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ECONOMIC FLAWS IN COMPUTERIZED SOCIALISM

by Joseph Kane



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Abstract

Voices from Oskar Lange in the 1970s to those more contemporary hold that if only technology could become advanced enough, central planning would work. This paper analyzes whether current, or any conceivable, proposals that the radically connected modern age could solve the knowledge problem and make central planning a viable method of economic organization. It finds that claims that technology can solve the problems with central planning simply miss the point of the Austrian critique in the socialist calculation debate. Central planning, using the Internet or any other means, still cannot dispense with the competitive market process without which the discovery of the information necessary for economic calculation is impossible.

Author Bio

Joe Kane is a Technology Policy Associate at R Street Institute and an Alumnus of the Mercatus MA Fellowship. He holds an MA in economics from George Mason University and a BA in political science from Grove City College.

Committee Members

- Peter Boettke, University Professor of Economics and Philosophy, George Mason University, vice president and director of the F. A. Hayek Program for Advanced Study in Philosophy, Politics, and Economics, Mercatus Center at George Mason University
- Virgil Storr, Senior Research Fellow, Senior Director of Academic and Student Programs, and Don C. Lavoie Research Fellow with the F. A. Hayek Program for Advanced Study in Philosophy, Politics, and Economics at the Mercatus Center at George Mason University
- Jayme Lemke, Senior Research Fellow, Associate Director of Academic and Student Programs, and Senior Fellow with the F. A. Hayek Program for Advanced Study in Philosophy, Politics, and Economics at the Mercatus Center at George Mason University
- Stefanie Haeffele-Balch, Senior Research Fellow, Deputy Director of Academic and Student Programs, senior fellow with F. A. Hayek Program for Advanced Study in Philosophy, Mercatus Center at George Mason University

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Contents

I.	Introduction	4
II.	The Austrian Perspective in the Socialist Calculation Debate	6
	a. Techno-Socialist Proposals	10
	b. Project Cybersyn	13
III.	Contemporary Technology and Possibility of Socialism	18
	a. Energy Markets	19
IV.	Policy Implications	22
V.	Conclusion	25

I. Introduction

In the first half of the twentieth century, economists associated with the Austrian school argued information necessary to effective economic calculation requires the use of market prices and cannot be centralized in a way that would make central planning a viable alternative. It followed from this conclusion that socialism, in any meaningful sense, is impossible. But new technology leads some to question that claim. Voices from Lange in the 1970s to those more contemporary hold that if only technology could become advanced enough, central planning would work.

Given the large technological leaps of the past few decades, the socialist claim has never seemed more plausible. The rise of the Internet of things, ever-faster supercomputers, and gigabit Internet access provides a glimpse into the now radically connected world in which precise information about minute details of goods is transmitted around the world at nearly the speed of light. Some on the socialist side are now claiming that the very information that the Austrians told them had to be decentralized and conveyed by market prices can now be assimilated by computers. This paper analyzes whether current, or any conceivable, proposals could solve the knowledge problem and make central planning a viable method of economic organization. It finds that claims that technology can solve the problems with central planning simply miss the point of the Austrian critique. Central planning, using the Internet or any other means, still cannot dispense with the competitive market process without which both the generation and the discovery of the information necessary for economic calculation are impossible. By reapplying the Austrian critique to the prospect of central planning with advanced computer technology, we can helpfully demonstrate the necessity of humility in policymaking. After all, as Hayek (1988, 76) reminds us, "The curious task of economics is to demonstrate to men how little they really know about what they imagine they can design."

In the socialist calculation debate, Austrian economists made a strong case against the feasibility of rational economic calculation under central planning (Mises 1920, 1922). Nevertheless, the Austrian case has not always been fully understood. Proponents of central planning since then have considered how to circumvent the Austrian critique using advanced technology (Lange 1970; Cockshott and Cottrell 1993; Morozov 2015). Mises and the Austrians held that private property and market prices were necessary to determine the most productive use of resources. Later proponents of central planning have proposed that the same information contained in prices can be obtained by modern technology, and, therefore, central planning can be just as productive as a market economy or even more so. This project seeks to evaluate those claims and the extent to which they constitute an effective response to the Austrian perspective in the debate. The central question is whether the information produced by the competitive market process and encoded in money prices can be replaced or replicated by a technological process using advanced computing devices and networks.¹

I argue that attempts to replace the competitive market process with technologically guided central planning misdiagnose the problem they must solve. They characterize the knowledge problem of central planning as though it were merely that the necessary data is

¹ Note that the question here is one of technological capabilities not what values the political or economic order ought to prioritize. I claim that socialist proposals fail if their goal is to produce a society as or more prosperous than would be realized in a competitive market order. Many proponents of central planning make clear, however, that this is not the measure by which they judge their own proposals. Their goal is not to match the productivity of a market economy but to maximize some other end—equality, fairness, etc.—regardless of whether it costs overall productivity. If one desires a society in which everyone is equally poor, then central planning may be well suited to achieve that end.

difficult to collect or that assimilating all that data is too complex a mathematical operation. This construal of the knowledge problem is not the fundamental problem as the Austrians saw it. Rather, the flaw in central planning is that the data necessary to plan does not exist absent the competitive market process that generates it.

This paper begins by recounting the major issues and developments of the calculation debate through the first half of the twentieth century. I then lay out several proposals which claim that modern computing and networking devices can overcome the Austrian critique of central planning. I argue that these proposals do not address the central issue of the necessity of markets as a discovery process. I then examine theoretical and empirical examples of how modern technology does fit in to the endeavor of economic calculation. I close by drawing conclusions and policy implications.

II. The Austrian Perspective in the Socialist Calculation Debate

This project builds and draws upon the Austrian perspective in the Socialist Calculation Debate of the early to mid-twentieth century. The foundation for my argument, therefore, is rooted in the arguments of Ludwig von Mises (1920, 1922). Mises first argued that typical socialist proposals to match the productivity of a market order with central planning were impossible because such proposals lacked any mechanism for economic calculation. There is no way for a central planner to know the relative scarcities and urgency of alternative uses of various resources. Whether to build train tracks out of steel or platinum (or whether to build them at all) requires the planner to know all the alternative uses for those resources and judge which are most valuable. Mises claimed the planner could never possess all this knowledge in the absence of market prices. If one is planning a new railroad, he must decide not only whether and where to build it but also

what materials, machines, and workers to use. Since there is no common unit to compare all the relevant choices with their opportunity costs, planners are left "groping in the dark" (Mises 1920, 23). Economic calculation, said Mises, requires one to make comparisons of relative values of alternatives, and this valuation requires units of comparison. But since value is subjective, it can never be quantified in a unit. Instead, money prices capture the opportunity costs of a particular use for a given resources. These prices are a common unit allowing them to be used to rationally calculate and make economic decisions.

Mises's impossibility argument is succinctly stated by Peter Boettke (1998, 134) as follows:

- Without private property in the means of production, there will be no market for the means of production;
- 2. Without a market for the means of production, there will be no monetary prices established for the means of production;
- Without monetary prices, reflecting the relative scarcity of capital goods, economic decision makers will be unable to rationally calculate the alternative use of capital goods.

The socialists, chiefly Fred Taylor (1929), Abba Lerner (1934), and Oskar Lange (1936, 1937), fired back, saying that Mises had gone too far. Socialism is not impossible, they claimed, it just has to find a different way of discovering the information that would be discovered by the price mechanism in a free market. To this end, they proposed solutions that became known as forms of "market socialism." This involved allowing markets to allocate consumer goods and labor while vesting production decisions with a central planning board. The planners could then use the information borne by the market prices for consumer goods to direct production of those

goods. Using basic rules such as setting price equal to marginal cost and minimizing average cost would be sufficient to set appropriate "prices." If the prices set by planners did not accurately reflect relative scarcities, then shortages and scarcities would signal that they should be higher or lower. This would yield productivity similar to that of a free market system, but it would also allow the planners to allocate social surplus towards ends more desirable than the accidental outcomes of capitalism.

It is at this point in the debate that F.A. Hayek's emphasis on the knowledge problem focused the debate on a major shortcoming of even market socialist proposals (1940, 1945, 1948). Hayek stressed that central planning ought not to be preoccupied with a static end state that is the "right" answer. One of the central aspects of the Austrian view is the conception of the market as a discovery process. That is, markets are not a static phenomenon in which all the data needed for economic calculation is lying around and preordains an equilibrium outcome. Rather, entrepreneurs exist in a world of radical uncertainty in which knowledge is dispersed and specific to time and place, and they learn which uses of resources are most valuable by seeking profit. Markets are more than a discovery process, but they are not less. The problem of coordinating disparate and dispersed knowledge about capital which is heterogeneous and multispecific cannot be so easily dispensed with as it is in market socialism.

At its foundation, market socialism takes as already discovered the very things for which markets are most essential. Specifically, Lange explicitly takes as given individuals' preference scales and knowledge about the resources available (1936). He justifies this step by saying that they are given in a competitive market, so socialists should be able to take them as given as well. But this is wrong. The knowledge available in the competitive market system and the impact of individual preferences are products of that system and is not easily separable from it. Such

knowledge, including knowledge of how to combine and transform resources most productively, is only known after the fact through the market process. It is the generation of this knowledge and the revelation of individual preferences in the market process and their transmission through market prices that allows the competitive, private property order to overcome the calculation problem. By assuming the ex-ante availability of this knowledge, market socialism assumes the very thing it needs to demonstrate, namely, how it can acquire similar knowledge which is necessary for economic calculation.

The role of knowledge and preferences is further emphasized later on by James M. Buchanan ([1983] 1999) and Don Lavoie (1985). Buchanan sums up the problem with leaving out a means by which preferences are determined by writing, "The potential participants *do not know until they enter the process* what their own choices will be. From this it follows that it is *logically impossible* for an omniscient designer to know unless, of course, we are to preclude individual freedom of will" ([1983] 1999, 5).

Lavoie highlights the roles of rivalry in the market process. The fact that prices convey information about relative scarcities and individual preferences is a product of their arising from a process in which different individuals pursue their own ends and engage in rivalrous competition for the scarce means to achieve those ends. The alternatives from which capital is bid away in a competitive market are the essential ingredient of opportunity cost captured in the final price. Central planning replaces the many competing goals with the unified goal of the planning board so that the "prices" cannot contain the same richness of information.

Real world attempts to implement central economic planning exemplified these shortcomings. Boettke recounts the disastrous economic conditions that befell Russia after the First World War (1988). He writes, "By 1921, all areas of economic output had fallen far below

pre-war levels." He goes on to show that the dramatic decline in productivity is attributable to the faithful application of a political ideology that embraced central planning and the calculation failures it entailed (Boettke 1988, 161–169).

More recently, implementation of socialism in Venezuela disabled the price mechanism which resulted in widespread shortages (Kurmanaev 2016). Replacing market prices with government mandated prices resulted in exactly the outcome Mises and Hayek predicted: without any information about the opportunity costs of different goods or accurate unit of calculation, coordination between competing uses for resources could not take place.

This overview of the calculation debate and the failure of socialist and market socialist proposals leads to the present topic. Technological solutions offered by more recent proponents of socialism are often just new spins on these older ideas and suffer many of the same shortcomings.

a. Techno-Socialist Proposals

Proponents of socialism have intimated that technological advancements, particularly computers and networks of computers, will circumvent these concerns from Mises and Hayek and "innovate" a functioning socialism.

Lange (1970) conducted significant research into cybernetic economics. He viewed cybernetics as an essential step toward the feasibility of socialist planning; the feedback and adjustment capabilities made possible a type of dynamic system akin to the human body.

As technology has progressed and the twentieth century waned, the application of new technologies to economic planning began to see other supporters. One optimist about the feasibility of socialism is activist Andy Pollack who writes,

The material possibility of socialism, as reckoned in the sheer productivity of industry and the availability of masses of goods and services, has existed for most of this century.

Now the technical basis for the process of managing those things, i.e. for the process of socialism, has taken huge leaps forward with the advances in information technology of just the last few years. (1997, 32)

W. Paul Cockshott and Allin Cottrell provide a detailed account of a "new socialism" in which

they assert "we need a computerised information system that gives production engineers

unbiased estimates of the labour time costs of different technologies ... The computation of

labour values for a whole economy is now feasible in a few minutes using modern

supercomputers" (1993, 45).

More recently, author and senior editor of The New Republic Evgeny Morozov

connected fresh developments in Internet technology directly to overturning the result of the

calculation debate in a 2013 interview.

The only way to beat the market... is by relying on cybernetics.... The unfortunate episode in the development of cybernetics is that... most... experiments in the socialist context never had the ability to work on the assumption of constant connectivity and interconnected feedback systems that can communicate in real-time at virtually no cost. If you think about the Soviet experience... it's actually surprising that it carried on for so long given how poorly informed the planners were. And also how easy it was to cheat the system by submitting false data and so forth. Many of these problems can now be resolved thanks to the Internet of Things on the connectivity front and technologies like blockchains on the trust/security front (imagine: replacing the lying Soviet bureaucrats with a blockchain!). Where the neoliberals won the debate in the 1980s and the 1990s is in convincing all but hardcore believers in the communist project that socialism and even more broadly communism were practically impossible [due] to the implausibility of designing an adequate communication system that can be as effective as the market in allocating knowledge dispersed through the economy. I'm not sure that this argument is still valid today. (Morozov 2013, 18)

As the Internet of Things becomes ubiquitous and processing power continues to expand,

one must expect that the above positions will seem increasingly plausible to proponents of

socialism. They can admit that socialism was impossible in the past, but now the world is ready;

socialism can finally work! This optimism, however, is misplaced.

To begin with, the plausibility of central planning even with advanced Internet and computing capabilities fails on a superficial, technical level. First, Morozov's implication that the modern Internet allows for communication "in real-time at virtually no cost" (Morozov 2013, 18) is highly questionable on both counts. The speed of light is fast, but not negligible on a planet-sized scale, and there are obviously large costs to building and maintaining Internet infrastructure. Second, As Jesús Huerta de Soto argues, the same technology that allows one to account for the collection and operationalization of more data also allows for the creation of a greater volume and complexity of data such that the information to be known will always run ahead of the ability to know it (2010).

And while Cockshott and Cottrell's work comprises a comprehensive explanation of calculating within socialism, it is premised entirely on a labor theory of value. It might be true that "computation of labour values for a whole economy is now feasible in a few minutes using modern supercomputers" but any objective measurement of labor does not per se convey the necessary economic knowledge necessary to rationally plan (Cockshott and Cottrell 1993, 50). Communicating the value of resources is essential to economic calculation, but this theory of value is long since refuted by Carl Menger ([1871] 2007) who explained how labor is not the relevant factor in determining value. He writes,

The value an economizing individual attributes to a good is equal to the importance of the particular satisfaction that depends on his command of the good. There is no necessary and direct connection between the value of a good and whether, or in what quantities, labor and other goods of higher order were applied to its production. Whether a diamond was found accidentally or was obtained from a diamond pit with the employment of a thousand days of labor is completely irrelevant for its value. In general, no one in practical life asks for the history of the origin of a good in estimating its value, but considers solely the services that the good will render him and which he would have to forgo if he did not have it at his command. (Menger [1871] 2007, 146)

In other words, value is subjective. It is the product of competing individual preferences that are never explicitly stated. A great feature of the market process is that it allows these preferences to be coordinated and reconciled anyway. Markets compile the relevant information into a form that is explicitly stated: a price. This piece of data makes possible economic calculation in a market economy. The great question of socialist calculation is whether this coordinating function can be achieved by other means. Positing that labor is the unit of value does not answer this question.

In addition to these shortcomings, however, hope for a revival of socialism based on improved technology is flawed on a much more fundamental level: they fail to account for necessity of market to discover both the opportunity costs of alternative plans and the subjective preferences of economic actors. These flaws can be observed in one of the few cases in which computerized socialism has been attempted: 1970s Chile.

b. Project Cybersyn

The application of computers to solve the difficulties of socialism has been attempted before. Project Cybersyn in Chile was just that. From 1970 to 1973, under the rule of Salvador Allende, the Socialist government enlisted the help of Stafford Beer, a British cybernetic theorist, to build a computerized central planning mechanism. This meant literally constructing a control room in which Captain Kirk would feel at home. Complete with a plethora of screens and chairs with buttons on them, the Operations Room was supposed to present planners with the information and means necessary to direct the Chilean economy. Sophisticated models were meant to predict the long-term effect of setting a certain price or mandating a certain production quota. Ordinary Chileans were to be given "algedonic meters"—dials in their homes which they would use to indicate their happiness (Morozov 2014). This data would be relayed to the Operations Room to

provide the planners with feedback on their schemes. Beer and his colleagues sought to understand the production processes of individual industrial plants in order to build potential outcomes into the computer models. As Eden Medina (2011) relates, they wrote down, for example, the process of building wooden furniture and detailed parameters for the inputs such as the humidity of the wood. They built further models to predict the ripple effects of bad weather on resource shortages. They sought to aggregate the tacit knowledge from the heads of plant managers into a format that could be assimilated into algorithms in order successfully predict and plan for the future. The inputs and production processes for all goods needed to be accounted for. Once all this information was assembled, planners in the Operations Room could allegedly test the feasibility of any plan and produce a flow chart of instructions on how to implement it. But the high hopes for project Cybersyn came to nothing, and the project was abandoned in 1973 (Medina 2011).

To be sure, the technology available in Chile in the 1970s is quaint compared to today's world of big data and the Internet of Things. But the problems that arose within Project Cybersyn were not strictly technological. They were fundamental to the endeavor of central planning and illustrate the impossibility of such planning, regardless of the technology employed.

In one instance, a cement factory manager realized he was running low on coal and went to the nearby coal mine to stress the importance of keeping up coal production (Medina 2011, 186). Days later Cybersyn notified the manager that he would soon experience a coal shortage. This may appear to be a problem that could be solved with faster computers, but noticing the future shortage is not the important economic activity here. Whether the shortage is noticed by the manager or by a computer, the solution would have been the same: simply telling the coal producers to provide more. That is not rational economic calculation. The problem of economic

calculation is not "how can I get more coal?" The relevant questions are: Is using this quantity of coal economically viable? And, what are alternatives could I use instead? Simply informing coal producers that the cement factory needs more coal does not consider that perhaps coal has become relatively scarcer and the cement factory should economize on its use. It does not cause the cement factory manager to consider what alternatives might be profitable if the price of coal rises. Rivalrous competition and market prices are absent, and, therefore, so is economic calculation.

While Beer is said to have wanted a more decentralized process that took into account the knowledge of individual workers, Tomás Kohn, an engineer who worked on the project, said things were different in practice. As Medina notes, "Kohn described the process of modeling a factory as 'a fairly technocratic approach,' one that was 'top down' and did not involve 'speaking to the guy who was actually working on the mill or the spinning machine or whatever" (2011, 134). He recalls having some discussions with workers, but they not understand what he was talking about, because of the technical nature of the discussion, and could not contribute very well. Overall individual factory workers were uninterested in the workings of Project Cybersyn and often failed to report the relevant data (Medina 2011). Medina attributes the lack of worker incorporation into the process to an unnecessary and unfortunate clash of personalities and politics, but that is an understatement (Medina 2011). It is a political, and economic, clash, but it is not borne out of an unlucky coincidence of the particular individuals involved. Rather, it is inevitable and inherent within the ideology that accompanies socialist economic planning. The clash between engineers and factory workers illustrates the importance of allowing decision to be made by the "man on the spot." The factory workers did not know the full plan of the economy, despite the planners' attempts to explain it to them. If the

economy is engaged in a complex division of labor, however, the specialized, rather than general, knowledge contributes to productivity growth. But the diverse capabilities of diverse people require extraordinary coordination to function together productively. This sort of coordination emerges from the market process, but it does not do so under central planning.

Morozov (2014) is quick to note that computer systems are now used by companies like Walmart and Uber to plan their business activities, and he claims that this fact shows that the Cybersyn concept is essentially sound but before its time. But central planning within a firm is not generalizable to the whole economy. As Ronald Coase (1937) explained, the firm exists to centralize transactions that would be too costly execute using the price system. Organization within a firm does not solve the knowledge problem. Such organization is beneficial when transaction costs are greater than the costs of lacking knowledge, but the knowledge shortcoming is still present. Therefore, the size and scope of central planning within firms is limited; if they get too big, knowledge problems become more costly than transaction costs. Central planning schemes take the firms size to the extreme and should, therefore, expect to experience knowledge problems that significantly impinge on their economic calculation capabilities.

The use of similar techniques to Cybersyn by private firms today is also not comparable with their use for national economic planning because firms must engage in rivalrous competition for resources. Walmart, for example, has found that Pop Tarts are in high demand after natural disasters because they are non-perishable and require no cooking. When Walmart's algorithms tell it to stock up on Pop Tarts before a storm, Walmart is bidding resources (including labor and higher order goods) away from other inventory in other location into Pop

Tart procurement in an area hit by disaster.² The change in relative scarcities of the relevant resources is conveyed by a change in prices so that other users of those resources can rationally adjust their activities.

Another example of this phenomenon is the way Netflix scaled back its DVD shipping operations while investing more in its online streaming service (Rodriguez 2014). When Netflix found its shipping costs no longer profitable, it was the result of an act of economic calculation in which changes in relative prices drove the discovery of changing consumer preferences.

Whether Walmart and Netflix's use of resources was an efficient way of employing them to satisfy consumers' preferences is communicated by a profit or loss. All of this feedback and dynamic adjustment is made possible by the fact that there is competition between plans. A central planner's directive to stock up on Pop Tarts or to ship fewer DVDs would not result in a similarly robust outcome. In that case, there would be no rivalrous competition for resources because they are simply allocated in accordance with a planners' directives. And the planners are not subject to profit and loss considerations.

III. Contemporary Technology and the Possibility of Socialism

Lavoie (1985, 113) envisions the possibility of a "technological revolution in informationhandling systems". But he argues that such a revolution would only address the issue of collecting information, and would not solve the essential problem of utilizing information that is "inherently uncollectable" (Lavoie 1985, 113). He explains that, "Minds, whether human or not, achieve a greater social intelligence when they are coordinated through the market than is

² Times and places of disaster give central planners a particularly difficult time in procuring all the accurate and relevant data needed to respond. See e.g. Sobel and Leeson (2006).

possible if all economic activity had to confine itself to what a single supercomputer could hierarchically analyze" (Lavoie 1985, 55).

Now, in 2017, it is safe to say that a "technological revolution" has occurred, and is still occurring. We can, therefore, examine Lavoie's prediction with reference to how technological advancement has actually played out. Perhaps the specifics of the Internet revolution have produced technology so sophisticated that it can overcome knowledge problems that plagued earlier attempts.

The rise of the technologies such as the Internet, blockchains, and the Internet of Things certainly constitute Lavoie's vision of a revolution in information processing. What does the implications of this new generation of technology mean for economic calculation?

To begin with, it is clear that today's computing devices would improve the technical capabilities of central planners, but these do not address the central economic problem. The Soviet Union and Chile would likely have had greater volume and accuracy of data if they had access to the modern Internet and blockchains rather than the technology they had on hand. However, whether we are examining socialism in the 1970s or 2010s, the relevant question is not about computing power or technical capability alone. How it is used will determine if improved technology also improves the capacity for rational economic calculation in a socialist system. Technological improvements only facilitate economic calculation when they facilitate the competitive market process which generates the relevant information. Simply having more and more data about resources as they are does not provide information about the opportunity costs of alternative uses of those resources and, therefore, does not enable economic calculation.

When we examine the application of today's technological capabilities, Lavoie's prediction is supported: even a central planning scheme with advanced computing technology

would underperform compared to a system which used those computers in a competitive market process instead. Examples of this phenomenon are especially visible in energy markets.

a. Energy Markets

The case of energy smart grids in the Olympia Peninsula, examined by David Chassin and Lynne Kiesling (2008)³, is one example of how economic calculation, within a decentralized system, can be facilitated (but not replaced) by modern technology. The federal agency that controls power in the region, the Bonneville Power Administration, may seem to be more of a central planning body than one that would facilitate markets. But as population in the peninsula grew, they needed a way to economize on electricity to meet growing demand (ibid., 53). Essentially, they faced a problem of economic calculation, and the solution was introducing and more competitive market with prices. Chassin and Kiesling report the mechanism of price formation in the new system:

The [real-time price] was determined using a uniform price double auction, in which buyers (households, commercial, and industrial) submit bids and sellers (wholesale and retail-level distributed generation) submit offers simultaneously. The digital technology in the household enabled residential customers to participate actively in such frequent markets because they could automate the bidding of their demand functions into the market. (Chassin and Kiesling 2008, 54)

So the price system was not mimicked or replaced, it was merely used more quickly as Internet of Things (IoT) devices lowered transaction costs. IoT refers to a network of objects connected to the Internet. These are often household appliances, like refrigerators or thermostats. But IoT also encompasses new types of devices used, for example, by farmers to monitor the status of individual plants and cultivate them accordingly. In the case of "smart" energy grids,

³ For more details on the *GridWise* project see Pacific Northwest National Laboratory (2017).

these devices allow for more transactions to be processed on a more granular level, increasing the overall efficiency of the system.

More expansive smart grids and IoT devices will likely continue to develop and balance supply of and demand for electricity in the Olympia Peninsula. Individuals and devices that use electricity will bid for it in real time, allowing the electrical grid to efficiently allocate power. In practice, this system means that people who own these devices (e.g. a washing machine) will use them at times when the opportunity cost of doing so is lowest, or, at least, low enough. The use of Internet-connected devices allows for new information to be utilized in the marketplace much faster than before. With the new systems in place, traditional systems of flat rates per kilowatthour, overall prices will be higher than necessary to cover losses that would be incurred to meet demand at peak periods. In short, consumers are able to satisfy more of their preferences thanks to technological advances. But the means by which these benefits come about is still reliant on these consumers have property rights in the outputs of their devices and real competing preferences that are coordinated by market price formation.

Another example of using next generation technology to facilitate economic calculation in energy markets is being undertaken by an alliance of power companies operating in the Netherlands, Germany, and Denmark. Their initiative, PowerMatcher, seeks to more efficiently match supply of and demand for electricity. In their system, individual devices and producers send bids across a network through an "auctioneer" which gathers bids from supplier and demanders and awards power to the winner. This process automatically results in economizing behavior. For example, one apartment building in which PowerMatcher was implemented allowed the indoor temperature to respond to changes relative scarcity by fluctuating 0.8 degrees around a set point preferred by the tenant (Netherlands Enterprise Agency 2015). This small

change multiplied across many units results in large reductions in quantity of electricity demanded with little additional discomfort. Other applications of PowerMatcher involve delaying tasks which are not as time sensitive until electricity prices drop. Car chargers or dishwashers can keep sending and receiving bids until they meet a certain threshold and then start using power that was too expensive when peak demand bid up prices (PowerMatcher 2016).

These examples are textbook economic calculation. They allow individuals to account for the many competing alternative uses for electricity at different times. Utilizing market prices that update close to real time ensures that more urgent uses of electricity are coordinated with those that can be postponed for a few minutes or hours, thus reducing peaks in usage. These systems make use of advanced technology and benefit consumers and producers. But they yield these benefits by using technology to more quickly and better interface with the competitive market. The prices signal that make these improvements possible are not by having a central plan of how much electricity should be used by each device. Miller (2016, 25–30) states that the decentralized nature of the system contributes to its efficiency: "[Devices] attempt to operate the associated processes in an economically optimal way, whereby no central optimization algorithm is necessary and communication with the auctioneer is limited. The only information that is exchanged between the agents and the auctioneer are bids."

The technology in use here is the same technology that has been said to alleviate the problems of economic calculation with a central plan. But its usefulness to economic calculation extends only so far as it is used in a discovery-inducing market context. Destroying that context hampers its usefulness. So while advanced technology may marginally improve the functioning of a central planning regime. Shortages would be less frequent and pronounced if the planners could acquire data about them in a timely manner. Even so, this would not solve calculation

problems; it would only prolong the inevitable demise of the system. Technologically advanced planners could tell producers to make more and more, but that would only deepen the misallocation of resources because they still cannot account for the value of those resources in alternative uses. Central planning could drag on longer thanks to more and better data, but it is still subject to the fundamental limitations discussed above.

At the bottom of the competitive bidding process are separate individuals with their own subjective preferences—one wants to washing his clothes, another wants to charge her cellphone, etc. It is these rivalrous plans that are reconciled and coordinated by the bidding process. The competition between them and all other market participants drives the resulting price at any given time. At the bottom of a centrally planned system, however, is only the planners' preferences. If they control the uses of resources, then there is no need to bid them away from alternative uses, and the market price cannot emerge. There is no way for the planner to calculate if the next unit of electricity would be more economically used to wash clothes or charge a cellphone.

So experience suggests that technology is being used, not to replace market prices, but to utilize the price mechanism more efficiently and closer to real time. In short, technological advancements bring improvements to—but cannot supplant—the market process.

IV. Policy Implications

Calls for comprehensive central planning in the United States have died down for the moment, but they are not gone entirely. The aforementioned Pollack and Morozov provide two examples of ill-advised proposals that serve as reminders of why warnings against such designs should be repeated frequently.

The central planning mindset does still prevail in many areas in the form of technocratic policy prescriptions, however. The idea that we can know what production process ought to take place and that we can steer production to improve this or that sector of the economy is still attractive to many policymakers and regulators who find the allure of designing a better world from the top down only too appealing. For example, calls for government to run the healthcare market have become more prevalent among significant policymakers (Lima 2017; DeCosta-Klipa 2017). Others have joined the push to hamper the price mechanism in the market for Internet service in the name of helping consumers (Crawford 2017).

Also in the field of telecommunications, subsidy programs are still quite popular. These programs such as the Connect America Fund often provide funds to build broadband Internet infrastructure in areas where doing so is unprofitable for private actors, and they fall victim to the hubris of ignoring the information transmitted by prices (Federal Communications Commission 2017). The very fact that a project is unprofitable announces to the world that the necessary resources are more productive in alternative uses. Overruling those price signals does nothing to improve the underlying economic conditions. It merely directs resources away from the more productive use. Indeed, such practices actually delay the implementation of technological advancements, such as low-earth orbit satellite broadband, which could potentially resolve the problem lagging rural broadband deployment economically. Such innovation would be encouraged by the allure of profits for the innovating party, but that incentive is destroyed when the price signal is stamped out by subsidies for inefficient alternatives.

These positions are representative of a mentality that still believes better coordination and production results can be designed *ex ante* rather than arising and being discovered in a competitive market. The antidote to this planner mentality on the part of governments is humility

in policymaking. Acknowledging that efficient orders may emerge that are not the result of any single design is a sobering prospect for regulators accustomed to reasoning their way to the "right" answer and who frequently face demands to explain the plan behind their decisions.

It should be noted that lack of humility in policymaking is not always a manifestation of the desire for central planning *per se*. Rather, it is often a result of government officials having a specialized purview in which to make their optimization decisions. Government agencies responsible for issues like broadband deployment can too easily fix their gaze immovably on that problem while failing to account for the opportunity costs of their actions.

Still, history has demonstrated the productive gains that are possible when competitive allocation is substituted for government plans. The electromagnetic spectrum used to be meted out according to what the Federal Communications Commission (FCC) decided was in the "public interest" (Hazlett 2017, 193). The futility of such deliberations was demonstrated when the FCC eventually switched to competitive auctions and much greater productivity prevailed (Hazlett and Spitzer 2006, 658-659). It became obvious that the public was actually better served by the market process and that earlier rationales for the necessity of central planning were false (Kane 2018, 2-4).

The use cases described above may also be instructive to policymakers. The case of PowerMatcher, for example, shows how relying on the price mechanism can generate more efficient use of resources, which, in the case of electricity, means increased viability for clean, renewable energy sources. Before, the inability to smooth demand meant that coal power was necessary to meet constant demand. Now, less total power is needed. Utilizing such a system might be preferable to focusing on technocratic approaches in which the government decides to subsidize or tax different technologies or methods of power production. Harnessing the

knowledge producing function of the market will allow for policy to be more informed, productive, and economical.

Relying on the market process alleviates this danger because opportunity cost is encoded in prices. Listening to these signals rather than myopically focusing on maximizing a few, easily viewable parameters requires humility. Public policy in general would benefit learning the lesson that the outcome of the market process is not separable from the process which generates it.

V. Conclusion

There is, therefore, no reason to be optimistic about socialism given modern technology. Today, more (and more reliable) data can be gathered more quickly than ever before. It can be more quickly analyzed; patterns can be more quickly spotted and predicted. But all of this new knowledge does not solve socialism's knowledge problem: discovering the dispersed and tacit knowledge and capturing subjective preferences still requires the use of the market process. In this respect, computerized market socialism is no better than regular market socialism. It takes consumer preferences as given and then directs production toward the "right" equilibrium for those preferences. But those preferences are not given; they change in and are changed by the market process. They are subjective and cannot be quantified abstractly. Furthermore, equilibrium is not an end state to be achieved. The market produces not some fixed end state, but a process of coordination between disparate ends by people with dispersed knowledge.

Computerized market socialism also continues to assume that simple rules, now enshrined in algorithms will allow for efficient production (e.g. set price equal to marginal cost). But when bringing in concepts such as cost, one must remember that all costs are opportunity costs, and opportunity costs are neither given nor are they a characteristic inherent to each good.

The opportunity cost of using particular inputs is discovered by the process of bidding factors away from alternative uses. Centrally planning directives will not contain information about the alternative uses of factors of production because they can acquire that property only from being bid away from alternative uses of which there are none under central planning.

In light of new technology, humility, not hubris, is the order of the day. Proposals for computerized socialism are nothing more than older market socialism models with better data, faster processors, and fancier chairs. The Austrian critique of socialism was never an issue of the quality or quantity of data about resources themselves but about the use of those resources in competing possibilities by individuals with subjective preferences. The crucial fact about the flaws in even the market socialist thesis is that it is not a technical problem but a fundamental flaw in the idea of central planning. Proposing to solve the calculation problem with ever more advanced and connected computers is, therefore, to misdiagnose the problem. Supremely interesting and useful innovations have been will be produced by solving technical problems with the Internet of things, blockchains, and related technologies, but to set these phenomena as solutions to the problem of socialist calculation gives the right answer to the wrong question.

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