

Calculation and the Question of Arithmetic

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The view that Ludwig von Mises had more in mind in his calculation critique of socialism than the Hayekian knowledge problem has recently been attacked by Leland Yeager.¹ This article addresses Yeager's central claim that,

I cannot believe Mises was merely saying that *if* the socialist planners possessed in some remarkable way all the information normally conveyed by genuine market prices, they still would be stymied by inability to perform *calculations* in the narrow arithmetical sense, an inability that advances in supercomputers might conceivably overcome.²

Yeager then asserts that Joseph Salerno, Murray Rothbard, and I (SRH) claim that this is what Mises meant. If Yeager means by this assertion that we believe that this is Mises's entire calculation argument, then Salerno is correct in responding that,

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¹Leland Yeager, "Mises and Hayek on Calculation and Knowledge," *Review of Austrian Economics* 7, no. 2 (1994): 93–109. Also, Israel Kirzner asserts that the Mises and Hayek contributions to the calculation debate, "are simply ways of expounding the same basic, Austrian insight, viz., that only market processes are able to harness the *discovery* potential of entrepreneurial competition." Italics in the original, see Israel Kirzner, "Book Review of *Hayek, Coordination and Evolution*," *Southern Economic Journal* 61, no. 4 (April 1995): 1244. If Kirzner is correct, it would seem that Mises and Hayek were both Kirznerians and the entire calculation debate was a debate about Kirzner's concept of entrepreneurship. On his concept of entrepreneurial discovery, see Israel Kirzner, *Competition and Entrepreneurship* (Chicago: University of Chicago Press, 1973) and *Discovery and the Capitalist Process* (Chicago: University of Chicago Press, 1985).

²Yeager, "Mises and Hayek," p. 94. Italics in the original.

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"it is wholly beside the point, because it rests on a gross misinterpretation of the meaning explicitly attached to the term 'calculation problem' by SRH."³ In response to Yeager, Salerno says,

it does not follow that, for SRH, *the* calculation problem as Mises conceived it refers narrowly to the mathematical techniques employed for manipulating the given quantitative data; it refers, instead, to the origination and meaningfulness of the data themselves. It is, in short, a problem of "appraisal" and not of "arithmetic."⁴

From this beginning point, he proceeds to cogently rebut Yeager's claim by demonstrating that entrepreneurial appraisal is not subsumed under market information.

Yet Yeager seems to imply something else in his claim that by its nature goes untouched by Salerno's rebuttal. Yeager seems to imply that the arithmetic facet of Mises's calculation argument is trivial. This claim is not only false but is odd coming from a student of Mises's work; for Mises made several true and non-trivial arguments based solely on arithmetic or mathematics and statistics, more generally: the impossibility of interpersonal utility comparisons (lack of a unit of subjective value), the impossibility of economic calculation (inability of comparing heterogeneous units of factors of production), the impossibility of mathematical equations in economic theorizing (lack of constants in human action), and the impossibility of statistical analysis in economic theory (lack of a probability density function for the data of human action).⁵ Acceptance of these *merely* arithmetic, mathematic, and statistical points destroys several major branches of orthodox economic theory: utility and welfare, socialist, mathematical, macroeconomics, and econometrics. Together these constitute a significant portion of what passes for economic thought today.

While it is true that Mises's calculation argument is not *merely* arithmetic; it is also true that it is not *merely* appraisal. Mises argued that economic calculation is a problem of both

³Joseph Salerno, "Reply to Leland B. Yeager on 'Mises and Hayek on Calculation and Knowledge,'" *Review of Austrian Economics* 7, no. 2 (1994): 112.

⁴*Ibid.* Italics in the original.

⁵Mises discusses each of these points in *Human Action: A Treatise on Economics* (Chicago: Henry Regnery, [1949] 1966).

arithmetic and appraisal.⁶ More precisely, Mises's calculation argument has two dimensions: the impossibility of central planners performing the arithmetic of profit and loss computation in pure socialism which, in turn, makes it impossible for them to engage in entrepreneurial appraisals necessary to give meaning to profit and loss, and, thus, rationally allocate factors of production.⁷ Although information enters into the latter, it cannot enter into the former.⁸

The arithmetic facet of Mises's argument deals with the existence, or lack thereof, of a format in which information can be put and appraisals can be made. A format is necessary because the "raw data" required to answer relevant economic questions posed by the operation of a social process of exchange and division of labor are denominated in incommensurate units. Unless these units can be converted into a common standard, they cannot be compared; unless they can be compared the economic questions cannot be answered. As Mises said of one socialist scheme of economic calculation, "Calculation in kind is to be substituted for calculation in terms of money. This method is worthless. One cannot add or subtract numbers of different kinds (heterogeneous quantities)."⁹ The impossibility of comparing the number of apples to the number of oranges is an arithmetic problem; and a

⁶I am not asserting that Salerno fails to understand or appreciate the arithmetic facet of Mises's concept of calculation. He mentions it twice in his "Reply to Yeager," (pp. 112 and 120) and it is this point that Yeager himself notices in Salerno's work. My contention is only that proper recognition of this facet of Mises's argument also defeats the Yeager position.

⁷By the phrase, "impossibility of performing the arithmetic of profit and loss computation," we do not have in mind what Yeager seems to accuse us of meaning. As Salerno says, "the Misesian demonstration of the logical impossibility of socialism is not predicated on the central planners' incapacity to perform tasks that can conceivably be carried out by individual human minds," including adding and subtracting. See Salerno, "Reply to Yeager," p. 112. The arithmetic problem of calculation is not the inability to add common units together, it is the absence of such units. No "advances in supercomputers" can overcome the impossibility of adding together apples and oranges.

⁸These two steps correspond to the two conditions Mises claimed were necessary for calculation to take place: voluntary exchange of all goods including factors of higher order and the use in these exchanges of money. The first is necessary to bring higher-order capital goods under the orbit of the entrepreneurial "intellectual division of labor"; the second is necessary because without it, "It would not be possible to reduce all exchange-relationships to a common denominator." See Ludwig von Mises, *Economic Calculation in the Socialist Commonwealth* (Auburn, Ala.: Ludwig von Mises Institute, [1920] 1990), pp. 17-18.

⁹Ludwig von Mises, *Human Action*, p. 703.

fundamental, not trivial, problem of arithmetic. Without its solution, no arithmetic operations can be conducted at all.

The profit and loss calculation solves the arithmetic problem inherent in answering both economic questions posed by the operation of a social process of exchange and division of labor: what consumer goods should be produced and which combination of factors of production should be used to produce each consumer good. The arithmetic problem of the first question is the incommensurability of the subjective values of different individuals who participate in the social process of exchange and division of labor. There are two dimensions to the impossibility of making interpersonal comparisons of utility: no unit can be defined for preferences since they are subjective and even if units of subjective value existed for each person, they would not be comparable from one person to another.¹⁰

The solution to the problem of the incommensurability of the subjective values of individuals and the answer to the question of what consumer goods should be produced to satisfy them lies in the possibility of market prices denominated in money. Consumers demonstrate their preferences for some goods relative to others by purchasing and refusing to purchase. Since all preferences are demonstrated using the same standard, viz. money, the effects of action based on these preferences, viz. money prices, are commensurate, and, therefore, formatted for meaningful economic calculation.

Entrepreneurs then impute market value to each factor of production according to its marginal value product via their demand for the factors. Factors prices are then determined by the intensity of entrepreneurial demand relative to the opportunity cost placed on them by their owners. These prices make the different units of the factors commensurate and therefore, permit entrepreneurs to efficiently allocate factors across the production of consumer goods.¹¹

As a student of Mises's work, Yeager is surely familiar with his account of the relationship between the subjective values of

¹⁰As Mises said, "In an exchange economy the objective exchange value of commodities enters as the unit of economic calculation. This . . . renders it possible to base the calculation upon the valuations of all participants in trade. The subjective use value of each is not immediately comparable as a purely subjective phenomenon with the subjective use value of other men. It only becomes so in exchange value, which arises out of the interplay of the subjective valuations of all who take part in exchange." Mises, *Economic Calculation*, p. 12.

¹¹*Ibid.*, p. 23.

consumers and market prices as well as the impossibility of interpersonal utility comparisons. Even for those economists, few in number and among whom one should not expect to find Yeager, who disagree with the latter claim, it would seem strange for them to characterize the problem of interpersonal utility comparisons as anything but an arithmetic problem. You can only add or subtract items of like units. This fact is both arithmetic and non-trivial. An entire branch of economics (welfare economics) crashed to the ground on this point and another branch (utility economics) was completely revamped because of it.¹² The arithmetic dimension of Mises's calculation argument is based on the same arithmetic truth that makes interpersonal utility comparisons impossible; and recognition of this fact helps clarify and strengthen instead of, "caricature and trivialize," Mises's argument as Yeager claims.¹³

Mises understood that the question of what consumer goods should be produced can be answered by the central planners and therefore, is not a barrier to the establishment of a centrally-planned economy.¹⁴ The planners can do this by simply substituting their preferences for the unknowable and incomparable preferences of consumers. They produce, or attempt to produce, the goods they themselves value. This solution, however, is arbitrary with reference to the preferences of consumers. These, the central planners cannot know and even if they did they could not make the relevant comparisons to determine what subset of valuable goods should be produced to the exclusion of other goods consumers find valuable. Central planners with perfect information of consumer preferences still could not calculate what to produce to satisfy such preferences because they are ordinal rankings and therefore, cannot be compared. Even if central planners had perfect information of the subjective values of each individual denominated in units, they could not perform economic calculation because it is impossible to compare any items that are denominated in dissimilar units. Only if the central planners knew how to

¹²The old welfare economics and utility economics were based on the concept of cardinal utility which embodied two arithmetic mistakes: units of subjective value are possible and such units are interpersonally comparable. See Murray N. Rothbard, "Toward a Reconstruction of Utility and Welfare Economics," in *On Freedom and Free Enterprise*, Mary Sennholz, ed. (Princeton: Van Nostrand, 1956), pp. 224-62.

¹³Yeager, "Mises and Hayek," p. 94.

¹⁴Mises, *Human Action*, pp. 695-98.

convert the subjective units of each individual into a common standard would they be able to perform this part of economic calculation.

The central arithmetic facet of Mises's calculation critique is the incommensurability of the different factors of production that could be combined in different ways to produce each consumer good. Hours of labor cannot be compared to acres of land nor can these units be compared to units of each capital good. As Mises, discussing his example of central planners contemplating building a railroad, wrote in 1920, "Where one cannot express hours of labor, iron, coal, all kinds of building material, machines and other things necessary for the construction and upkeep of the railroad in a common unit it is not possible to make calculations at all. The drawing up of bills on an economic basis is only possible where all the goods concerned can be referred back to money."¹⁵ Nearly thirty years later, he wrote,

The director wants to build a house. Now, there are many methods that can be resorted to. . . . Which method should the director choose? He cannot reduce to a common denominator the items of various materials and various kinds of labor to be expended. Therefore he cannot compare them. . . . In short, he cannot, in comparing costs to be expended and gains to be earned, resort to any arithmetical operation.¹⁶

Concerning the pricing process of the market by which economic calculation solves the problem of incommensurability, Mises concluded that socialism cannot reduce the value of the means of production to "the uniform expression of a money price." In a market economy, "all prices can be referred back to a common expression in terms of money."¹⁷

If there were no arithmetic facet of this "common expression in terms of money," (contrary to Mises's explicit statement that there is) then the problem of economic calculation would not exist since the planners could discover the value of each factor in each use by withdrawing it.

Mises summed up the problem of calculation in socialism by saying, "In the main, socialist production might only appear

¹⁵Mises, *Economic Calculation*, p. 25.

¹⁶Mises, *Human Action*, p. 698.

¹⁷Mises, *Economic Calculation*, pp. 23-24.

rationally realizable, if it provided an objectively recognizable unit of value, which would permit of economic calculation in an economy where neither money nor exchange were present."¹⁸ If this problem has no *merely* arithmetic facet, then why did socialists struggle to employ the labor theory of value to solve it? Mises finished the quote above by saying, "And only labor can conceivably be considered as such." But, why not perform economic calculation in all factors of production at once claiming each of them to have intrinsic value and thereby dispense with the search for a "socially necessary" amount of labor, i.e., a common unit of labor in which all factors can be rendered? The existence of cardinal units is not sufficient for economic calculation to be performed. One cannot add together factors denominated in incomparable cardinal units, nor compare the efficiencies stated in cardinal numbers, e.g., the average product of labor with the average product of capital, of different factors of production. The task of economic calculation requires, in addition to cardinal units, a method by which the different units can be transformed into a common cardinal unit.¹⁹ If it is not necessary to have a common objective unit in which all factors can be meaningfully compared, then a large part of the debate about the labor theory of value was so much spilled ink.

Yeager's contention about the arithmetic facet of Mises's argument makes it neither erroneous nor trivial. To the contrary, it is both correct and devastating to naive socialists who believe that the economic problem of factor usage can be solved by central planners in the absence of profit and loss calculation based on monetary prices, i.e., in pure socialism, including those who think the problem could be solved by "advances in super-computers."

It is only to defeat those socialists who wish to enter the debate on economic theory that Mises moves to more complex dimensions of his calculation argument.²⁰ To the assertion that socialism can overcome the incommensurability of different factors by having central planners set monetary prices for all goods and factors, Mises responds that the problem is calculation of objective value,

¹⁸*Ibid.*, p. 33.

¹⁹These two issues, the existence of cardinal units and the existence of a common denominator into which the various cardinal units can be put, are analogous to the two dimensions of the impossibility of making interpersonal comparisons of utility discussed above.

²⁰Mises moves to some of these steps, in a different order than that presented here, when addressing a list of suggestions for socialist economic calculation in *Human Action*, pp. 703ff.

not objective units *per se*. Such a procedure would not solve the allocation problem since it leads to a "solution" that is arbitrary even from the viewpoint of the central planners, let alone that of consumers. The problem of factor usage cannot be solved by having the central planners assign a monetary wage to be multiplied by labor hours, and so on for each factor, so that the monetary costs of different combinations of factors capable of producing a given consumer good can be compared and the least cost method selected. Such cost calculations have no relationship to the preferences placed on the consumer goods and therefore, are useless for economic calculation. Only the market process can connect the value of factors to the value of consumer goods in a meaningful way.

Mises demonstrates this point by allowing that a socialist state could have a medium of exchange, limited in its scope to trading in some consumer goods. But, as he said,

where the means of production are state controlled . . . because no production good will ever become the object of exchange, it will be impossible to determine its money value. Money could never fill in a socialist state the role it fills in a competitive society in determining the value of production goods. Calculation in terms of money will here be impossible.²¹

To the assertion that the central planners can overcome the arbitrary nature of prices set by their own decree by having the managers of state-operated production facilities act as if they were entrepreneurs engaged in trade, Mises argues that one cannot "play" market.²² For entrepreneurial competition to perform the function of factor evaluation, the possibility of bearing the opportunity costs of different factor allocations must be real. Only with private property can entrepreneurs and capitalists risk their own wealth in the process of social production and therefore be in a position to make accurate appraisals of factor values.^{23, 24} To argue that play acting could mimic the results of

²¹Mises, *Economic Calculation*, p. 6.

²²Mises, *Human Action*, pp. 707-9.

²³Mises, *Economic Calculation*, p. 28.

²⁴One particular target Mises aimed at was the "market socialism" of Oskar Lange in his, "On the Economic Theory of Socialism," reprinted in *On the Economic Theory of Socialism*, vol. 2, Benjamin Lippincott, ed. (Minneapolis: University of Minnesota Press, 1938), pp. 57-129. Yeager, in using the debate between Mises and Lange as the text for criticizing the SRH view, reveals the source of his lack of appreciation for the arithmetic facet of Mises's calculation argument. See Yeager, "Mises and Hayek," pp. 103ff. Mises had no need to mention the arithmetic

the market was to confuse the functions of management with those of entrepreneurship.

One cannot *play* speculation and investment. The speculators and investors expose their own wealth, their own destiny. This fact makes them responsible to the consumers. . . . If one relieves them of this responsibility one deprives them of their very character. They are no longer businessmen, but just the group of men to whom the director has handed over his main task, the supreme direction of the conduct of affairs. Then they—and not the nominal director—become the true directors and have to face the same problem the nominal director could not solve: the problem of economic calculation.²⁵

To the assertion that the central planners can overcome the “game-playing” nature of market socialism by using the pre-existing market set of prices, i.e., those prices existing in the capitalist system just prior to socialization, Mises argues that the transition from capitalism to socialism is too fundamental for the old prices to bridge the gap and that pricing must be “dynamic” since underlying economic phenomena are constantly changing. By destroying the differences in wealth in the existing market economy when expropriating private property, socialism disconnects the prices that correspond to those inequalities with the different conditions now prevailing for which calculations must be made. Moreover, any changes in conditions that underlie the economic allocation of factors makes the existing set of prices obsolete, and all the more so the greater the extent of such changes.²⁶

problem in response to Lange; market socialism overcomes that problem by employing money—the common denominator necessarily absent in a pure socialist system—and money prices. Mises was, thus, required to move to more complex dimensions of his calculation argument and criticize market socialism for its inability to perform entrepreneurial appraisals based on money prices which are not established in market exchanges of private property.

Because Rothbard fails to mention the arithmetic facet of calculation but does mention information in discussing the debate between Mises and Lange, Yeager attempts to construe Rothbard as once holding the Yeager position and then shifting to the SRH view. See Yeager, “Mises and Hayek,” p. 106. But Rothbard had no more reason to mention the arithmetic facet of calculation in this context than did Mises. Moreover, neither Mises, nor Salerno, nor Rothbard, nor I claim that the central planners do not face an information problem. The SRH claim is that Mises’s calculation argument has more to it than the information problem. Yeager’s claim that it does not is not proven by noting that Mises and SRH recognize information as a problem.

²⁵Ibid., p. 709. Italics in the original.

²⁶Mises, *Economic Calculation*, pp. 25–26.

Furthermore, as Salerno pointed out, Mises understood that answering the economic questions of what and how to produce requires entrepreneurs to correctly project appraisals of goods and factors into the future.²⁷ Since the data are continually changing, static modeling cannot be substituted for entrepreneurs to perform economic calculation. Comparative statics serves no better since it cannot determine how human action moves the solution from one point to another.²⁸

Moreover, general equilibrium is irrelevant to the actual problem that economic calculation must solve and that can be done so only by entrepreneurial activity. Neither the actual prices, both present and future, nor the preferences necessary for factor allocations to be made have any relationship to those of equilibrium. As Mises said, "what impels a man toward change and innovation is not the vision of equilibrium prices, but the anticipation of the height of the prices of a limited number of articles as they will prevail on the market on the date at which he plans to sell."²⁹

General equilibrium equations are formed by knowing the constants of those equations, under the assumption that no further change in the data is permissible. Without the assumption of no further changes, no constants exist and no equations can be formed. Yet, the economic system cannot achieve, or move toward, the equilibrium without changes from the existing set of data. The equations are, thus, useless for the task of allocating factors of production toward their general equilibrium uses. As Mises said, "What acting man needs to know is not the state of affairs under equilibrium, but information about the most appropriate method of transforming, by successive steps, [the total supply of produced factors allocated as they are today] into [the total supply of produced factors allocated as they need to be in equilibrium]. With regard to this task the equations are useless."³⁰

Even if the central planners had full knowledge of the state of general equilibrium and could see how to move production from original factors to the final equilibrium state, this would not suffice to circumvent the problem that only economic calculation can solve. The existing state of production does not correspond to any state of this perfect-knowledge production process. Existing

²⁷Salerno, "Reply to Yeager," pp. 120-23.

²⁸Mises, *Human Action*, pp. 710-11.

²⁹*Ibid.*, p. 711.

³⁰*Ibid.*, pp. 712-13.

capital goods embody past allocation errors relative to their perfect knowledge uses. Since these capital goods can neither be freely transferred into other uses nor transferred efficiently without taking account of their existing characteristics, central planners with perfect knowledge would still need to resort to economic calculation to properly allocate them. Mises concludes his discussion of economic calculation at this step where no recourse is made to the arithmetic facet of the argument when viewed in its entirety.³¹

Instead of realizing the logical construction of Mises's argument—beginning with its arithmetic facet and then in turn allowing, for the sake of argument, that the central planners can overcome progressively more difficult aspects of the calculation problem—Yeager implies that SRH assume that Mises was conceding that the central planners could solve these problems. Yeager says,

The necessary preparations for the vast central calculation, let alone the calculation itself, could *not* be accomplished; they are, to use Mises's word, "impossible." It seems perverse, then, to interpret Mises as nevertheless conceding the possibility of all those preparations and of balking only at the possibility of the calculation itself.³²

But Mises did not concede that a "preparation" or "information" problem could be solved by the central planners in the actual operation of socialism. He conceded the solution to these problems, *for the sake of argument*, for the very purpose of demonstrating that his calculation argument proved the impossibility of economic calculation, *even if these problems were solved*. The fact that he chose this method of argumentation is proof that his calculation argument has more to it than just the lack of information available to central planners.

In fact, Mises "concedes" much more than the solution to the "information" problem, in the final step of his argument. If Yeager has this perfect-information scenario in mind in his quote at the beginning of this article, then he misstates Mises's hypothetical conditions (under which there is no arithmetic facet of the argument). Mises is not, here, assuming that the central planner has

³¹Ibid., pp. 713–14.

³²Yeager, "Mises and Hayek," p. 101. Italics in the original. Also, see his other statements on Mises's concessions, pp. 97–98.

perfect information and *therefore*, can perform economic calculation, as Yeager implies in his quote. Mises is assuming that the central planner has “miraculously” solved the problems of economic calculation—not just information but calculation itself—and could therefore construct a perfect production structure over time, starting without any capital goods, to achieve some final equilibrium state. Even if the central planners had perfect information and the ability to calculate with that information, however, they still could not calculate how to effectively operate any actual existing economy they are attempting to control.

If Yeager means what he seems to say—that Mises could not have meant that a central planner with perfect information about preferences and factor conditions could not perform the arithmetic operations necessary to calculate—then he is wrong; for this is precisely the first step of Mises’s argument demonstrating the impossibility of economic calculation in the socialist commonwealth.³³

On the importance of the arithmetic aspect of the economic calculation, Mises said,

every action can make use of ordinal numbers. For the application of cardinal numbers and for the arithmetical computation based on them special conditions are required. These conditions emerged in the historical evolution of the contractual society. Thus the way was opened for computation and calculation in the planning of future action and in establishing the effects achieved by past action. Cardinal numbers and their use in arithmetical operations are also eternal and immutable categories of the human mind. But their applicability to premeditation and the recording of action depends on certain conditions which were not given in the early state of human affairs, which appeared only later, and which could possibly disappear again . . .

Modern civilization is above all characterized by the fact that it has elaborated a method which makes the use of arithmetic possible in a broad field of activities. This is what people have in mind when attributing to it the—not very expedient and often misleading—epithet of rationality.³⁴

³³Mises explicitly made these assumptions in the development of his calculation argument. In addition to the statements already quoted, see Mises, *Human Action*, p. 696.

³⁴*Ibid.*, p. 199.