

Time, Constant Capital, Accumulation, Sustainability, and Economic Theory

In the Grundrisse, Marx remarked that all economics ultimately reduces itself to an "economy of time" (Marx 1973, p. 173). Marx, for whom social relations were central was not about to reduce economic theory to a system of stop watches, which would soon become common in U.S. factories that practiced what was called scientific management rather than intensified exploitation. Marx also was familiar with the troubling disruptive complexity raised by questions of time in classical political economy, beginning after Ricardo posited his labor theory of value. -His critics challenged his theory because time can affect prices. They contended that the (exchange) value of wine increases while the wine ages, without a contribution of any additional labor.

The concept of time, of course, was also important to Marx on many levels. After all, socially necessary abstract labor time is his measure of value. In addition, Marx gave great prominence to the subject of the duration of the working day and, even more, by the historical perspective that ran through his whole body of work made his analysis dynamic rather than static. Finally, as Volume Two of Capital makes clear, the time required for the turnover of capital is a major factor in the rate of profit, as the example of wine suggests.

Although, Karl Marx laid out a devastating critique of what became modern, mainstream economic theory, scholars of economics paid virtually no attention to his work until right after the uprising that created of the Paris Commune, which created an international panic -- an early version of the Red Scare of the mid Twentieth century.

Marx inaccurately became accused as the inspiration for the Paris Commune, which created a widespread fear of new popular uprisings as far away as the United States, where fear of socialism suddenly became widespread among the elite. Economists were not immune from this epidemic of fear.

Marx's presumed status as the central figure in the Paris Commune moved many of the founders of modern economics to respond to his work before it had time to create a feared massive popular support among presumably ignorant members of the working class, who might want to follow the example of the Paris Commune or even worse.

This sense of urgency led to a sudden burst of work, by William Stanley Jevons, Leon Walras, and Carl Menger, who respectively hailed from England, France, and Austria. Their analysis collectively constituted what became known as the Marginal Revolution. In this way Marx became an inspiration for modern economics, although the marginal revolutionaries merely ignored Marx's work without addressing it.

The marginal revolutionaries built their economic theory around people's subjective state and its resulting behavior, whereas Marx was concerned with the material side of the economy. [Marx used the term variable capital for labor inputs because the value of labor's outputs exceed the value of the sustenance required to maintain workers' capacity to labor. Accordingly, variable labor creates surpluses while capital goods produce no such a surplus, which is why Marx described them as constant capital. Only labor creates value.

Instead of producing value, constant capital is constant because it merely transfers the value of the congealed past living labor that consumed in its own production into new commodities, the value of which comes from a combination of the labor of those who had produced that capital goods and the workers who directly contributed to the production of the new products.

Marx used a simple commonsensical explanation to make this point: The working class as a whole produces commodities, but workers only get to consume a fraction of the total output. The difference between production and workers' consumption represents a surplus. While workers produce a surplus, capital goods, such as tractors, amplify workers' capacity to produce, but human input (over and above the labor required to build a tractor) contribute to production.

While tractors require human beings to be productive, workers can be productive without capital goods. Even if someone would invent a self-driving tractor, the machine would still require human beings to operate the controls, keep the tractor in good repair, or even to write the software that would determine how the tractor would function.

From this perspective, capital goods can justifiably be described as constant capital because the sustenance consumed by the working class is less their production, a difference that is the source of profit. Even though physical capital

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Instead of producing value, constant capital is constant because it merely transfers the value of the past living labor that had been consumed in its production into new commodities in which the congealed dead labor consumed in its production into new products.

The subject of constant capital never seems to have received the attention it deserves. This paper emphasizes constant capital in the form of fixed, long-lived capital goods, the durability of which distinguishes it from forms of capital that are quickly consumed in the process of production, such as coal that can be quickly consumed as fuel or cotton that will be transformed to fabric. The acquisition of durable constant capital generally provides no immediate benefits -- only a means for profiting from potential future opportunities; however, these advantages cannot be precisely known beforehand. For example, new technology can make existing capital obsolete leaving its embodied

dead labor to waste away. Similarly, market conditions can change, eliminating some or all of capital's value.

In this respect, fixed capital provides an especially rich entry point for long-term considerations of time. By sticking its head in the sands, conventional economics tends to avoid looking at some of the most crucial problems that the concept of time poses for economic theory. Nonetheless, something akin to Marx's concept of constant capital reached the boundaries of conventional economic theory in a way that is certainly worthy of our attention. This near penetration into academic economics came by way of an unlikely figure; Nicholas Georgescu-Roegen, an avowed anti-Marxist, Romanian economist with monarchist leanings. The core of Georgescu-Roegen's work remains virtually unknown outside of a relatively small group of environmental economists; however, Paul Samuelson once described Georgescu-Roegen as a "scholar's scholar, an economist's economist." Ironically, Samuelson, who probably did more than anyone else to spread the modern style of conventional, mathematicised economics in the Anglo-Saxon world, still wrote, "I defy any informed economist to remain complacent after meditating over [Georgescu's] essay!"

However, Samuelson resisted his own challenge by failing to follow through with Georgescu-Roegen's analysis.

The reason for the neglect of both time, Georgescu-Roegen, and constant capital is not difficult to discover.

Although Georgescu-Roegen's work is highly mathematical, his mathematics was meant to explain matters that could just as well be done with words, rather than take the form of an abstract theorem. His work, however, undermines the simplistic, pseudo-scientific mathematical modeling that conventional economists, such as Samuelson had worked so hard to develop. For example, Georgescu-Roegen retrospectively mentioned his three most important contributions to economic theory, among which was "the proof that the standard production function involves a crashing absurdity, the necessity of distinguishing between flows and funds, and the role of idleness in the various processes of production." By funds, Georgescu-Roegen meant stocks of productive capacity, which take the form of either fixed capital goods or natural resources. For both Marx and Georgescu-Roegen, natural resources are obviously different from fixed capital because of their origins. Unlike nature, however, constant capital is intentionally produced for a market made up of capitalists who intend to use it in the process of production.

Like natural resources, long-lived fixed constant capital represents a fund that can be exhausted during the production process.

Marx correctly recognized the productive capacity of natural resources in general as a limited fund, which he described as an inheritance rather than a product of labor although, he recognized that, like capital goods, resources can be augmented by labor, such as when farmers build up their topsoil. However, such behavior is not common.

For example, in the seventh edition of his book, "Agricultural chemistry," the most influential German agronomist, Justus von Liebig, whose work Marx studied deeply, introduced the term "robbau" -- "robbery culture -- bau, meaning agriculture, and "rob suggesting robbery in both German and English. In short, Liebig, Georgescu-Roegen, and Marx were all concerned with the profit-minded destruction of the environment, which took billions of years to evolve, yet requires only a short period to destroy.

For the most part, profit-minded agriculture squanders the inheritance of the funds of natural resources. In this sense, the function of natural resources and fixed capital are superficially similar in that they both contribute to the productive capacity of labor while being consumed in the process of production. Georgescu-Roegen's analysis of funds emphasized that both capital and natural resources represent a configuration of material, which the production processes diminish over time as part of the larger process of the creation of entropy -- a central concept in Georgescu-Roegen's analysis.

The idleness to which Georgescu referred to inherent delays in the production process. First, some the past labor embodied in fixed capital may lay dormant until its value will be gradually transferred later to finished products. For example, capital goods may remain inactive for long periods, such as in the case of a snow plow that sits unused in the summer until its services are once again needed later in the year.

Many less predictable factors can idle valuable machinery. Destructive weather conditions may make access to power, supplies, or even labor difficult.

##Lord Ashworth, an English cotton magnate, imparted the following lesson to Professor Nassau W. Senior one of

the leading economists in Britain: 'When a labourer lays down his spade, he renders useless, for that period, a capital worth eighteen pence. When one of our people leaves the mill, he renders useless a capital that has cost 100,000. Just imagine that! Making 'useless', if only for a single moment, a piece of capital that has cost 100,000! It is in truth monstrous that a single one of our people should ever leave the factory! [Marx 1867, p. 529]

While machinery induces employers to may eat away at workers' leisure, workers have the potential of creating an idleness of capital. Workers' protests may disrupt production, such as when they strictly follow management's policies. For example, Verizon workers once followed a work to rule strategy. They refused to go out on calls while they wasted time by carefully checking every little thing about their vehicle, following to the letter Verizon's unenforced system of rules (ostensibly developed in the name of safety, but probably created to shift any liability from Verizon to its employees), while significantly limiting the time available to carry out the tasks that management expected.

In chapter 15 of Marx's first volume of capital, entitled Machinery and Modern Industry, Marx looks much deeper into the question of idleness and the demands on labor from a very different perspective.

For more of Georgescu-Roegen's powerful critique of the production function and the mathematization of economics see his short essay (Georgescu-Roegen 1970).

The inevitable production of entropy violates the sensitivities of conventional economists, who seem to see markets as a system capable of unlimited growth so long as capitalists continue to accumulate increasing amounts of productive capital. William Stanley Jevons was one exception, who was mocked for suggesting that the supply of coal was limited.

Later, economists mocked those who warned that whale blubber was a limited resource for fueling the means of lighting. Fossil fuel made the whales irrelevant as a fuel source and set a pattern for the idea that modern technology is capable of surmounting environmental limits.

Economists' conventional vision of markets' capacity for unlimited production probably explains why so few economists exist in the small world of serious environmental economics.

As a committed critic of Marx, Georgescu-Roegen was familiar enough with his foe to be able to learn from him. Although he did not approve of either Marx's economics or his politics, yet his analysis of funds, as well as his emphasis on time, comes quite close to some of Marx's treatment of long-lived fixed capital, especially with respect to the question of time.

The great lengths to which conventional economics goes to eliminate time from its analysis is also worthy of our attention. Conventional economics' inattention to time is not an oversight, but an intentional effort to eliminate a serious complication to their theory. Once time is incorporated into the mix, the purported proofs of market efficiency disintegrate as will soon be explained. One key tactic that conventional economics uses is to remove time from consideration is to emphasize transactions, which occur almost instantaneously as funds move between individual buyers and sellers with unimaginable speed and presumptive efficiencies: "There can be little doubt that the mythical species *Homo economicus* -- with unwavering rationality, unbounded ability to compute solutions to difficult optimization problems, and an unrepentant selfish attitude -- has served economists well. Indeed, it is difficult to find another paradigm that permits such crisp insights into modeling human behavior" (Ferschtman et al, p. 131). In short, this approach helps economists to congratulate themselves for developing sophisticated models to demonstrate the imagined beneficial effects of capitalism.

In the process, conventional economics strips away any sign of the actual content of economic activity with its frequent problems. Economics also remains indifferent as to whether the commodities exchanged are Bibles or pornography, bombs or medicine.

That conventional approach also represents a step back from the perspective of many of the precursors to Adam Smith, who took account of the social nature of the complex production process. For example, Bernard Mandeville explored the parts of the intricate network of production and exchanges required for the producing a single coat.

Mandeville initiated that analysis, then Smith blatantly copied him, whom he frequently plagiarized without attribution. However, neither of them noticed that each stage of the process involved a real person with a real history, just as the purchaser of the finished coat also is a real person with a real history. The histories of both consumers and producers evolve through complex experiences with a multitude others, each of whom, in turn, is driven by a full set of dreams and needs.

Even the capitalists are shaped by their role in the production process. Marx noted as much in describing the capitalist as the character mask of capital, meaning that a capitalist must behave like a successful capitalist to succeed in the market. For examples, retail stores have often refrained from hiring black employees to work on the floor for fear of displeasing customers who would be offended by having to deal with salespeople of another race.

To collapse the world into a set of transactions, such as when labor is treated as an exchange of leisure time for a money wage. Leisure is a very time-related concept, but it obscures the role of time, as well as the social relations that provide the context for the social relations between workers and capitalists.

Second, conventional economics teaches that prices tend toward marginal costs. Especially in cases of strong economies of scale, because fixed costs are not counted as part of marginal costs, meaning that costs do not proportionally increase with the level of output. For this reason, the role of long-lived fixed capital dramatically shrinks in the marketplace even though it plays a significant part in the production process.

Much of the rest of this paper will expand on this last assertion.

This disappearance is very important for conventional economics. Otherwise, economists would have to face the fact that the congealed labor of the past is used to create means of production for use in an uncertain future. Whether fixed capital will ultimately produce a profit or not will depend on unknown future market conditions and technologies. Conventional economics goes even further in eliminating considerations of time by assuming that capitalists have a statistically accurate probability distribution of the future, which allows them to effortlessly deal with the complications uncertainty. Given the assumed rationality of consumers together with capitalists' knowledge of the

future, the efficiency of the capitalist mode of production is assured.

Of course, to consider an analysis of capitalism without taking the nature of fixed capital into account is ridiculous. But then again, conventional economics ironically presents itself as a scientific analysis of a profit-driven mode of production without a serious theory either of profit or capital.

Ironically, Karl Marx unintentionally contributed to the conventional defense of markets. William Stanley Jevons, Carl Menger, and Leon Walras led what became known as the marginalist revolution by developing the modern marginalist theory of market efficiency during the panic caused by the Paris Commune, the inspiration of which was commonly, but incorrectly attributed to Marx. Unlike Marx, who was revealing the dysfunctional nature of unfettered markets, the marginal revolutionaries, intended to persuade the public that everybody benefits from undisturbed markets and that everybody will be harmed by any effort to interfere with markets' beneficial process.

An oversimplified version of marginalist economics is that the economy depends upon people's behavior and people are rational, therefore markets are rational.

The brilliant iconoclastic economist, Thorstein Veblen mocked this approach, writing:

The hedonistic conception of man is that of a lightning calculator of pleasures and pains, who oscillates like a homogeneous globule of desire of happiness under the impulse of stimuli that shift him about the area, but leave him intact. He has neither antecedent or consequent. He is an isolated definitive human datum, in stable equilibrium except for the buffets of the impinging forces that displace him in one direction even if it was in good condition or another. [Veblen 1898, p. 232]

Lionel Robbins, whose An Essay on the Nature and Significance of Economic Science, 2d ed. (London: Macmillan), served as a roadmap for the proper execution of economics for a generation of graduate students gave a pseudo-scientific explanation for marginalist economics, which included some unintended humor that exceeded Veblen's:

##The propositions of economic theory, like all scientific theory, are obviously deductions from a series of postulates. And the chief of these postulates are all assumptions involving in some way simple and indisputable facts

of experience relating to the way in which the scarcity of goods which is the subject-matter of our science actually shows itself in the world of reality. [Robbins 1945, p. 78]

How is a theory based on postulates unrelated to any scientific research like a science?

Robbins went on to claim:

##In the light of all that has been said the nature of economic analysis should now be plain. It consists of deductions from a series of postulates, the chief of which are almost universal facts of experience present whenever human activity has an economic aspect. [Robbins 99-100]

What science justifies Robbins' confidence in "indisputable facts" and "universal facts," which are not the result of scientific research, but rather indicate a stubborn refusal to engage in dialogues concerning different perspectives-?

Without any evidence, people are assumed to be rational, thus, so too are markets. This unwillingness to hear criticism of unproven assumptions is a symptom of ideological rigidity that seems very unscientific. Those who might have questions about markets' rationality must be still or risk exposing themselves to a charge of ignorance of economics by doctrinaire economists.

What then makes economics scientific except for abstract mathematical models assumed to be based indisputable facts, which arise without any scientific research.

If people in the marketplace do behave rationally, one might ask why the advertising industry gets paid billions of dollars to influence prospective consumers by targeting their emotions.

Despite the "efficient market hypothesis," which holds that markets naturally produce rational outcomes, emotionally-driven investment bubbles are commonplace.

The marginal revolutionaries' basic analysis was quickly called into question because much of the world was already in the midst of what was then known as both "The Great Depression" and "The Long Depression, which can be dated from around 1873 to the early 1890s. That depression created a great deal of resistance to conventional economic theory at the time, especially because the most important economists in the United States received their graduate

training in Germany, home to the most advanced universities in the world. Their education was somewhat similar that which Marx experienced.

Like Georgescu Roegen, these German-trained economists had no love for Marx's politics, but some of them could readily see that his economics was more grounded in reality than the abstract marginalist theory, which was taking hold in the United States. Much of this dissatisfaction helped to spark the Progressive Movement arrived With this dissatisfaction, a group of the leading US economists at the time formed the American Economic Association, in 1885, which was intended to put conventional economics aside and promote a method of economic analysis that in many ways paralleled some of Marx's technical work, while supporting a political analysis quite close to what was common in Germany at the time.

Within a relatively short period of time a small group of economists who were attracted by the marginalist revolution's refutation of Marx turned the organization on its head, so that it rapidly evolved into a powerful bastion of conventional economics.

In my book, Railroading Economics, I showed how the railroad industry in the late Nineteenth Century, which held most of capital stock in the country, experienced repeated bankruptcies because competitive prices, which were approaching marginal costs, as the marginalists assumed to be natural but marginal costs were far too low to stem an ongoing shortfall in revenue, which would not permit the railroads to cover their fixed costs, which, to a large extent, took the form of payments due for the overpriced bonds that they floated. The resulting serious market failure took a serious toll on industries that relied on heavy amounts of fixed capital.

During this time, industry was first learning to effectively harness fossil fuel on a large scale, putting downward pressure on prices. Competitive pressures from the development of increasingly efficient technologies, forced business to quickly adopt new methods with great economies of scale, destroying much or all, of the value embodied in the expensive fixed capital. Technical change in the United State during this period was extraordinarily rapid, For example, Andrew Carnegie, upon hearing about a superior design for a rolling mill his young assistant, Charles

Schwab, ordered him to raze and reconstruct an existing three-month-old mill (Livesay 2000, p. 130). By the 1870s, new disruptive technologies were coming so fast throughout the economy that profits were consumed by the enormous increase in productivity, which flooded markets, lowered prices, and marginal costs to the point that lower revenue made much debt that was taken on to invest in now obsolete capital goods became unmanageable. In the end technical progress, which is usually seen as the elixir of a good life, drove prices down at an extreme rate, so much so that the period was rightly called, the Great Depression, which was finally ended with the Spanish American War -- the same war that signaled the enormous imperial future of the United States. Many economists, especially monetarists attribute the discovery of new sources of gold, which helped to curtail the existing deflation.. Technical change in the United State during this period was extraordinarily rapid, intensifying the Depression.

The resulting increases in output added to the competitive pressures. At the same time, new technological change also rapidly devalued large swaths of existing capital stocks, putting further downward pressure on balance sheets. The end result of these conditions was the Great Depression of the late nineteenth century, driven, in large part by the devaluation of large swaths of fixed capital, which ended in good part by the Spanish American War.

What is fascinating about this period is that the behavior of the economy so closely paralleled Marx's description of modern industry, which had been published before this crisis emerged.

This crisis also illustrates why investment in fixed capital is a speculation that depends upon future changes in technology and market conditions. The English economist, John Hicks, one of the earliest economists to win a so-called Nobel Prize, pointed to the obvious problem: "an entrepreneur by investing in fixed capital gives hostages to the future" (Hicks 1932, p. 183).

Marx used a better metaphor: the "mortal leap," which refers to the gap in the circuit of capital prior to an expected sale in which future profits might be had. The "mortal leap" first appeared in The Critique of Political Economy

Marx expanded his discussion of the subject in Chapter 3 of the first volume of Capital. His analysis of the mortal leap should be an important part of crisis theory. The mortal leap is most dangerous in the case of long-lived capital

goods, such as the enormous mass of fiber-optic cable laid just before the dot.com crash, which occurred in an environment in which many industry leaders and pundits predicted that the Internet would grow too fast for the existing network of fiber-optic cable to serve. Instead the investment in cables far outran the demand. Since the end of the dot.com boom, much of the cable, known as "dark fiber" still lies dormant.

Keynes had something to say about the something relevant to the dark fiber episode. He never Keynes never recognized Robbins' indisputable facts which would not be published until after, passed away. Keynes recognized impossible nature of solid information about the future, which might avoid the dangers of the mortal leap. Instead, Keynes compared decisions about investment in long lived capital goods. to games, such as "of Old Maid, of Musical Chairs -- a pastime in which he is victor who says Snap neither too soon nor too late, who passed the Old Maid to his neighbour before the game is over, who secures a chair for himself when the music stops. These games can be played with zest and enjoyment, though all the players know that it is the Old Maid which is circulating, or that when the music stops some of the players will find themselves unseated. [Keynes 1936, p. 156]

Or, to change the metaphor slightly, professional investment may be likened to those newspaper competitions in which the competitors have to pick out the six prettiest faces from a hundred photographs, the prize being awarded to the competitor whose choice most nearly corresponds to the average references of the competitors as a whole; so that each competitor has to pick, not those faces which he himself finds prettiest, but those which he thinks likeliest to catch the fancy of the other competitors, all of whom are looking at the problem from the same point of view. It is not a case of choosing those which, to the best of one's judgment, are really the prettiest, nor even those which average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practise the fourth, fifth and higher degrees. [Keynes 1936, p. 156]

In other words, Keynes is suggesting that much investment in fixed capital is guided by the idea if enough people are moving in the same direction that must be the direction to take as was the case with fiber optic. This example of mass

psychology, however has nothing to do with any indisputable facts; instead it refutes Robbins' position.

Mortal leaps may prove fatal for a number of reasons. To make this point, Marx used a dramatic example of capital devaluation, based on the experience of Charles Babbage, who invented the computer in the early nineteenth century. Needing precise parts for his computer, he paid careful attention to modern production techniques. Babbage reported that a new piece of equipment for making frames for patent net, which cost originally 1200 pounds within a few years sold for 60 pounds even if it was in good condition. Such destruction of embodied value may be due to changed market conditions, new technology, or a general condition of over-accumulation, all of which was in play at the time.

Seeing the buildup to the crisis of the late 19th century may well have given Marx a suggestion about the effects of over-accumulation -- something like China's overinvestment in steel mills and other heavy industry -- a route by which a rising organic composition of capital may create crises.

The temporary solution for the 19th century American economic crisis was a wave of mergers, which served as a means of limiting competition, which further lower prices. However, the mergers eventually created new problems. For example, corporations, freed from competitive pressures, did little to advance technical change, effectively putting an end to the period of rapid progress that preceded the 1873 crisis.

Conventional economists implicitly recognize this serious problem inherent in markets for commodities with low marginal and high fixed costs, but they restrict this analysis to the case of intellectual property and other forms of natural monopolies, which are characterized by low marginal and high fixed costs. Granting property owners monopoly rights avoids the danger of destructive competition, but economists fail to recognize how comparable competitive pressures can affect other parts of industry as well. Looking back at the first Great Depression shows that capital cannot prosper in a deeply competitive environment plagued by repeated bankruptcies and only saved by government generosity or supported anticompetitive policies, such as mergers, protectionist international trade policies, regulatory protections, and other forms of government support. So much for the fairy-tale of free competition. However, such defenses create problems of their own in the same way that anti-competitive mergers put

an end to periods of rapid technological change.

At this point, it is useful to remind ourselves that Marx's analysis is kaleidoscopic. For this reason, many people use Marx to answer very different questions, anything ranging from a mathematical analysis of the tendency for the rate of profit to imagine foreknowledge of coming revolutionary conditions. This paper turns to Marx to learn from his warnings about the dangers and deficiencies of the capitalist mode of production, which were confirmed in the Great Depression that quickly followed the publication of Capital and continue to be confirmed. The negligible attention to constant capital compared with other Marxian concepts is striking. Perhaps, the reason for this neglect is that constant capital creates complications for those who would regard value theory as something that lends itself to precise quantitative measurement and mathematical analysis. As discussed earlier, because of uncertainty, long-lived constant capital defies measurement. For many kinds of capital, physical depreciation can be calculated, in the same way restaurants can measure the gradual diminution of a salami while individual slices are removed for making sandwiches. For most businesses, depreciation remains unmeasurable. For that reason the time dimension of constant capital needs to be hidden. Despite the common assumption of economic rationality, capitalists' expectation of future profits from investments in constant capital may fall by way of the mortal leap. Unexpected moral depreciation by way of technical change or deteriorating market conditions -- neither of which can be measured -- can make optimistic plans go up in smoke. When disappointed expectations become too common, the economy suffers a crisis, as was the case during the Great Depression of the late 19th century.

This paper has several messages. To begin with, people who study the economy should do so with an eye to making a better world possible, rather than descending into a shallow ideological exercise, which calls for respect by virtue of its sophisticated mathematical and statistical modeling.

Despite its neglect, constant capital is probably the most important marker of the physical accumulation of capital. The concept of constant capital is also useful in analyzing conflicts between the profit-minded decumulation of the stock of natural resources and the need for sustainability. Like Georgescu, Marx's analysis of nature is similar to that

of constant capital. Both constant capital and natural resources represent a stock that is consumed in the act of production without the utmost care. However, Georgescu's entropy emphasizes the constant consumption the act of production without the utmost car. However, Georgescu's entropy emphasizes the constant consumption of nature because of the inescapable second law of thermodynamics, denying the possibility of absolute sustainability, while calling for measures to minimize the damage to the resource base. Georgescu Roegen would accept Marx's understanding of the role of local replenishment of nature. However, such local progress would ultimately come at the cost of the production of more entropy because of the inescapable second law of thermodynamics -- denying the possibility of absolute sustainability, while calling for measures to minimize the damage to the resource base. Georgescu-Roegen would accept Marx's understanding of the role of local replenishment of nature. However, such local progress would ultimately come at the cost of the production of more entropy.

Marx, unlike Georgescu-Roegen, clearly recognized the consequences of a system characterized single-minded pursuit of profit in exploiting natural resources. The inevitable result would be a failure to protect the resource base as well as the masses of society. This destructive behavior added to the urgency of transcending capitalism. For example, Marx referred to careless forestry as a "hidden socialist tendency."

The second message regarding the intellectual bankruptcy of conventional economics is already obvious. Introducing constant capital into that discussion reinforces that indictment. The experience of Georgescu-Roegen is useful in this regard. Although he was trying to improve conventional economics, his work never garnered much attention within the world of academic economics. No economist to my knowledge ever bothered to make a case that his ideas should be ignored. Such stubborn resistance to new ideas makes conventional economics even more dangerous because it impairs any potential to be on the lookout for warning signs about future problems, which are not consistent with pre-existing ideas.

A more subtle third message is that close attention to constant capital warns us that attempts to squeeze economic theory into a mathematical straitjacket is counterproductive because of the uncertainty associated with any investment

in fixed capital, as Hicks' observation makes clear. Probability distributions, used in conventional economics' analysis of investment, have no grounding in reality because the future remains unknown. As the American baseball player, Yogi Berra, is reputed to have said, "Prediction is difficult, especially for the future."

The final message is the need to think of the world within a broad timeframe -- an approach, which is in line with traditional Chinese culture. That timeline must include considerations of how our actions might affect the future. Toward what ends will the accumulation of capital be directed? What are the future environmental consequences of our present actions? Will the current pattern accumulation of constant capital be likely to produce future profits or advantages for society as a whole?

This perspective raises several questions that the profit-oriented accumulation of constant capital answers negatively: Capitalism will not work toward the elimination of poverty. It will not contribute to environmental sustainability. Sustainability means something more challenging than pollution taxes, carbon credits or some other kind of tinkering with the market. It requires or the cultivation of the sort of knowledge and the creativity necessary to improve our future prospects as well as developing an appropriate replacement for markets.

Given the negative answers to those questions, we all need to get to work on creating a better world in which categories, such as constant capital, abstract labor, and the like become historical curiosities, relevant only to a distant past. Good luck to all of us.

References

Daly, Herman E. 1995. "On Nicholas Georgescu-Roegen's contributions to Economics: an obituary essay." Ecological Economics, pp. 149 54. Ecological Economics: 149 54."

Fershtman, Chaim, Uri Gneezy, and John A. List. 2012. "Equity Aversion: Social Norms and the Desire to Be Ahead." American Economic Journal: Microeconomics, vol., vol. 4, No 4 (November): pp. 131 44.

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Georgescu-Roegen, Nicholas. 1970. "The Economics of Production. American Economic Review. Vol. 60, No. 2, Papers and Proceedings of the Eighty second Annual Meeting of the American Economic Association (May, 1970), pp.

19.

Keynes, John Maynard. 1936. The General Theory of Employment, Interest and Money (London: Macmillan).

-

Marx, Karl. 1867. Capital. Volume 1, tr. Ben Fowkes (New York, Penguin, 1976).

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Marx, Karl. n.d. Grundrisse. (New York, Penguin, 1973). 1976): p. 173.

Robbins, Lionel. 1945. An Essay on the Nature and Significance of Economic Science, 2d ed. (London: Macmillan).

Veblen, Thorstein. 1898. "Why is Economics Not an Evolutionary Science?" Quarterly Journal of Economics, Vol. 12, No. 4 (July): pp. 373 97; reprinted in Max Lerner, ed. The Portable Veblen (NY: Penguin Books, 1977): pp. 215 40.

References

Fershtman, Chaim, Uri Gneezy, and John A. List. 2012. "Equity Aversion: Social Norms and the Desire to Be Ahead."

American Economic Journal: Microeconomics, vol. 4, No 4 (November): pp. 131 44.

Georgescu Roegen, Nicholas. 1970. "The Economics of Production." American Economic Review. Vol. 60, No. 2, Papers and Proceedings of the Eighty second Annual Meeting of the American Economic Association (May, 1970), pp.

19.

Fershtman, Chaim, Uri Gneezy, and John A. List. 2012. "Equity Aversion: Social Norms and the Desire to Be Ahead."

vol. 4, No 4 (November): pp. 131 44.

Marx. n.d. Grundrisse. (London: Penguin Books, 1973).

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Marx. 1876. Capital. (London: Penguin Books, 1976)