The Epistemic Impossibility of Economic Calculation

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Events regarding individuals' preferences that do not always follow from standard measures such as "value of statistical life" or "quality-adjusted life years" as well as events that occur in some market-related settings which distort the information conveyed by price mechanisms, suggest that a notable chunk of what Hayek called "local knowledge" remains inaccessible by scientific tools and that only the individuals who interact in these local frameworks can have access to it. This casts serious doubt on the epistemic possibility of economic calculation for if events in the local world do not observe the economic models, it is hard to see how central planners can have knowledge on them. Refined modeling strategies and cutting-edge Artificial Intelligence systems do not manage to overcome this hurdle. They may provide huge datasets in a data model, but since not all events represented in the data model are embeddable in known economic models, the knowledge problem is not evaded. Even if a theory ever manages to capture all possible events as they appear in the data model then we are left with a relationship between models (the theoretical model and the data model) with no direct access to the local world and thus the problem of accessibility of local knowledge remains unresolved.

Introduction

Mises and Hayek offered different conceptualizations of the same problem i.e. the problem of how –and in fact whether—economic calculation can be done effectively by central planners. Mises argued that the knowledge required for economic calculation is actually inextricably linked with private property and thus it becomes impossible to have prices and hence the necessary knowledge to conduct economic calculation in the absence of private property (Mises 1920/1990). This proposition was part of a more general project endorsed by Mises regarding the impossibility of socialism. Hayek was in accordance with much of Mises's work by and large and in particular with his thesis on economic calculation, albeit he added another distinctive layer of analysis according to which economic calculation is a matter of knowledge that is not related solely to private property. According to Hayek, knowledge can be of two types: the scientific knowledge and the knowledge of the specific spatiotemporal circumstances, the so-called "local knowledge" (Hayek 1945). What is remarkable with local knowledge is that it is accessible to the individuals that interact within this framework and not to everyone in the society, and thus central planners have no knowledge of it even if they try to obtain it via theoretical tools. It becomes therefore nearly impossible for a single individual to acquire the amount of information required to plan the entire economy and so central planners cannot be regarded as carriers of such credible information and it follows therefore that they are

unable to plan the economy and make effective economic calculations. While Hayek's analysis also focused mostly on socialism when his argument first appeared, it seems that it finds application to contexts where Mises's does not, such as in modern democracies whereby private property is a matter of fact and nevertheless central planners may lack sufficient information to make fully-informed economic calculations and regulate accordingly. I will therefore focus on Hayek's take on the subject matter since it is an issue that governments of all regimes can face (and hence it appears more often than Mises's account that is related solely to socialism). For the same reason I use the terms "economic calculation" and "central planning" instead of "socialist calculation" or "socialist planning".

The standard version of the pro-central planning case was that if a free-market price mechanism is replaced by a central-planning one and swift calculations take place, then economic planning becomes possible. As we will see though, from the existence of a price mechanism (either socialist, democratic or free market one) it does not follow that no knowledge problems appear, let alone that central planners' knowledge problem is solved, for there is the possibility that individuals' actions make prices convey information that is at odds with economic models. If the information of the price systems is not captured theoretically, this suggests lack of knowledge thereof. This is the market aspect of local knowledge. Since individuals' choices and risk-perceptions are not always directly linked to markets, it can be said that there is moreover a non-market aspect of local knowledge which is related to individuals' preferences as they are mostly represented in "value of statistical life" (VSL) and "quality-adjusted life years" (QUALYS) measures. These are the measures used by economists to estimate policy tradeoffs by calculating how peoples' preferences are served by the proposed policies. So if economic calculation is to be based on knowledge of individuals' preferences it needs to take into account the evidence VSL and QUALYS offer. However, empirical findings indicate that individuals' choices do not always square well with these two methods which in turn implies that a great deal of agents' preferences goes unnoticed by the ordinary economic apparatuses. The fact that evidence related to price systems and to individuals' preferences are not always embeddable in theoretical models showcases a serious epistemic drawback for economic calculation, namely that it is conducted without accounting for events either directly related to prices and markets and/or to individuals' preferences (which can be market or non market in nature).

The quantum leaps in technology over the last decades have brought to the fore once again the debate on economic calculation and have revamped the counterargument to Hayek's view. The advent of Artificial Intelligence with its information-grabbing and computing systems (AI systems) has motivated some scholars to argue that AI enables central planners to obtain knowledge of the particular circumstances since its technology and the cutting edge algorithms it uses, manage to offer a complete view of the social world and hence provide the basis for sound economic calculations. So the economic and philosophical questions pertain to whether it is about time Hayek's

claim was refuted by the way a novel and an ever developing AI technology works or whether a decades old argument is still valid. While this controversy typically amounts to a wrangle about socialism and free markets and on whether a centrally planned economy produces better outcomes than an unplanned one, to see whether central planners can obtain knowledge of the particular circumstances, one needs to focus on the epistemological aspect of the issue and to reflect on the extent to which knowledge of particular circumstances is *on principle* obtainable or not. Hence to make an epistemic case for or against the possibility of economic calculation, we need to explore not only whether Hayek's local knowledge is attainable by past means or through current trends in technology, but whether there is the epistemological possibility that such knowledge can *ever* become accessible by others than the individuals that interact within the local setting *no matter how much* technology develops and *regardless* of the theories that are on offer.

To the best of my knowledge, even the way Hayek himself treated the issue seems to allow that obtaining local knowledge is mainly a practical impossibility and thus he does not exclude it formally (Hayek 1935, 207; 1945, 529-530). He therefore seems to be aware of the fact that while his analysis does showcase that we have no good reasons to expect central planners to retain local knowledge, it does not provide a conclusive epistemic argument against such a possibility. Late Lange—a prominent advocate of central planning and a scholar who challenged Hayek repeatedly—was confident that upon the arrival of supercomputers calculation would become an easily achievable task and scholars describe him as being convinced that under such circumstances Hayek's knowledge problem would no longer be an issue for central planners (Lange 1967, 158; Caldwell 1997, 1864). Hence Lange's sureness was likely due to the fact that he was not confronted by Hayek with an epistemic argument that rendered impossible on principle the acquisition of central knowledge. In my view this is because Hayek discusses the issue in semi-epistemological terms and in semi-political ones and so he adds a normative insight in order to capture the unlikely, albeit not impossible, scenario that an omniscient mind retains all the necessary information. That is why Hayek stresses not only the practical impossibility of centralized knowledge but also the *need* for dispersed knowledge so that it is used by individuals optimally and not by central planners who, even if obtain such knowledge, they could not manage to use it better than individuals at a local level (Hayek 1945, 530). While Hayek attempted to hone his epistemic part of the argument by appealing to Mises's central view and by claiming that competitive markets through their price-values could establish that production of goods will take place at the lowest possible cost and that if prices are centrally dictated that cannot happen since the lowest cost will not become known to central planners (Hayek 1940; Lavoie 1990), this, if interpreted in purely epistemological terms, indicates that prices eliminate knowledge problems, but, as it has been suggested, knowledge problems keep appearing even in the presence of prices. To be clear, I do not imply that Hayek did not make a sound epistemic case against economic calculation; I am simply mentioning that while the epistemic aspect of his reasoning is certainly on the right track, it leaves room for a

possible omniscient mind or a machine to grasp both market and non market local knowledge—as some argue it may happen with AI systems. However, we will see that there are strong epistemic reasons that preclude such a possibility regardless of the development of technological or scientific means.

To that end, we can retain the gist of Hayek's description of local knowledge and to describe it as knowledge the individuals own which is related either to their own preferences and/or to the institutional framework in which they interact (Boettke 2018, 12) while amending Hayek's epistemic terminology and draw a distinction between knowledge that comes from direct observation and knowledge that comes through scientific representations. Direct observation gives us primarily access to local knowledge and knowledge of the particular circumstances, while scientific representations give us mostly theoretical knowledge of the social world which may or may not include elements drawn from direct observation. AI systems make a fine grained attempt to access knowledge that is otherwise conferred mainly through direct observation and to transmit this information to others via representations. It can be said that AI gives (or could give sometime) data models which represent information about the particular circumstances and this information is interpreted with the aid of theoretical postulates so that economic calculation can become attainable. However, a series of problems seem to appear; since not all events of the local world fit the known models, the data model would entail events not embeddable in the economic models, and if calculations are made without accounting for a great chunk of what the data model entails, the calculations will not be fully-informed (I use the term "elliptic calculation" or simply "elliptic" to describe calculations of this sort). Even in case a "theory of everything" ever emerges in economics by making all events in the data model embeddable in this theory's models, there appears to be a relation between the theoretical models on the one hand and data models of the AI systems on the other hand but *no direct access* to several aspects of the local part of the social world is achieved. On the contrary, those that interact in specific spatiotemporal settings have knowledge of the relevant events through direct observation which does not miss observed and observable events, as representations often do. This creates problems for economic calculation since it is based solely on representations of the social world and not on direct observation of the local settings. The fact that AI conveys information via representational schemes—and it is hard to see how else that can be done—indicates that this hurdle can barely be overcome even if AI systems keep developing.

As far as I am concerned, the epistemic side of the debate is barely discussed decoupled from its political or its ethical one and even when this happens, key epistemological issues such as the inability of a price-mechanism to convey full information regarding local knowledge as well as the epistemically advantageous position of those that interact in local frameworks in comparison to those that seek to elicit local knowledge through representations, remain largely underappreciated and hence unaddressed. For example, a counterargument to the claim that AI systems can

solve the calculation problem is already on offer in the literature and it mainly compares the credibility of the information offered by prices and of the information AI systems can accumulate and concludes that AI can, at best, assist a *price-based* economic calculation, not run it on its own by replacing prices or by paving the way for governments to run it without the presence of price-mechanisms (Phelan and Wenzel 2023; Lambert and Fegley 2023; Boettke and Candela 2023). This objection thus rests on the premise that prices can convey the information which enables a fully-informed economic calculation and that AI cannot do such a work. However, this brings us back to square one, for the existence of prices does not resolve all knowledge problems. Even if we take for granted that prices are indeed able to inform better than AI systems can do, the knowledge problems are still persistent. Moreover, these accounts do not provide a response to one of the central claims advocates of AI central planning put forward, according to which a group of planners can run a country in the same way CEOS of big corporations run their companies: via AI systems that have solved knowledge problems in the corporate world (at least according to proponents of this argument) and hence they can solve them at a country-level as well. These issues require further epistemological examination than is currently available and the observation/representation distinction will turn out to be the key to this discussion.

Since in this paper I focus on the epistemic impossibility of overcoming the knowledge problem and on how the AI systems face certain shortcomings that make them unable to get over it. Thus a number of issues that are related, such as possible mishandling of the AI-induced information by self-interested politicians, as public choice theorists could argue it may happen, or concerns on the economic efficiency of making local knowledge available to central planners (Gmeiner and Harper 2022) are left out since even though they are still relevant, they are not directly linked to our discussion and they can find application regardless of whether local knowledge is accessible or not.

What does Economic Calculation stand for?

The economic calculation debate is having its roots, both conceptually and historically, in the attempts of central planning advocates to find a social mechanism that can be put into work and manage to replicate the economic outputs produced by free markets, albeit without the drawbacks induced by a free market interchange, such as capitalist waste. What was ventured therefore was a shift from rational economic calculation in which markets engaged, to rational economic planning, which was supposed to be conducted effectively by central planners. The key difference between the two is that while in the former case individuals interact freely and produce economic outputs based on each one's attempt to increase their own utility, in the latter case economic outcomes that (are said to) make everyone better off are to be planned in advance by a group of decision makers. This could be done, the argument

goes, if scientific knowledge could be bestowed upon society so that rational planning that was scientifically informed could replace market transactions that were based solely on interactions between individuals and, even though they were assumed to be rational, they lacked scientific grounding and hence produced systemic waste, such as monopoly power and instability from business circles (Lavoie 1985a). To avoid such economic outcomes, central planners argued in favor of "the rationalization of the economy" which entails exactly that instead of leaving individuals interact and generate economic results through their mutual engagement in utility maximizing, production will be dictated centrally by decision-makers that have the knowledge on how to shape production and allocation of goods. While it was initially a debate between two distinct poles of the political spectrum i.e. socialist economies vs. free markets, as it was mentioned in the introduction, the debate is moreover relevant when it comes to regimes such as modern democracies that most of them are neither strictly speaking socialist regions nor capitalist ones[1]and, in spite of this, decision makers often need to overcome knowledge problems during decision-making. Thus the term "economic calculation" that is used here, seems to me to capture all the historical and conceptual episodes of the debate, including socialist regimes where no property rights exist as well as various types of democracies whereby regulations of any sort are said to be based on knowledge of the relevant local settings.

The standard theory of economic calculation relies mostly on some famous "input-output models", such as the one first proposed by Leontieff (1986).[2] The model estimates how the outputs produced by several sectors in an economy are related to production outcomes of other sectors (such as whether the output of the one can be used as input to another sector). It ultimately provides results that can be used to estimate the amount of goods each sector needs to produce if it is known that society needs good *x* in *x'* amounts and good *z* in *z'* amounts. This model shares similar features with some others, widely used in economics, the ones known as "computable general equilibrium" (CGE) models which are also based on an input-output structure and use as inputs various databases to estimate the impact several policies could have. The policies CGE models target to include, but are not limited to, taxation policies, energy policies, health-related policies, climate policies and so on (Dixon and Jorgenson 2013).

[1] At least in the most extreme sense of the concept of capitalism according to which everything is privatized, there is no government, no public sector and all that exists is interactions between individuals.

[2] Hayek took issue early on with Leontieff's work by applying his standard repertoire against central planning to Leontieff's input-output modeling (Hayek 1976). Lavoie also criticized Leontieff's account on the grounds that it suffers the woes the project of rationalization of the economy suffers, such as that it seeks to replace individual relations and spontaneous order that both produce local knowledge with data aggregation and scientific knowledge and that this is an unsuccessful strategy both in epistemic terms and in terms of efficiency (Lavoie 1985b, 93-112).

The results these models provide therefore are heavily based on the inputs used. Two methods for assessing policy tradeoffs have been proposed and these are the "value of statistical life" (VSL) and the "quality-adjusted life years" (QUALYS). These are key measures for they try to estimate individuals' preferences on a number of issues from health-related ones to risk-perception and to market choices. Based on evidence elicited from these two, politicians estimate whether a policy passes cost/benefit tests and whether it will make society better off. Hence if central planning is said to take place in the light of knowledge of the needs and preferences of individuals, events that are related to this part of local knowledge need to be obtainable via these two economic methods. Apart from events related to agents' choices and preferences, theoretical knowledge is integrated in central planning for it is this knowledge that enables decision-makers to interpret the data that are induced from several measurements and real-world settings. So the facts of the social world need to be embeddable in some well-known economic models. Taxation policies for instance cannot take place without taking into account Laffer curve. The model suggests that the ability of governments to raise tax revenue is limited. If tax rates are low, then the government receives low revenues while if they increase then government's revenues do increase as well; but if tax rates increase beyond a threshold (45%-55%, roughly put) the relationship is inversed and the revenues start to become lower. Fitting real-world data on tax rates and revenues in Laffer curve is thus an integral part of the relevant economic calculation and planning.

This description of economic calculation makes the tacit presumption that public interest theory of politicians' actions holds. That is, politicians take expert advice on a number of issues, they obtain all the necessary knowledge, make the calculations based on this knowledge and then regulate in order to increase well-being. Increased well-being is often moreover linked to value judgments. So a policy is said to increase fairness or equality and it is simultaneously claimed that this is more efficient for the society in comparison to leaving things unplanned. As I mentioned in the introduction, whether this is the case or not is an important issue, albeit not an epistemological one. The epistemic part of the discussion pertains to whether decision-makers are able and, if not, whether they can ever be able, to acquire knowledge of the particular circumstances. Whether they use this knowledge in order to promote common good or not, is a concern that need not be included in this discussion. To put it differently, discussions on value judgments and on the efficiency of the planning policies (should) confront decision-makers *after* having acquired all the knowledge and the empirical and theoretical inputs are on display at a CGE model (or at other input-output one) which will help planners calculate the allocation of goods or plan whatever policies they have in mind. On the contrary, the epistemic side of the discussion is concerned with whether the inputs used can be said to be the result of having full knowledge of the social world which includes not only the theoretical postulates but moreover, as even advocates of central planning admit, knowledge of the particular circumstances.

Scientific Representation and Direct Observation

We can describe two modes of acquiring knowledge: the one is via direct observation and the other is via scientific representations. Of course, directly observable facts can be part of a scientific representation, but typically not all observable facts are embedded in scientific representations even if they are semantically related to them. When we say that country *X* suffered 10.4% inflation rate the previous month, we give a scientific representation of the overall changes in the prices in country *X* in the previous month and economists work with this figure to estimate the effects of this inflation rate in the economy. This rate was estimated by taking into account observable conditions but it does not give a precise figure of how much particular price rates have changed. That is, certain goods may vastly exceed or lag behind the average inflation rate and if that is so, for those goods the 10.4% is a misleading figure even though it is still a reliable and informative scientific representation of the overall trends in prices. GDP figures is another example of a representation that misses important parts of economic activity even though they are useful measures to estimate a country's wellness. A formula of the GDP adds up all goods and services produced in an economy by individuals, government and institutions, at a given period of time. However, it is known that it misses voluntary work (which also produces outputs), non market activity such as food growing on one's garden or grey economy. Hence it leaves out interactions that contribute to a society's well-being. This is common feature among scientific representations across sciences and is not only related to economics. To give a crude example, when natural scientists measure the melting point of lead and say that this point is 370°C, this is a representational result of several observations and measurements that gave values that approximate this point and are nearly never precisely 370°C (Bogen and Woodward 1988). This is also a reliable scientific representation even though it does not describe the exact melting point of lead.

By and large, the two main kinds of scientific representations that are mostly used are theoretical models and data models. In economics, theoretical knowledge is presented primarily via diverse theoretical models. Well-known relations between events and tradeoff articulations are presented via models and attempt to capture aspects of the social world. Theoretical models are typically consisted of measures like the GDP figure and the inflation rates and such measures are paired with other variables (recession, unemployment, government spending, and so on) as well as a set of assumptions that describe the setting in which the relation between variables occurs (such as monopoly, economy with/without public sector and so on). Since these models are constructed based on measures and variables that miss aspects of the observable domain, then their conclusion will also hardly manage to describe all aspects of the world. Another type of scientific representation the so-called "data models" share similar features, in spite of the strong empirical content which they are composed of. Experimentalists (in all domains of science) often encounter huge datasets which are primarily produced by measurement actions and processes in

experimental settings. The data model is the result of such measurements and it represents the *recorded data* (Giere 2018) while it typically makes no conclusive claims on which the *actual* data may be. At best, it *denotes* them, in a similar way a theoretical model denotes its target system.

The notion of denotation is important in scientific representations for it establishes the binary relationship between the representation-bearer and the state of affairs that is to be represented (Salis, Frigg and Ngyngen 2020). It moreover carries no particular ontological commitments vis-à-vis the objects that are represented since not all denoting symbols need to have denotata (Russell 1956, 41; Elgin 2009, 78) and hence it can be applied both to the observable and to the unobservable part of the world,[3] as well as to hypothetical entities, such as some monopsony market settings or a Robinson Crusoe model, that are often used alongside empirical premises to represent relations between economic entities. Hence scientific representations perform as binary relations of this sort, namely as representation-bearers that denote the existence of a mind-independent reality which shares comparable resemblance to what the representation entails, without being tied to the binding belief that an one-to-one relationship between the content of the representation and the target of the representation holds. Such a belief needs to appeal to strong metaphysical commitments that will enable us to go one step further and treat the representations of the world as carrying information that describes exactly how the world is (van Fraassen 2008, 254-256). Making such a step seems to me to require knowing beforehand how the world is and then claim that all there is to the world is what the representation portrays. But if we were omniscient to such a degree (scientists barely claim that they are), then the representation becomes epistemically redundant, for the knowledge it was supposed to convey would have already been obtained by scientists (and perhaps other human beings). On the contrary, given the documented absence of observed and observable events in some representations, it seems to be much more compatible with scientific practice and much more epistemically sound to claim that regardless of whether other than the represented relations exist what the representation tells us is that it denotes the existence of the events, entities and relations that it represents and not that the world is precisely at it is represented.

It appears to follow from the above that instances of particular circumstances in economics (such as price rates of some goods that are not exactly 10.4% or grey work

[3] The observable/unobservable distinction is more intense in physics than in economics for unobservable entities such as electrons can only be inferred by signals in some experimental set ups and are not directly observed while in economics I am unaware of events or entities that can only be inferred and not directly observed (at least by those that have access to the particular circumstances). Nevertheless, the epistemic side of the issue is of equal importance in both fields since it boils down to the fact that both physicists and economists work with representations and their denotations.

and voluntary exchanges between agents in GDP) become inaccessible when scientific representations are our epistemic tool. On the contrary, knowledge through direct observation can offer us such access (given that no unobservable events confront us in economics). Individuals interested in goods with price increases lower than 10.4% are the ones with direct access to such information and likewise people interested in goods and services the prices of which have increased more than 10.4%. Similarly, voluntary interactions among individuals as well as grey work in the economy is known only to those who participate in the very specific circumstances and go unnoticed when scientific representations such as the GDP measure are taken into account. Hence knowledge through direct observation may be spatiotemporally restricted and is not always scientifically charged, albeit it hardly misses or assumes away instances of particular circumstances, as it happens with representations. To elaborate a bit on it, I can be sure for example that in my room there is one desk and one chair or the owner of a cafeteria is pretty sure that when his cafeteria closes at 10 p.m. this is related to higher revenues whereas when it closes at1a.m. is related to lower ones. This is knowledge that has come from direct observation and describes correlations between events, though it is not scientific in any meaningful sense. There are of course several occasions whereby directly observed events become parts of a representation. The way objects fall either in terrestrial conditions or in vacuum, the way individuals react given certain incentives and constraints are some examples one can find. Therefore scientific representations offer knowledge of the world at the cost of excluding aspects of it, while direct observation offers knowledge of particular circumstances, though without being necessarily scientific. Since direct observation of all local settings is not possible for central planners who rely on theoretical models and on data models, we need to see whether these modeling strategies can confer knowledge of the local world to central planners without missing the events that are captured by direct observation. [4]

[4] When representations become accepted scientific knowledge, the observation of these events can be described as being "theory-laden". So it could be argued that direct observation and scientific representation may turn out to be indistinguishable modes of knowledge acquisition for what we observe is already determined by a theory's conceptual apparatus. However, that is not the case for even when we observe an event or a series of events directly and we are under the sway of a theory in doing so, while we may indeed try to capture the observed events by making use of the theoretical model's concepts, it does not follow that what we observe is identical to what the concepts entailed in the theoretical representation describe and so, as the examples of the inflation rates and of the melting point of lead indicate, if our description is based only on the theory's concepts it may turn out to be only approximately accurate. To have a fairly accurate description of what is directly observed extra information is usually added which pertains to the particular circumstances under which observation occurs. This discrepancy is often taken to be innocuous and so scientists work with the representations (the theoretical and the data

Market and non-Market Local Knowledge

One typical critique against the possibility of economic calculation is that only prices can confer the information needed to make decisions based on which we can effectively allocate goods and services and thus, the argument goes in a Misean way of reasoning, the absence of prices makes such a project unattainable. The underpinning of this view is that local knowledge is related to markets and to prices (or their absence) which convey the relevant information about goods and consumers' choices and hence and the presence or absence of prices indicates whether local knowledge is obtainable. This seems to be for example, the central claim Meadowcroft makes when discussing the NHS as a case study that highlights the shortcomings of central planning. Meadowcroft points to the absence of prices in the NHS as an epistemological barrier that prohibits central planners from acquiring the necessary knowledge. Meadowcroft links the absence of prices (and hence of knowledge) to NHSs failures and argues that they could have been largely avoided if a price system of a privatized health care was allowed to occur (Meadowcroft 2003). Setting aside issues regarding efficiency, Meadowcroft's analysis carries the implication that if one shows that prices exist, this indicates that central planners can have all the knowledge at their disposal. This is easy to do, even in the state-owned NHS. UK's department of health (which is at the helm of the NHS) comes constantly in agreement with pharmaceutical industries to buy drugs and also with other producers (say ventilator producers) to buy the relevant equipment. These exchanges do not take place in a priceless context for the means of production are not adjusted by the UK Government, but by pharmaceutical industries. These industries set a price for their products and the governments make orders based on the needs and buy these products by offering them money which both the government and the industries accept as a medium of exchange. Thus prices exist, transactions occur by taking prices into account and hence it could be argued that local knowledge is attainable. Of course, Meadowcroft could reply that more efficient purchases could be done if the NHS was privatized and was funded by individuals with private insurance and not through taxation so that those that run the privatized NHS would acquire knowledge of the needs of the hospitals and of patients via the information conveyed by the prices health insurance companies set. However, this seems to be primarily a matter of efficiency and not being strictly related to the epistemological portion of the issue while Meadowcraft puts it as a matter of efficiency and epistemology at once. On closer inspection, it appears that even if we treat Meadowcroft's analysis in merely epistemological terms and moreover assume that his scenario came into being, knowledge problems would have not been tackled and it seems that we should allow

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model) and they assume for the sake of simplicity that the models capture all the events in their domains (even if they are mindful that they do not do so), but when it comes to economic calculation such events include individuals' preferences in both market and non market contexts and this that if economic calculation takes place it is done without accounting for the preferences of a notable segment of the population.

for the possibility that there may be a price system and simultaneously to have events that are hardly accessible to the outsiders (i.e. to those that lack direct access to the local world) which in turn suggests that the existence of a price system does not guarantee knowledge of the particular circumstances.

Think of the following example elicited by US's house market which describes how intricate the relationship between the level of prices and the number of competitors can be. The economic theory on the issue suggests that when more competitors enter a market, then the price of the goods that are on offer in this market will fall. At least that is what the oligopolistic models and the monopolistic competition models show, namely that the price will be marginally above the production cost (entry may drive prices even lower). In the US residential real estate agency market there are thousands of competitors yet the market outcomes do not observe the predictions of the models. The brokerage fee in the US is 6% which remains constant in spite of the numerous brokerages that interact in the market. When two individuals want to buy/sell a house they cannot transact directly but through agents. So they search out for realtors. However, finding and hiring realtors is not enough to proceed to the transaction for the realtors of the buyer need to agree to work with the realtors of the seller and vice versa. Hatfield and Lowery provide evidence indicating that realtors can maintain high prices by refusing to cooperate with brokers that work below the average price level and furthermore with anyone who cooperates with someone who does so (Hatfield, Lowery and Kominers 2020). So we see that agents manipulate prices by engaging in a behavior that boycotts their fellows. This behavior takes place in a market-oriented framework and nevertheless prices convey information that does not fit some well-established economic models.[5] This is in fact a portion of local knowledge that *is* related to markets while it is *not* accessible via price signals or through economic theories because the price-related data that emerge are at odds with them.

Another part of local knowledge is not explicitly related to markets and hence since a price system does not always reveal local knowledge in its entirety, we can assume that the non market aspect of it i.e. non market local knowledge, is even more shadowy for the information that prices are supposed to convey is not even misleading, as in the house market case, it is simply absent here. Seemingly trivial issues are typically difficult to grasp by theoretical tools and have knowledge on them are nevertheless omnipresent in both market and non market contexts. Providing the set up for an academic conference for instance, is knowledge only the organizing committee has since it has direct access to the building that the conference is to take

[5] It is thus not unreasonable to assume that even in a fully privatized healthcare setting, insurance companies would respond to incentives to tacitly cooperate in order to keep prices artificially high or artificially low (depended on the relevant tradeoffs) thus making the transmitted piece of information distorted even to those at the helm of the NHS, let alone to central planners.

place, the needs of the particular conference and of its participants and so on. Thus it can hardly be obtained by others who lack direct access to this spatiotemporal region.

Less trivial cases of non market local knowledge are related to the project of measuring individuals' well-being. I treat it as a non market aspect of local knowledge, for it seems fair to assume that among the things people value in life a great deal of it is not directly linked to markets even though measuring well-being can be reduced to a price-related issue by economists. A standard method therefore is by implementing VSL and by asking individuals how much they are willing to pay to live under a state of affairs *X* or to engage in an activity *X*' so that a numerical representation of agents' preferences will be at our disposal which in turn would be used in cost/benefit estimates. If one gives a relatively high value to *X* or to *X'*, then it is said that implementing policies that lead to one of them will increase the individual's wellness. However, it is not clear that full access to such knowledge is achievable that way for a number of reasons. First, social desirability bias suggests that people many a time give answers that are socially desirable, not the ones that reflect their beliefs (Kormos and Gifford 2014) and if that is so (which it seems it is to a notable degree) the evidence that will occur will be distorted. Perhaps this can be avoided to some extent if instead of asking individuals how much they are willing to pay (which is not always feasible), economists assign by themselves a dollar value to each life (which is what mostly happens). While this is a widely accepted practice, we need to be mindful that scientists who do such a research run the risk of assigning values that could be different from the ones the very same individuals would assign and then make estimates on flimsy grounds by arguing in a circular manner. That is, they postulate a value on one's statistical life that lacks empirical grounding and they estimate the costs and benefits of a policy based on this assumed and not elicited from observation value. For instance, scholars may assume that a group of people will pay 15$ to reduce risk of car accidents without accounting for the possibility that some in this group may have other priorities and hence are willing to pay more than 15$, less than that or even null dollars. Attempts to correct this may include an age-stratification of the dollars individuals are (said to be) willing to pay but nevertheless the problem remains. That is, those who calculate have no direct access to the preferences of the individuals and to each one's risk-perception and thus the circularity remains. This suggests that a part of the local knowledge goes missing and does not appear in the VSL estimates. Hence conclusions on the relevant policies on well-being based on these measures indicate they can be based on vastly skewed evidence.

Another way to make cost/benefit estimates of policy prescriptions is by applying QUALYS measure which attempts to take into account both the quality and the quantity of life. Thus in this respect it aims, at least in theory, to capture more aspects of non market local knowledge by representing the quantity of life lived expressed in years with the quality of these years expressed as a utility preference score. QUALYS are derived from expected utility theory and measure a range from 0 (death) to 1

(perfect health). One year lived in perfect health equates to one QUALY; one year lived in nearly perfect health (in case for example a professional footballer cannot participate in matches due to an injury, but other than that he goes about a normal daily routine), could equate to, say, 0.7 and so on (Whitehead and Ali 2010). To calculate the precise number of QUALYS, one can multiply the utility value associated with a given state of health by the years lived in that state (Drummond et.al. 1997; Prieto and Sacristan 2003). In the footballer's example, his QUALYS are 0.7 (0.7 x 1). However, the QUALYS measure does not always withstand testing against the empirical record. The ECHOUTCOME (European Consortium in Healthcare Outcomes and Cost-Benefit Research) research project undertook the task of testing the QUALYS's assumptions to see whether they are compatible with stated preferences expressed by multinational participants. The experiment included 1,361 subjects from Belgium, France, Italy, and the UK. The subjects were asked to express their preferences regarding various hypothetical health states derived from combining different health states with time durations in order to compare observed utility values of the couples (health state, time) and calculated utility values using the QALYS formula. The researchers found a significant asymmetry between observed utility values and QUALYS-based calculation values which in turn suggests that the theory's assumptions do not find application to groups in the society (Beresniak et.al. 2015).

The bottom line is that either directly related to prices or not, local knowledge contains of events that cannot always be embedded in theoretical models and hence be interpreted according to economic knowledge. It appears therefore that local knowledge is *partly* obtainable and we can frame it as being consisted of *scattered* events, namely events that can hardly be embedded in the known models of economics and *scientifically loaded* events that can be predicted and explained by our theoretical apparatus. Both market and non market local knowledge can entail scattered events as well as scientifically loaded ones. Armed with these notions we can go on to see whether economic calculation is epistemically possible if modeling practices are employed or if cutting edge AI systems are used.

Computational Modeling and Local Knowledge

The attempts to make a case for economic calculation face a serious methodological hurdle: they make no attempt to figure out how local knowledge is obtained. Instead they start off by taking for granted that central planners have knowledge of the particular circumstances and then they go on to show how effective central planning is. It seems that this is due to the commitment that local knowledge is strictly related to prices and so once a free market price system is replaced by its central planning equivalent then local knowledge will be obtained by central planners. However, as discussed in the previous section even when prices are in place it is not uncommon that among the signals that are transmitted some can be hardly interpreted by the known economic models and that furthermore there is a non market local knowledge

that is independent of the existence of a price system. It appears therefore that central planning advocates are prone to the same epistemological flaw supporters of free markets are for they both presuppose that price signals (or an equally informative alternative) convey local knowledge in its entirety.

Lange and Taylor have proposed one of the most famous models in the central planning literature. They recognize that prices convey all the necessary information and they propose a "trial and error" mechanism which could—after several attempts—bring the necessary knowledge to central planners and the economy to equilibrium. Their story holds that society can be thought of as an experimental design in which central planners test various hypotheses on how to effectively allocate sources. After some mistakes during the first attempts, the effective way to allocate goods will be achieved. Prices convey the information of local knowledge that central planners take into account in order to find the ideal price set up (Lange and Taylor 1938). The possibility of price-manipulation here becomes apparent for it does appear that in a setting whereby governments experiment repeatedly with prices in order to find the optimal price set up which would allow for allocation of goods, individuals will have incentives to cooperate and thus send distorted signals via prices to central planners so that they will pursue their own interests (and perhaps benefit more from allocation programs than they would without such a cooperation). Moreover, the non market side of local knowledge and the possibility to acquire it is also left unaddressed here.

Cockshott and Cortell's modeling is following the same pattern. The authors put forward a dual schema in which production is not solely state-driven but in which private sectors also participate, albeit their domains of action are heavily controlled by government. Instead of a currency they argue for a labor time certificate which can be considered as a voucher that is not a universal medium of exchange but is eliminated when the targets the central planners set are met (Balsam 2020, 265). This voucher is different for consumers and different for producers; the labor time cost will be likewise different from the consumer demand and a comparison of the two will convey knowledge to central planners so that they can regulate and adjust the production (Cockshott and Cortell 1993).[6] This mechanism faces the same hurdles Lange and Taylor's price mechanism does for it does not account for the possibility of individuals cooperating in order to manipulate price-related information; in the version of market system proposed by Cockshot and Cortell, individuals can still establish a network of interactions that manipulates the signals sent by the labor tokens thus perverting the information transmitted. Incentives to prolong the time-duration of the certificates by leaving production targets unmet or a cooperation

[6] Indeed, Cockshott and Cortell seem to be of the view that the only thing that hinders full access to local knowledge is that it is treated as private property. Once this is accommodated, and in the light of the voucher-based price mechanism which they propose, local knowledge can be conveyed to central planners (Cockshott and Cortell 1993, 112).

between producers and consumers to channel production signals towards a product these individuals value most can be among the events that distort the voucher-based signals. Such a possibility, which is empirically grounded as we saw, is not prohibited on this account and no theory on the incentives to adhere to such a system is offered. The authors' schema furthermore leaves out central sides of non market local knowledge such as preferences that advance individuals' well being that are not linked to a price system.

Chockshott and Cortell seem to moreover share the conviction that updated technologies can lead to rapid and accurate calculations by managing to calculate results from huge amounts of data and in a very short time. But if scattered events are coming to the fore and are not embeddable in some well-established economic models it follows that the calculations will be elliptic no matter how well the system runs. The problem is not eliminated even if AI systems are in place.

AI Systems and the Epistemic Inaccessibility of Local Knowledge

In line with the claims that computer simulations can give us access to local knowledge by making credible calculations in time is the proposal that novel AI systems can surpass the problem of the accessibility of local knowledge. An increasing body of literature mentions exactly this: that the knowledge problem is no longer an issue for central planning due to the advent of AI systems. This is a stronger claim than the one described above, for it does not restrict itself into replacing the free market price system with a central planning one, it instead suggests that AI systems can provide governments all the knowledge that was so far difficult to acquire. Hence it is no longer another type of price system that will convey the information; it is AI that will fulfill this task. The guiding idea is that an AI system can accumulate all the data that include information about individuals' actions and preferences in any possible domain and offer it in real time to central planners. Then governments and central planners, by having obtained this knowledge, they can go on economic planning and, via swift and well-informed calculations, to allocate goods effectively (Cohen 2009; Pentland 2009; Mayer-Schönberger and Cukier 2013; Morozon 2019; King and Petty 2021; Samothrakis 2021).

Philips and Rozowski use the example of big-tech corporations, such as Walmart, to show how AI can be used to fill in knowledge problems and primarily to meet consumer demand without suffering much of a waste. They recognize that centrally planned economies in the past have failed to solve the problem and have not managed to acquire local knowledge, but they argue that this is possible if sophisticated technologies are in place which will provide the data that were previously hidden. If that happens and decision makers have them at their disposal then planned economies can work without being laid open to the accusation that they miss local knowledge (Philips and Rozowski 2019). At first sight it seems that Philips and Rozowski make a

point when they claim that running a huge corporation is not dissimilar to governing a country and so, if technology solves knowledge problems big companies have then we have good reasons to claim that it can do so if it is applied to the entire society. To put it in epistemological terms, it could be argued that in Walmart's case and in similar cases that include corporations that are so big (Amazon can be another example), knowledge through direct observation becomes obsolete and that all the CEOS have is knowledge through the data provided by AI systems and since AI solves the corporations' knowledge problems, then it can do the same to the entire society. In other words, all CEOS have is knowledge through representations by having a data model that confers the information. If that is so, then either the knowledge problem is even more intense than described so far and it appears even in local frameworks or, conversely, AI systems have managed to represent all the events that possibly occur in a data model thus making knowledge through representation able to include all aspects of local knowledge by leaving no room for scattered events. The latter seems to be what Philips and Rozowski in fact call for, albeit without using the distinction between direct observation and representation. Their claim is that AI solves knowledge problems of any kind. However, caution is needed when extrapolating the results of one subject matter to another one, especially when this is one of greater generality, because different epistemic features in each domain can render the conclusions mistaken.

We need to tread carefully here and to discriminate between the application of AI systems to local settings by those who have access to this context and to the application of AI systems to the entire society by central planners. When AI systems are at work in a local framework they appear to reflect the knowledge of the particular circumstances the individuals of the local framework have (call them "local planners"). In the Walmart's case for example AI systems can be used to provide those at the helm information about the need of replenishment stocks and of consumers' reaction to a novel product. This information comes into data sets and is in fact a data model that represents the replenishment of stocks as well as the rate of purchases of the novel product. Since these were the inputs of the AI algorithm in the first place it appears that the relationship is self-sustained: the local planners put in place an AI mechanism to acquire information about these aspects of their corporation and the system offered them a data model with information thereof. No scattered events appear and hence everything that comes out of the AI system is not only semantically in agreement with the local planners' initial propositions, but it is moreover interpreted by them. That is, even though it may reject or confirm their hypotheses on purchase rates or on the amount needed to fill in stocks, nothing remains unexplained in the data model. While one cannot exclude the possibility of missed events i.e. of events that do not appear in the data model or of events that convey distorted information (and hence of scattered events)[7] the self-sustained

[7] For instance, a warehouse manager who is the one that directly observes the quantities of the products in stocks can have incentives to send distorted signals vis-à-

system will not recognize them as such and will be interpreted in the light of the initial premises. The reason is that local planners do not rely on a theory to interpret the events (as it happens when knowledge from diverse fields in society is needed), but instead on their own knowledge of the local framework and so they have the ability to interpret the information the data model carries and thereby have knowledge of all the information the data model entails. Hence one can remain agnostic on the possibility of missed events by claiming that the data model provides a representation that denotes the replenishment stocks and the consumers' purchase rate of the novel product and can moreover claim that even if missed events exist and go unrecorded and even if parts of the data model carry distorted information, since this is not interpreted that way, the economic calculation in the local setting will be based on a self-sustained system whereby the information the data model entails is informationally on a par with the local planners' initial premises.

Figure 1 illustrates the self-sustained case for economic calculation whereby {x1…xn}…{Z1…Zn} represent sets of issues related to local planners' company. Note that as the {…} implies, the sets {x1…xn} and {Z1…Zn} from which the data stem from are not the only ones, they are the ones the local planners asked information for (represented by the dotted lines) via AI Systems (the upward arrows). The sets can change and the system will still be self-sustained, though the possibility of unrecorded events nevertheless remains. When a self-sustained system is at work local planners have direct access to the data model in which no scattered events appear.

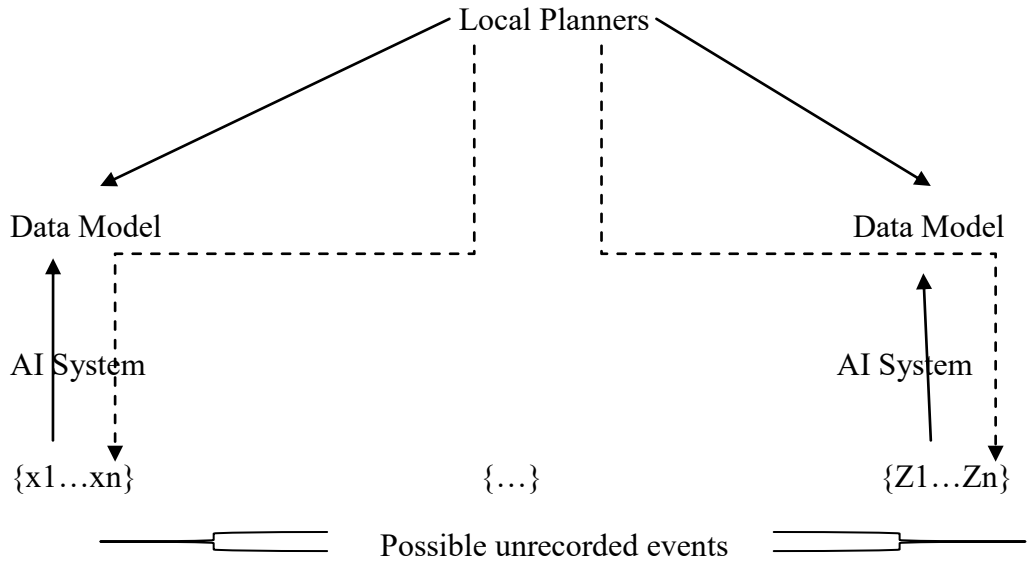

Figure 1:*Self-Sustained Economic Calculation*

vis the targets of replenishment and manages to do so through a set of actions. In such a scenario, the information the data model confers misses events like this one and is not an accurate representation of the replenishment needed.

This differs in substantial respects from the application of AI technology by central planners to the entire society. In these cases, central planners ask information about every aspect of the society via AI systems, and, as it happened prior to the advent of AI, a scientific theory is said to provide central planners information about the world. What is remarkable now is that the data induced by an AI system offer representations that were not previously at central planners' disposal, namely representations of the particular circumstances of the local world from any possible local setting. That is, data from all domains of society that do not appear in the scientific representations they now do appear in a huge data model. This data model makes sense if it becomes embeddable in a scientific theory since it hardly allows for knowledge of the events it represents otherwise, let alone for economic calculation. Such an optimization process therefore would require fitting different datasets in the respective economic models. So central planning will search out for the data that can be embedded in economic models by leaving the ones that do not fit the models out. However, this suggests that a pile of data will go unexplored and no knowledge of them will have been acquired. These are the scattered events *in the data model* for the scientifically loaded ones have already been embedded in the theoretical model. Hence we are left with a relationship in which on the one hand there are the economic models that give predictions for the world and on the other hand there are the datasets of the AI system that fit these models. What is missed is to take into account scattered events in the data model as well as events that perhaps occur and which do not appear in AI data models. And even if we can assume for the sake of convenience that cutting-edge AI systems will not allow for such a possibility,[8] since not all of them are theoretically captured the problem is still persistent. Thus the system is no longer self-sustained, it becomes elliptic; the presence of scattered events in the data model suggests that if economic calculation on such a model-based relation takes place then it is elliptic no matter how fast the data are collected and how speedily the calculations are made. Limiting the control space faces similar problems. Since VSL and QUALYS do not always manage to derive agents' preferences and risk-perceptions and given the possibility of price mechanisms to convey distorted information, scattered events in the data model are likely to occur irrespective of the domain of the application of the AI technology and of the parts of the local world it targets to.

Figure 2 shows the elliptic setting for economic calculation which accounts for both when the entire society considered and when particular aspects of it are taken into account. It is shown that central planners ask information about the local world (dotted line) and AI systems (the first from the bottom upward arrow) offer them a data model of it. Central planners have direct access both to the theoretical model and to the data model but they can have knowledge *only* of the theoretical model and of the scientifically loaded events that have been embedded in it by the data model.

[8] However, it is far from clear that such an assumption is credible even when AI is applied to local settings let alone when applied to the entire society.

Scattered events in the data model and possible unrecorded events remain out of the planners' epistemic scope while direct access to the local world is not achieved.

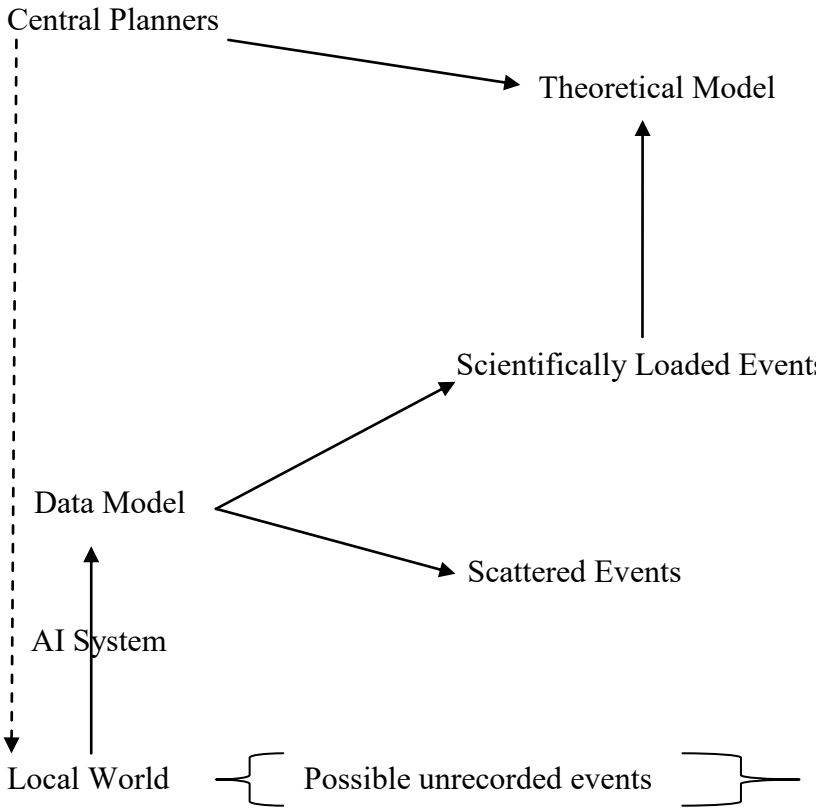

Figure 2: *Elliptic Setting for Economic Calculation*

A possible solution to the above could be to try to find correlations between scattered events and then calculate accordingly. However, even if correlations are found and they are moreover strong enough to be said to establish causality, these will be *ad hoc* causal relations based not on direct observation, but on a data model and moreover without any theoretical grounding. Lack of a theory and lack of direct observation leave us only with raw data in a data model and searching for causal relations in a data model without any theoretical or empirical aid, suggests that the conclusions will lack both theoretical and empirical basis which makes a calculation under these circumstances to be no less elliptic than it was prior to the search for correlations and causal relations. There are further problems besetting this approach. Causality entails great metaphysical commitments which can be assumed away (though not eliminated) if repeated causal patterns are observed (in nature, in the social world or in experiments) and are moreover embedded in theoretical scientific models. In the case of scattered events that appear in a data model though, the metaphysical underpinnings seem to become orders of magnitude stronger than in typical causal claims for the same reasons that weaken the validity of ad hoc causal claims in the first place, namely the lack of theoretical grounding and of direct observation. Hence any possible inferences drawn from raw data in the data model

will be made on very shaky grounds and it cannot be said to tackle the problem of acquisition of local knowledge,[9] which further enhances the argument that the respective economic calculations are also elliptic.

Can AI Systems and a Super-Theory Solve the Problem?

In the not very likely scenario that a "theory of everything"[10] is articulated by economists and social scientists which manages to capture all and every possible events that occur and that this theory is used alongside AI systems which offer huge datasets of the social world, the problems on the inaccessibility of local knowledge nevertheless remain, for we are left with a model-to-model relationship that lacks direct access to the local setting. To be sure, the epistemic side of the issue will be significantly improved in comparison to what is happening now and it will be akin to the results we have when AI systems are applied to local knowledge by local planners. That is, all events represented in any possible dataset will be able to fit in the theory's models and interpreted accordingly. Such a system is self-sustained and there are no scattered events in the data model. However, as we saw in the corporations' case and by furthermore considering the way scientific representations work (either theoretical models or data models), from the fact that no scattered events are represented in the data model one should not draw the conclusion that there are no such events whatsoever or that the event-representations in the data model will be without its asymmetries with respect to the local world (as the distorted price signals suggest). AI data models cannot evade this hurdle; its systems can give an informationally rich database but no formal proof that no other events occur that are not included in the data model is given. Even if we assume that AI systems sooner rather than later capture events that possibly occur outside the model, then update their databases regularly by including these events as well, again this problem is not addressed for one more time, central planners have direct access to two models: the

[9] Individuals that interact in a local setting can also make non-scientific ad hoc causal estimates, though this is spatiotemporally restricted knowledge that furthermore has the advantage of being elicited through direct observation which in turn suggests that there is hardly the possibility of events that go unnoticed, as it can happen with data models and all kinds of representations. This makes it epistemically superior to a situation whereby central planners try to figure out causal patterns in diverse, and often vastly different, fields in the society, from events that appear in a data model, without any theory to back their assumptions up and without the privilege of direct observation.

[10] This term is mostly used in physics whereby attempts to unify special relativity and quantum mechanics are made. However, at least as far as I am concerned, no such theory is on offer and some attempts to construct one (such as string theory) find little empirical support. So physics, pretty much like economics, is having different theories that apply to different domains.

theoretical model and the data model, but direct access to the local world, as the one individuals' that interact in this framework have via direct observation, is missing.[11]Hence even if all events in the data model fit the theoretical models, the best that can be said is that this relation denotes that the local world is pretty much as it is represented and that the calculation is self-sustained. Instead, those who directly observe events in the local world can base their knowledge thereof on more solid grounds, without relying on representations and on the notion of denotation and thus minimizing the possibility of missing the relevant events or of having access to distorted information about them.

In other words, it appears that even a self-sustained system cannot be said to be epistemically superior to the knowledge conferred by direct observation, not even equivalent to that. It can be (and it typically is) informationally richer in comparison to information transmitted by direct observation (which is moreover spatiotemporally restricted) though as the price manipulation interactions suggest and as hinted by the VSL and QUALYS drawbacks, it is exactly this spatiotemporally restricted knowledge that limits the applicability of our theoretical apparatuses and it is direct observation the optimal epistemic tool to obtain knowledge of it. It seems therefore that economic calculation, even under the best possibly conceived conditions, will rely on representations and not on direct observations and its inability to swift from a representation-based calculation to an observation-based one renders economic calculation epistemically impossible on principle.

Conclusion

The debate on economic calculation is having an epistemic dimension that is often conflated with arguments on the efficiency of free markets over socialism (and vice versa). Examining the issue isolated from the political discourse reveals some serious methodological and epistemological difficulties the project faces. The most important one is that access to local knowledge appears to be only partly achievable by

[11] Under the circumstances described in this section, the objection against AI-based calculation raised by Boettke and Candella would have been effectively circumvented for these scholars claim that modern economies are akin to a "wicked environment" in which parameters are relatively free and thus prone to changing as opposed to a "kind" one in which they are fixed (Boettke and Candella 2023, 205) and hence, if AI systems manage to capture all events and constantly update their datasets and these datasets moreover fit the assumed theory of everything, then, it could be argued that the knowledge problem is evaded since the changing parameters are instantly represented in the data model and find theoretical interpretation. But the distinction between direct observation and representation indicates that the knowledge problem is stronger than it is often said it is and is not merely a matter of changing parameters since these can be captured sometime by technological and scientific means.

theoretical and technological tools. Individuals who interact in certain spatiotemporally restricted regions will always be in the advantageous position to acquire knowledge of the particular circumstances via direct observation and not through diverse representational schemata, as central planners do. The representations may be scientifically charged, such as theoretical models, or the result of cutting edge technology, such as AI-induced data models, though they will, at best, be related to one another and central planners still lack direct access to the local world, as individuals that interact there have via direct observation.

The epistemological impediments to economic calculation are not necessarily a direct implication that planning offers inferior outcomes compared to an unplanned economy. One cannot exclude the possibility of effective calculations that are nevertheless elliptic from an epistemological point of view or of calculations that are in agreement with a set of value judgments while keep missing an array of events related to individuals' actions and preferences. However, since economic calculations are based on individuals' choices and preferences as well as on theoretical economic knowledge and since it has been found that events in the local world are not on always a par with such models, we need to be mindful of the epistemological barriers to central planning, regardless of the efficiency of calculations.

Supporters of the epistemic possibility of planning of any sort (of democratic or of an even more centralized one) are invited to show that standard economic models are able to capture events that make price mechanisms convey distorted information as well as events related to non market local knowledge and, speaking of the latter, to show that the VSL and QUALYS measures suffice to grasp peoples' choices in diverse local settings. Alternatively, they can provide a way out of the problem by suggesting other than VSL and QUALYS measurements or by proposing a pattern that makes central planners have knowledge of the local world through direct observation and not via representations. Unless these concerns are addressed, it appears that one is justified to consider economic calculations as epistemically impossible.

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