This lack of a foundational model for food waste is of course related to situation that there is no foundational economic model of the emergence of waste in general. Given this, economists try to use existing economic theory. For example, Lusk and Ellison (2020) consider it self-evident that food waste is an economic phenomenon, related to consumer decisions:

> In fact, many analyses of food waste seem to conceptualize food waste as a mistake or inefficiency, and in some popular writings a sinful behaviour, rather than an economic phenomenon that arises from preferences, incentives and constraints.

In their view, "it is imperative to view the waste decision like any other decision – one with costs and benefits". However, the insistence of seeing food waste because of consumer decisions unavoidably leads to the contradiction mentioned above: the assumption of optimal decision-making does not leave room for waste. Lusk and Ellison (2017) are at a loss to explain this:

> A challenge with the studies that model waste as an outcome of consumer maximization decisions, insofar as informing public policy, is that the decision to waste, at least from the perspective of the consumer, is optimal. If so, it is unclear what role there is for public policy or public education aimed at reducing food waste. If "waste" is a result of an optimal decision, forcing a lower level of waste would necessarily harm consumers.

WASTE AS DISCUSSED IN A TEXTBOOK FOR CONSTRUCTION ECONOMICS

In his popular textbook on construction economics, Myers (2004) says:

> In any free market economy businesses will never waste inputs. A business will not use 10 units of capital, 10 units of labour and 10 units of land when it could produce the same amount of output with only 8 units of capital, 7 units of labour and 9 units of land.

This of course contrasts to empirical observations stating that waste is omnipresent in construction (Arbulu & Tommelein 2002).

CONCLUSIONS

An overview on the approaches to waste in the three cases considered is given in Table 2.

Table 2: Conceptualisation of waste in the considered three cases.

Context of waste	What is the cause of waste?	Are decisions optimal?	How can waste be reduced or eliminated?	Is waste prevalent?
Healthcare	Decisions	No	Decisions	Yes
Food	Decisions	Yes	Decisions (?)	Yes
Construction management	Decisions (but only in principle)	Yes	No need	No

In all three cases, waste is seen to be caused by decisions, and correspondingly decisions are held as the means for waste reduction (if this is needed). In two cases, decisions are seen to be optimal, whereas in one case, this is denied. In turn, waste is seen to be prevalent in two cases, whereas in one case, the occurrence of waste is denied. Thus, beyond the idea that waste is caused and reduced by decisions, there is a major confusion regarding the existence and causes of waste.

The analysis of these three cases shows that the topic of waste has been left fallow in economics: "…economists have mainly assumed the problems of waste away…" (Williamson 1991). Arguably, Stigler's paper which concluded that waste is not a useful concept has contributed to this situation. All in all, this analysis of current economic application of the notion of waste supports the view that a clarification of this notion is badly needed.

BEHAVIOUR UNDER SCARCITY: A NEW CONCEPTION

CONSTRUCTING THE NEW CONCEPTION

Above, three major shortcomings in Stigler's conception of waste were identified as well as correctives, which include:

- waste is ubiquitous and of such a magnitude that it cannot be abstracted away but rather one should continuously act on it
- waste due to a decision can occur irrespective whether the context is market exchange or not.
- decisions often, if not usually, need to be implemented in the material world; it is also here that waste can occur.

A new conception for decision-making behaviour under scarcity is needed where all inefficiencies are covered. Thus, waste before a decision, waste directly originated by that decision, and waste possibly occurring after the decision, as an indirect consequence of it, have to be addressed. It is proposed that these are called background waste, decision related waste and foreground waste. This conception is compared to Stigler's conception in Table 3, and its different elements are discussed in the following.

Table 3: Comparison between the waste types in the new conception for behaviour under scarcity and in Stigler's conception.

Waste type	The new conception	Stigler's conception
Background waste	Waste existing prior to the decision, and affecting that decision (through general resource scarcity or as a factor in the decision)	Not covered
Decision-related waste	Outcome of a non-optimal decision	Foregone product can be obtained for less than its cost
Foreground waste	Waste occurring in the implementation of a decision	Not covered

BACKGROUND WASTE

Background waste consists of the waste "normally" emerging in the activities of an organisation. This occurrence of waste adds to costs, and relatively, adds to the scarcity of resources the organisation is experiencing. Williamson's (1991) first order economising addresses this kind of waste, whereas second order economising is about optimal allocation of resources.

Authors in production management argue that waste should be continually reduced. Especially, the approach of continuous improvement (Imai 1986), *kaizen*, focuses on background waste.

What is then the relation between background waste and a decision? Robbins defined economics in terms of scarce means in view of our limitless ends. First, the accumulated savings from continuous improvement and reduction of background waste diminish the scarcity of means: simply, there is more money for every need considered important. Secondly, background waste is also related to our ends. If our household can reduce the food waste, we would need to buy or otherwise acquire less food. Note that the relation of background waste reduction to a decision is generic in the first case. Instead, in the second case, decision-specific waste reduction (that is, waste related to an end should be reduced) is needed.

DECISION-RELATED WASTE

All non-optimal decisions lead to waste. The question may be about assumptions that turn out to be wrong, calculation error, etc. Surely decisions need to be as good as possible, based on the factors that are known at the time of making that decision. As it is well-known, uncertainty about the future, incomplete information on the current state and deficient understanding of the phenomena dealt with in the decision make it difficult if not impossible to determine the optimal, best possible, decision in practice.

FOREGROUND WASTE

Decisions represent mental commitments – however most decisions need to be implemented in the material world. During this implementation, waste can occur. This is called foreground waste as the room for it is created by the relevant decision. By not acknowledging the implementation of decisions, economics fails to recognise this type of waste.

The mundane example of buying milk on a hot summer day provides an example. When deciding to buy, we need to anticipate how long it would take to have the milk brought to the fridge, to avoid it being spoiled. Another example is offered through the case that a client decides to start a construction project. That decision leads to a multitude of subsequent activities in the material world, as well as to a multitude of subsequent decisions in the world of ideas, and the possibility of waste is lurking everywhere.

ILLUSTRATION

Let us illustrate the new conception through the case of a hospital project.

Background waste

The OECD report (2017) and other literature gives abundant evidence on the prevalence of waste in healthcare settings, including hospitals. The reduction of such background waste is already a reality in some hospitals (Virginia Mason Institute 2021, Reijula & Tommelein 2012). By reducing operational costs, there is more room for capital investment.

On the other hand, some background waste may be directly related to an upcoming decision. Through a new facility design, the daily walking time of the nursing staff may be reduced. By reducing re-admissions, the number of beds needed may be reduced.

Decision-related waste

Decision-related waste is mostly related to the continued need for the facility in question. Thus, the correctness of assumptions and predictions accentuates.

Foreground waste

Hospital design, as such, is a complex endeavour, and proceeds under many uncertainties. The best available approaches need to be used for avoiding waste. Life cycle thinking and future-proofing (Memari et al. 2023) can be mentioned as promising countermeasures regarding issues emanating from the long life of the facility and the uncertainties surrounding it. However, the primary consideration should be given to approaches and methods addressing waste in design and construction, for the sake of continuous improvement during these stages and beyond (Koskela & Ballard 2021). Especially the Target Value Delivery procedure (Ballard 2020) has turned out to be instrumental for reducing avoidable cost. The commonly achieved savings, in the region of 10 – 30 %, give a manifest proof of the existence and magnitude of foreground waste.

CONCLUDING DISCUSSION

The idea of scarcity of resources as a starting point for economising, and indeed, economics, is fundamental. The conclusion drawn from this has been that resources should be allocated to different uses in the best possible way, optimally. However, there is a critical shortcoming in this reasoning: for its part, resources are scarce because we are wasting them. As Williamson (1991) argues, reduction and elimination of waste should be the primary form of economising, only after that come optimal decisions.

However, economics has acknowledged only optimal decisions, and been silent on the need to tackle waste. Because of the immense influence economics has had from the middle of the 20th century onwards, this has had considerable consequences on many fronts. Let us just remind that many of the sustainability problems are waste problems, starting from the considerable food waste to the inefficient use of energy resources.

It is noteworthy that the concept of waste has never been explicitly and convincingly argued to be useless in economising; it has just been incompatible with the theoretical constructions of neoclassical economics, and attempts to import waste into the economic theory have been aggressively shot down, with strong rhetoric but weak justification.

The suppression of the concept of waste in economics is also related to the neglect, in economics, of a phenomenon which shows perhaps the majority of waste: production. Background waste exists in all activities of an organisation, including especially production. Much, if not most foreground waste likewise falls into production. Thus, the exclusion of production from economics, which was strongly propagated by Robbins (1932) and then realised through the proliferation of neoclassical economics, was a grave mistake.

The declared purpose of academic economics is to explain and predict; however, in practice, the economic theory is taken as a description of economic phenomena, and as a normative guideline. The many books of managerial economics are examples of the latter. Waste being absent both in the description and in the normative guidelines has led to a situation where waste reduction is not recognised as a valid and necessary line of practical action. Furthermore, without awareness of the possibility of the emergence of waste, it may be that lines of action based on economics have actually increased waste.

The new conception of behaviour under scarcity, if accepted, arguably leads to the need to reassess the neoclassical economic theory; there is no visibility on all implications now. However, a more immediate and important consequence is that the normative guidance on the part of economics needs to be changed to cover both optimal decision and waste reduction.

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