

***ON METHOD AND ETHICS IN RAWLSIAN INVESTMENT RULES DESIGNED
TO ACHIEVE 'INTERGENERATIONAL EQUITY'***

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Running Head

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ABSTRACT

In his philosophical treatise, *A Theory of Justice*, John Rawls prescribed a 'social investment agenda' intended to maximize the 'well-being' of the 'least well-off generation.' With Rawls as their acknowledged catalyst, John Hartwick and Robert Solow have developed 'investment rules' designed to assure at least a constant level of '*consumption*' for each generation. But Hartwick and Solow define 'constant consumption' differently. To the end of achieving constant consumption in a more traditional sense, Hartwick advocates governmental investment of Hotelling rents in 'reproducible capital.' For Solow, the requisite governmental investment is broadened to include amounts necessary to 'repair or prevent environmental resource degradation.' These investment rules have become paradigmatic but fail methodologically for reasons bearing on the praxeological nature of many of the central concepts. For example, income, saving, capital, depreciation, and depletion are grounded in the goal-seeking actions of individual owners of property rather than the imagined actions of generations of people. Ethical breaches found in these investment rules are evident principally in proposed assaults on rights of private property and upon confiscation of private property for public investment aimed at what is claimed to be intergenerational equity.

ON METHOD AND ETHICS IN RAWLSIAN INVESTMENT RULES DESIGNED TO ATTAIN 'INTERGENERATIONAL EQUITY'

JOHN BRÄTLAND¹

I. Introduction

Harvard professor of philosophy, John Rawls, can be credited with provoking the most recent angst over the issue of intergenerational equity. As Rawls sees the issue, intergenerational equity is a public-policy issue necessitating intertemporal redistribution through a process of governmental intervention. For Rawls, the focus of concern is the lot of the poorest generation. The economists, John Hartwick and Robert Solow, credit John Rawls' treatise, *A Theory of Justice*, as the inspiration for their investment rules aimed at achieving 'intergenerational equity.'² For Rawls, saving and investing are equitable if these actions increase or enhance the 'welfare' of the least well-off generation of people.³ "Saving is achieved by accepting as a political judgement those policies designed to improve the standard of life of later generations of the least advantaged."⁴ However, Hartwick and Solow address this Rawlsian concern not by focusing on the needs of the least favored generation but rather on the objective of assuring each future generation a non-declining level of 'per-capita consumption.' The work of both of these economists has been inordinately influential in establishing the direction of economic research into the issues of intergenerational equity.

The purpose of this paper is to highlight and discuss the respective breaches in methodology and ethics implicit in the work of both authors. The examination of method is intended to be

¹ John Brätland is a Ph.D. economist with the U.S. Department of the Interior. The views expressed in this study are strictly those of the author. Remaining errors are the author's responsibility.

² John Rawls. 1971. *The Theory of Justice*. Harvard University Press: Cambridge, Massachusetts.

³ Rawls, pp. 284-293. Rawls arrives at principles of distributional justice through a type of universally applicable thought experiment in which the individual is asked to imagine himself behind a *veil of ignorance* functioning as a kind of decision-making spirit. The veil of ignorance imposes on the individual an absence of any specific knowledge about circumstances about his existence. While the individual has a general knowledge of society, the individual is necessarily ignorant of information on gender, wealth, abilities, physical characteristics, station in life or even what generation of people into which one may be born. One must also infer that as the veil of ignorance is defined by Rawls, the individual is ignorant of any concepts attendant to self-ownership, property or resource scarcity. This situation establishes the *original position* from which principles of justice are to be inferred. See Rawls, 1971, pp. 136-142. For an excellent critique of Rawls' veil-of-ignorance technique see Hans-Hermann Hoppe, "Introduction" to Murray N. Rothbard. 1998 [1982]. *The Ethics of Liberty*. New York, NY: New York University Press, pp. xiv-xv. Hoppe is particularly critical of Rawls for ignoring the issue of scarcity.

⁴ Rawls, pp. 292-293. See also Geoffrey Heal. 1998. *Valuing the Future: Economic Theory and Sustainability*. New York, NY: Columbia University Press, p. 8.

practical rather than philosophical. Praxeology, the science of human action, is used as a practical means to highlight the scientific illegitimacy of employing Rawlsian investment rules as a framework in formulating ‘public policy’ on intergenerational equity. In other words, praxeology is used as tool of policy analysis. Praxeology focuses on the goal-oriented actions of individual human beings who subjectively reckon cost of employing scarce means to achieve the benefits of subjectively chosen ends. All action reckons uncertainty, which means that action is seen as essentially and most fundamentally *entrepreneurial*. Methodological breaches in the Rawlsian investment rules are revealed in the fact that the major concepts arising in the economics of intergenerational equity are treated as physical aggregations of things to be managed by collective aggregations of people. The ethical breaches seem to center on the denial of and contravention of private property implied in their broad policy prescriptions. Just as the modern day research in intergenerational equity ignores the importance of individual human action, it also tends to turn a blind eye to the property rights of individual human beings.

John Hartwick’s attention is drawn to the supposition that current generations are not making sufficient allowance for depletion of exhaustible resources and are not investing enough to assure at least a constant level of per capita consumption for future generations. To address this concern, the Hartwick Rule offers the following injunction: “Invest all profits or rents from exhaustible in reproducible capital such as machines. Under such a program, the current generation converts exhaustible resources into machines and lives off ‘current flows’ from machines and labor. For the case of per-capita consumption remaining constant over time, one could say that no generation was better off than another.”⁵ This prescription (what is now referred to as the ‘Hartwick Rule’) has been very influential in the ranks of interventionist economists committed to what they define as the issue of ‘intergenerational equity.’⁶ Robert Solow has been impressed by the Hartwick injunction and observes: “the policy of investing resource rents in reproducible capital suggests irresistibly that some appropriately defined stock is being maintained intact, and that consumption can be regarded as the ‘interest’ on that stock.

⁵ John M. Hartwick. 1977. “Intergenerational Equity and the Investing of Rents from Exhaustible Resources.” *American Economic Review*. Volume 67 (5), p. 972. This article is reprinted in John Pezzey and Michael A. Toman, eds. 2002. *The Economics of Sustainability*. Burlington, Vermont: Ashgate Publishing Company, pp. 63-65. Hartwick’s ideas on investment are premised on the assumption that resource exhaustion is a virtual certainty. The market price of the un-recovered resource is assumed to increase through time with increasing scarcity brought on by what is assumed to be the ‘inevitable exhaustion.’ Economic conservation then is a matter of exploiting the resource at a rate that establishes equivalence between the rate at which the *net* present value of *in situ* deposits increases and the rate of return obtainable by the investor in competing investments. This simple decision rule is the Hotelling Principle. See: Harold Hotelling; “The Economics of Exhaustible Resources,” *Journal of Political Economy*, Volume 39, April 1931, pp. 137-175. Morris Adelman has debunked the exhaustion assumptions of the Hotelling Rule. See: Morris Adelman. 1995. *Genie Out of the Bottle*. Cambridge, Massachusetts: MIT Press. See also, Morris Adelman. 1993. *The Economics of Petroleum Supply*. Cambridge, Massachusetts: MIT Press. Adelman’s perspective is discussed below.

⁶ On the extent of Hartwick’s influence, John Pezzey and Michael Toman observe the following: “Hartwick’s rule is probably the single most powerful influence on sustainability policy... Many governments and multilateral institutions have invoked it, consciously or not, when declaring the importance of investing rents from natural resource depletion in building up capital in the rest of the economy.” John Pezzey and Michael A. Toman. “Introduction” In: John Pezzey and Michael A. Toman, eds. 2002. *The Economics of Sustainability*. Burlington, Vermont: Ashgate Publishing Company, pp. 63-65.

*This interpretation turns out to be quite right*⁷ (emphasis added).

Hartwick and Solow share certain perspectives on intergenerational equity. But they differ on both the scope of the ‘problem’ and what they see as the nature of the solution. For example, Hartwick implicitly sees the requisite level of investment as an example of market failure that is the responsibility of an interventionist government to correct. For his part, Robert Solow is very much in sympathy with the implicit ‘market failure’ theme of the Hartwick Rule. But Solow makes the market failure assumption more explicit largely because he sees Hartwick’s injunction as a model with much more extensive application in dealing with a much wider set of concerns. For example, Solow sees the relevant ‘capital stock’ in much broader terms to include resources of an essentially environmental nature. Hence, Solow applies the Hartwick Rule as a paradigm that could be applied to investment in resources yielding services not necessarily availed through market exchange. “In such cases, the same general principles apply [principles as outlined in the Hartwick Rule] as to other forms of capital. The same intellectual framework will cover reproducible capital, renewable and nonrenewable resources and environmental ‘capital.’”⁸

This paper will examine these two variants of Rawlsian investment rules as outlined by Hartwick and Solow. In the case of both, the breaches of method are seen in their failure to grasp the fact that concepts such as consumption, capital, depreciation, and depletion bear on goal-seeking actions of individual owners of property rather than the on imaginary but non-existent actions of generations of people. Moreover, particularly in Robert Solow’s application of the Hartwick Rule, methodological errors are grounded in a failure to address the requisite role of economic calculation in fostering a rational framework within which individuals can provide for the future. As noted above, the breaches of ethics bear, in major part, on the fact that Hartwick and Solow implicitly sanction public ownership and control of what could otherwise be privately controlled resources. Implicit in these Rawlsian investment rules as outlined by Hartwick and Solow are encroachments on private rights of property.

II. The Hartwick Rule: Its Breaches of Method and Ethics

Hartwick’s prescription that Hotelling scarcity rents be investment in reproducible capital is premised on the notion that the rents are a legitimate measure of resource exhaustion borne by society as a whole. He took the view that Hotelling rents should be seen as a form of social savings that should be used in a certain way for the benefit of both current and future generations. In presenting his model, he acknowledged that his idea was directly inspired by a criticism of Canada’s failure to properly ‘invest’ royalty receipts from exploitation of publicly owned exhaustible resources.⁹ Although Hartwick was inspired by a practical criticism of public policy, he responded by constructing a mathematical analysis implicitly reliant on assumptions of *equilibrium, legitimacy of governmental ownership of land and royalty receipts, leasing*

⁷ Robert M. Solow. 1986. “On the Intergenerational Allocation of Natural Resources.” *Scandinavian Journal of Economics*. Volume 88(1) p. 72; reprinted in John Pezzey and Michael A. Toman, pp. 67-75.

⁸ Robert Solow. 1992. *An Almost Practical Step Toward Sustainability*, p. 13.

⁹ John M. Hartwick. 1977, p. 972.

institutions that infringe on private rights of property, the assumption that royalty receipts are an accurate reflection of Hotelling rents, automatic nature of capital reproducibility and aggregative analysis in which governments are the actors. Hartwick's methodological and ethical breaches emerge out of these assumptions.

A. Breaches of method in the Hartwick Rule

The methodological breaches implicit in the Hartwick Rule can in part be traced back to the presumptive ownership of resources by a landlord government. This led Hartwick to treat Hotelling rents as though they were somehow unrelated to or not contingent upon the underlying property rights governing resource recovery. Other methodological errors in Hartwick's formulation arise from errors first committed by Harold Hotelling in formulating his theory of exhaustible resources.¹⁰ Harold Hotelling was first and foremost a mathematician whose avocation was the application of mathematical concepts to economic issues, only one of which was exhaustible resources.¹¹ True to typical form, Hotelling's approach to economics was quintessentially neoclassical in that it is premised on variables being objective magnitudes amenable to empirical assessment. However, for one to treat variables as objective, one must adhere to strong, virtually impossible assumptions of equilibrium. With such equilibrium assumptions, issues of human action and uses of property by individuals are essentially extraneous to the analysis. *But in fact, the central concepts of Hartwick's theory are essentially praxeological and have no coherent meaning outside the context of individual human beings using property to attain chosen ends.*

1. The supposition of Hotelling rent as an objective datum

Neoclassical economists like John Hartwick and Harold Hotelling implicitly find themselves treating neoclassical equilibrium to be a presumptive description of reality. This assumption of equilibrium allows economists to treat future prices of the exhaustible resource as objective and measurable magnitudes. Uncertainty plays no role. The same objectivist assumptions hold for all costs of extraction. The Hotelling Principle is actually premised upon an equilibrium in which the process of speculation necessary to achieve equilibrium is somehow an accomplished fact. Hence, given the assumptions of the Hotelling model and Hartwick's use of it, there would be no scope for speculation or entrepreneurial judgement. In essence, the praxeological nature of Hotelling rents is denied. Were such an equilibrium state possible, Hotelling rents would be an empirically measurable economic phenomenon. Objective Hotelling scarcity rents are assumed to be growing as increasing global scarcity of the respective exhaustible resources is increasing through time. As noted above, this rate of growth in the net price of the resource is established as the equilibrium rate of return of competing investments. To the extent that this equality attains, the present value of marginal Hotelling rents would be equal for each future time period. In static, idealized circumstances, marginal Hotelling rents, as realized in current acts of extraction, would be precisely equivalent to marginal opportunity cost or incremental user cost as

¹⁰ Harold Hotelling; "The Economics of Exhaustible Resources," *Journal of Political Economy*, pp. 137-175.

¹¹ See: Adrian Darnell. 1989. "Introduction." Adrian Darnell, ed. *The Collected Economic Articles of Harold Hotelling*. New York, N.Y.: Springer-Verlag New York, Inc.

reflected in the present value of future net receipts relinquished. At the margin, Hotelling rents and Hotelling user costs are the opposite sides of the same act. User cost is the incremental reduction in the present value of future rents relinquished through the current acts of extraction. It is this framework upon which Hartwick's investment rule is built

But this deterministic precision is nonsense in light of the fact that true markets are dynamic and uncertain in which action necessarily requires judgement.¹² Hotelling rents are mental constructs realizable through voluntaristic human action and the unencumbered use of private property. In other words, Hotelling Rents are a praxeological concept. Hotelling rents do not exist in any legitimate form outside of the bounds of human action and personal use of private property. To this extent, the act of extracting a resource in any time period involves a reckoning of a user cost. The reckoning is really a matter of judgement and discovery in the face of uncertainty. Hence, Hotelling rents never emerge as objective data to anyone including the extractive firm. This opportunity cost is always a subjective magnitude; it is a property owner's reckoning of the present value of the marginal net surplus revenue that is relinquished by the current act of extraction or resource recovery. It is a conjecture based on the acting entrepreneur's understanding of the market's future. Moreover, in a realistic disequilibrium world, no two actors are likely to see the future of the market in exactly the same way; owner-entrepreneurs may evince optimism or pessimism, boldness or timidity at any one moment in time.

Clearly this empirical barrier has stark implications for governmental uses of Hotelling rents proposed by the Hartwick Rule since the judgement involved lends them an unavoidable element of arbitrariness. Even if assessed retrospectively, rents necessarily contain elements of subjective judgement or convention. Extractive firms in the same industry, even if they owned identical extractive operations, could impute the same Hotelling rent only if they had imputed user cost at the same rate. Hence, the act of trying to discern Hotelling rents cannot simply be a matter of examining accounts. On the limitations of cost accounts in yielding relevant information, Ludwig von Mises notes the following: "cost accounting is therefore not an arithmetical process which can be established and examined by an indifferent umpire. It does not operate with uniquely determined magnitudes that can be found out in an objective way. Its essential items are the result of an *understanding of future conditions, necessarily always colored by the entrepreneur's opinion about the future state of the market.*"¹³ (Emphasis added). The correct inference is that Hotelling rents are a praxeological concept and an epistemological empty box from the perspective of a regulatory authority.

2. User costs of exhaustion as an external cost borne by society as a whole

A second methodological breach in the Hartwick Rule arises from confusions and errors in the treatment of ownership by the state. In fact, Hotelling user costs of exhaustion are a reckoning on the part of owners of private property and are, hence, borne by those owners. Only individual

¹² John Brätland. 2000. "Human Action and Socially Optimal Conservation: A Misesian Inquiry into the Hotelling Principle." *The Quarterly Journal of Austrian Economics* 3(1).

¹³ See Ludwig von Mises. 1998 [1949]. *Human Action: A Treatise on Economics, The Scholars' Edition* (Ludwig von Mises Institute: Auburn Alabama) p. 346.

human beings act; all action involves the use of property by the owner. All uses of property by the owner involve a valuation or ranking of alternatives uses. The most highly valued relinquished use of property is the opportunity cost of acting. Only individual property owners bear opportunity cost; social aggregations of individuals do not bear costs. But these realities are far removed from Hartwick's thinking. The problem arises from John Hartwick's assumption that the people of Canada are the collective owner of the land and the resources. For this reason, Hartwick is able to make no reference to the process by which exhausted deposits of the affected resource are explored and replaced by individual investors responding to increasing, privately borne user cost. This oversight leads Hartwick to assume that the government must bear the responsibility for replacing exhausted resources with other forms of capital. In other words, this prescription disregards the incentives created by the private-property owner confronted with the implications of resource exhaustion.

Hence, *user cost is not an external cost but rather an internal cost borne by individual investors.* Hartwick illegitimately ignores the role of individual entrepreneurial investors responding to increasing user costs. In the extractive industries, private entrepreneurs undertake replacement investment routinely and repeatedly. *In fact replacement of resources is an entrepreneurial undertaking to maintain capital; but this replacement process only occurs because of private property.* For many so called exhaustible resources, the reserve base expands through exploration and development by private property owners.¹⁴ The inducement for this new investment is privately borne user cost; at the margin, exhausting reserves become less profitable thus inducing entrepreneurs to discover and develop new deposits. These new deposits represent private replacement of capital. This replacement process requires no 'public investment.' The array of investment options and the subjectivity of opportunity costs convey the reality of the process by which capital replacement is achieved. The process of replacement is essentially a process by which all developers manage their respective portfolios seeking the highest rate of return consistent with their *subjective attitude* toward geological risk and market uncertainty. This process only unfolds as a process of continuous private speculation in which the capital stock – as it is embodied in privately owned assets—is being maintained and replaced. Speculative decisions are integral to this replacement process and cannot properly function without the property rights allowing choices in the timing of investments.¹⁵

¹⁴ See: Morris Adelman. 1995. *Genie Out of the Bottle*. Cambridge, Massachusetts: MIT Press. See also, Morris Adelman. 1993. *The Economics of Petroleum Supply*. Cambridge, Massachusetts: MIT Press.

¹⁵ When viewed in this light, speculation is seen to be productive. More than any other economist, Ludwig von Mises fully understood the productive nature of speculation. In his book *Socialism*, he trenchantly noted:

In the majority of cases in which it is assumed that there is a contrast between profitability and productivity no such contrast exists. This is true, for example, of the profits from speculation. Speculation provides for the adjustment of supply and demand over time and space. The source of the profit from speculation is ... an increase in value. The alleged contrast between profitability and productivity does not exist. ... Speculation performs a service which cannot possibly be eliminated without curtailing not only profitability but productivity as well.

Ludwig von Mises. [1951] 1953. *Socialism: An Economic and Sociological Analysis*. London, UK: Jonathan Cape, Ltd., p. 144).

*From a public policy perspective, the critical goal of capital replacement, as the issue is raised in the Hartwick Rule, is a system of property rights that allows the owner to manage deposits as capital assets. But the system of property rights currently governing the exploitation of some minerals such as petroleum does not accomplish this task. Under current property law, the petroleum reservoir never becomes the property of the petroleum developer. But economic conservation of petroleum requires secure private property in the *in situ* reservoirs. The issue is resolved if first discoverers acquire full ownership of petroleum reservoirs through the process of ‘original appropriation’ as described above. Surface owners would no longer have a contingent claim to a share (royalties) of the petroleum produced from beneath their property and would not be able to use state-imposed law to override decisions of the owner. As a full owner, the petroleum developer would be able to manage the resource as a capital asset.¹⁶*

3 ‘Hypostatization’: treatment of generations as actors

‘Hypostatization’ implicitly permeates the entire field of intergenerational equity and is patently evident in the Hartwick Rule. Each generation is treated as an individual actor undertaking actions to preserve the level consumption for future generations. In his 1962 book, *Ultimate Foundations of Economic Science*, Ludwig von Mises labels this treatment of social aggregations as an example of ‘hypostatization.’ Mises defines hypostatization as the act of ascribing substance or real existence to mental constructs or concepts. Mises offers the following observation on the error in this type of thinking: “Society is neither a substance nor a power nor an acting being...Society does not exist apart from the thoughts and actions of people.”¹⁷

But in the economics of the Hartwick Rule, the concern is over the investment necessary *by each generation* of people to maintain a constant or non-declining level of consumption for each succeeding generation. Hence in applying the Hartwick Rule, the government is the principal actor assuring that intergenerational equity is indeed achieved. As an example, note the following comment on the application of the Hartwick Rule offered by Geoffrey Heal: “if a country invests an amount equal to the market value of its use of exhaustible resources, then it solves the Rawlsian problem and achieves the highest possible level of utility for the least well-off generation. Remarkably, it also achieves the highest feasible constant level of utility given the economies initial stocks of capital and resources.”¹⁸ The generation is presented as the entity that does the investing. But as noted above, this assumption ignores the central and critical role of private rights of property and reliance on the action of individual human beings. Yet, to reiterate a central point, only individuals legitimately own property and only individuals act; collectives of people such as generations cannot own property and cannot act.

¹⁶ See: Robert L. Bradley, Jr. 1996. *Oil, Gas and Government: The U.S. Experience*. Lanham, Maryland: Rowan & Littlefield Publishers, Inc., pp. 71-73.

¹⁷ Ludwig von Mises. 1978 [1962]. *The Ultimate Foundations of Economic Science*. Sheed, Andrews and McMeel, Inc.: Kansas City, pp. 78-79.

¹⁸ Geoffrey Heal. 1998. *Valuing the Future: Economic Theory and Sustainability*, p. 8.

Part of the lapse into ‘hypostatization’ can be attributed to the misguided notion that intergenerational equity is a public good requiring ‘action by the state.’ While Hartwick himself does not explicitly state that intergenerational equity is a public good, this assumption is implicit in his presentation and, incidentally, virtually all literature dealing with intergenerational equity. Public goods are defined as being (1) non-rivalrous in consumption and (2) yielding benefits that do not allow the provider to exclude others from enjoying the benefits of the goods. With these properties, the theory of public-goods seems to necessitate an interventionist role for government in dealing with externalities affecting large numbers of people. This interpretation accords with that of John Rawls’ view of ‘social minimum’ that each generation is presumably obligated to provide for the least favored generation. In his book, *A Theory of Justice*, John Rawls notes:

It follows that arranging for and financing public goods must be taken over by the state and some binding rule requiring payment must be enforced.... it follows that the [social] minimum ... maximizes the expectations of the least advantaged group. By adjusting the amount of transfers...it is possible to increase or decrease the prospects of the more disadvantaged. ... The appropriate expectation ... is that of the long-term prospects of the least favored extending over future generations. Each generation must ... *put aside in each period of time a suitable amount of real capital accumulation.*¹⁹

But the above definition of ‘public good’ is misleading in that the classification of something as a public good is a premised on valuation that can only be made by individual human beings.²⁰ Moreover, given that subjective valuations of individuals are central to a thing being classified as a good, “their private or public character depends on how few or how many people consider them to be goods, with the degree to which they are private or public changing as these [subjective] evaluations change...”²¹

But in Hartwick’s exploration of intergenerational equity, he may also have been misled by the real-world example that prompted him to construct his model. The Canadian government had apparently accrued significant royalty receipts from private exploitation of exhaustible resources on public lands. In the view of some, these funds were misspent and not appropriated to purposes serving ‘the needs of the public.’ But there is also a problem with this perspective. For reasons that will be examined more fully below, no government is not the rightful owner of the land nor is it the ethical owner of the royalty revenues received from the exploitation of exhaustible resources. There are no apparent exceptions to this rule. These revenues should have accrued to the firms discovering and developing these resources. The user costs of

¹⁹ John Rawls. 1971. *The Theory of Justice*, pp. 267- 285.

²⁰ See: Jörg Guido Hülsmann,. 1999. Economic Science and Neoclassicism. *The Quarterly Journal of Austrian Economics* 2(4), p. 16.

²¹ Hans-Hermann Hoppe. 1993. *The Economics and Ethics of Private Property: Studies in Political Economy and Philosophy*. Boston: Kluwer Academic Publisher, p. 6.

exhaustion or depletion were privately borne in efforts by private firms to provide a marketable private good. The ethical issues arising in the context of the Hartwick Rule are examined below.

4. Aggregate production and Hartwick's 'reproducible capital'

Hartwick's methodological breaches arise from his reliance on mathematical models of a nation's entire economy. In fact, Hartwick's model is an example of the way in which mathematical specification can dominate economic content and economic conclusions of the analysis. He assumes the existence of a production function for an entire nation in which aggregate output is defined as a *single good*. This output is made a mathematical function of three aggregated inputs, capital, exhaustible resources and labor.²² In this function, proportionate increases in the three factors, capital, exhaustible resources and labor yield a greater than proportional increase in output (increasing returns to scale). Also, capital is infinitely substitutable for exhaustible resources.²³ As Hotelling rents increase through time (as they are assumed to do), output and consumption are maintained as these rents are invested in 'reproducible physical capital.'²⁴ With these latter assumptions, Hartwick has defined away the presumed challenge of maintaining at least a constant level of consumption for future generations. Regardless of the fact that the input of exhaustible resources may become increasingly small as exhaustion is assumed to occur, the level of per-capita output and consumption are maintained by investing the expanding levels of Hotelling rents in the so-called 'stock of reproducible capital.'²⁵

But Hartwick's mathematical exercise is clearly empty and meaningless. Considered more broadly, one must always be critical of efforts to employ aggregate production functions in any form of economic analysis. Peter Lewin observes:

If all of the relevant inputs are correctly identified, then it is possible, in principle, to replicate (therefore duplicate) the process [of production].... Replication, identification or production of the 'same' event is thus quite simple. In the social sciences, however, everything depends on correctly identifying these relevant conditions. Although simple, well-understood physical processes, like some production processes, easily replicated, the transition from these to the aggregate

²² John M. Hartwick. 1977, p. 972.

²³ Consider Hartwick's aggregate, per-capita production function in which x is per-capita output, k is per-capita capital, y is per-capita exhaustible resources and l represents a unit of labor:

$$x = k^\alpha y^\beta l^\delta, \quad \alpha + \beta = 1, \quad \alpha + \beta + \delta > 1.$$

In this aggregate production function, α , β and δ are respectively output elasticities for capital (k), exhaustible resources (y) and per-capita labor (l). The output elasticities for the three factors of production, each have values less than one, but which sum to a value greater than one. The function is characterized by increasing returns to scale.

²⁴ Hartwick. 1977, p. 973.

²⁵ As noted in a previous footnote, analysts have critically reexamined the assumption of exhaustion and have essentially debunked the notion. See in particular: Morris Adelman. 1995. *Genie Out of the Bottle*. See also, Morris Adelman. 1993. *The Economics of Petroleum Supply*.

economy level is extremely problematic... At the very simplest level, there is the insurmountable problem of aggregation of diverse outputs and inputs and the correspondence of aggregate statistical value to the theoretical symbols (supposedly in purely physical terms).²⁶

Lewin goes on to refer to the aggregate production function is a metaphorical device inviting conversation and not to be interpreted literally.²⁷ Hartwick's model should be seen in this skeptical light.

Hartwick is committed to the idea that capital is somehow spontaneously reproduced; Hotelling rents are to be invested in what he refers to as 'reproducible capital.' In his words, "invest all profits or rents from exhaustible resources in reproducible capital..." Clearly what Hartwick has in mind here is a Knightian view of capital as a quantifiable stock that, once created, would automatically be 'reproduced by the market.'²⁸ This perspective ignores the praxeological nature of capital "by assuming that the 'market takes care of it,' by assuring that the multitude of heterogeneous capital items in existence are somehow consistently and spontaneously integrated into the large, permanent organic network of production which had no beginning or end."²⁹ But, of course, this perspective is an absurdity. Capital is a praxeological reckoning that only emerges within plans of entrepreneurs.³⁰ The reckoning of capital is an entrepreneurial function that only has meaning within a market framework fostering economic calculation. There is nothing automatic about the creation and maintenance of capital; the extent to which it is reproducible is strictly an entrepreneurial judgement about the extent to which capital replacement is warranted in light of conjectured future net revenues. Hence, the injunction that governments invest their Hotelling rents in reproducible capital is meaningless.

B. Ethical breaches implicit in Hartwick's rule

The ethical breaches in Hartwick's investment rule all bear on the origin and nature of the private rights of property. Three breaches of ethics arise from the land ownership institutions presumed to be legitimate in the real world model he chose as a rationale for his theory. The first breach of ethics revealed in Hartwick's investment rule is seen in the fact that landlord government do not, in general, have any legitimate property right in the lands bearing exhaustible resources.³¹ In the choice of the Canadian model as an inspiration for his theory, he was implicitly sanctioning of

²⁶ Peter Lewin. 1999. *Capital in Disequilibrium: The Role of Capital in a Changing World*. London: Routledge, pp. 74-75.

²⁷ Lewin, p. 75.

²⁸ Frank Knight. 1936. "The Quantity of Capital and the Rate of Interest." *The Journal of Political Economy* Volume 44: pp. 433-463. An excellent critique of this perspective is found in Peter Lewin. 1999. *Capital in Disequilibrium*, pp. 65-67.

²⁹ Peter Lewin. 1999. p. 5.

³⁰ See Ludwig von Mises. 1998 [1949]. *Human Action: A Treatise on Economics, The Scholars' Edition*, p. 512.

³¹ The exceptions would be un-coerced purchase by government or by a donation to government.

government nationalization of lands bearing exhaustible resources. But John Locke observed that “commands of the state” are never a means by which ownership rights come into being. Murray Rothbard, Hans-Hermann Hoppe and others have examined the various ways in which individuals properly acquire ownership claims in property.³²

For example, Murray Rothbard has expanded upon Locke’s theory of property by presenting the logical actions that may be undertaken *by individual human beings to secure rightful or ethical ownership*.³³ First, building upon Locke’s insights, Rothbard notes that the individual owns himself and hence the product of his own efforts. Second, the individual may become a legitimate owner of property through a voluntary gift or grant from another party. Third, the individual may, by appropriating hitherto unused and un-owned resource and, through application of his own labor in the use of the unclaimed resource, rightfully claim ownership; this latter means to ownership has been labeled *original appropriation*.³⁴ Fourth, with resources already owned, the individual may establish legitimate ownership by making or manufacturing goods that have value in use and/or value in exchange. Finally, the individual may acquire property rights through the actions of *voluntary* exchange with another individual.

Publicly ‘owned’ lands have generally been acquired by governments through edicts or arbitrary acts of political power without undertaking ethically legitimate action that establishes a property claims to the affected lands. There is usually no history of original appropriation and voluntary exchange that brought these lands into governmental ownership. The preceding observations on the legitimate origin of property ownership leads one to the logical and correct inference that a government does not have proper title to the so-called ‘public lands’ even though its monopolistically held coercive power to enforce claims is clearly acknowledged. The principle one applies in making this latter inference is the requirement that title to *previously un-owned assets* such as exhaustible resources can only be established by an act of *original appropriation* or by legitimate purchase free of coercive taxation to raise funds for the acquisition. Such a requisite act of original appropriation would be satisfied by the discovery and delineation of a discovered deposit.³⁵

A second ethical breach follows from the first. The lack of any just property claim to subsurface resources on the part of the landlord government necessarily implies the absence of any rights to a royalty share of any subsequent production of an exhaustible or depletable resource. The resource defined by the land surface should be recognized as a separate resource distinct from *in situ* resources; the same legal principles of original appropriation should apply to *in situ*

³² Epstein, 1985, p. 61; *Murray Rothbard, Man, Economy and State: A Treatise on Economic Principles* 78-79 (1970); see also Hans-Hermann Hoppe, *Economics and Ethics of Private Property* 195-208 (1993) and Israel Kirzner, *Perception, Opportunity and Profit* 185-199 (1985).

³³ Rothbard, 1970, pp. 78-79.

³⁴ The phrase, *original appropriation*, is John Locke’s. See: Peter Laslett. 1970. *Locke’s Two Treatises of Government: A Critical Edition with Introduction and Notes by Peter Laslett*. Peter Laslett, ed. Cambridge, U.K.: Cambridge University Press. pp.305- 306.

³⁵ Robert Bradley. 1996. *Oil, Gas and Government: The U.S. Experience*, pp. 69-74. Under Bradley’s proposal, the means to acquisition of resource ownership is cast as Lockean original appropriation.

resources as should apply to the original appropriation of land surface. As Murray Rothbard has observed

... the answer depends on the justice of property title in each case. *Where, for example, an oil company...lays claim to the oil field that it discovers and drills, this is its just 'homesteaded' private property and it is unjust for the ...government to tax or regulate the company.... The government's claims are illegitimate and invalid, and the company [i.e., lessee] in the role of a homesteader is properly and not merely the renter of the oil land.... Ethically, any new oil company that enters the scene to discover and drill oil is the proper owner of its 'homesteaded' oil area*³⁶ (emphasis added).

Hence, the Hartwick Rule embodies a breach of ethics premised on an invalid theory of property.

The third breach of ethics in the Hartwick Rule stems from the implicit sanction of anti-property institutions employed by all landlord governments to extract royalty-receipts from lessees. Not only is the presumptive ownership of royalties by landlord government illegitimate, the institutional strictures imposed upon lessees to capture royalties are further assault on property rights of lessees. The royalty receipts accruing to any landlord government arise from the enforcement of implied covenants imposed by the courts to protect the interests of the 'royalty owner' [the government]. But these covenants are in fact an infringement on private property rights of lessees who have borne risk and invested capital in uncertain extractive ventures. The following comments outline only some of the unethical implications of these covenants:

It is apparent that the strict enforcement of these implied obligations [covenants] by the courts may, and often does, compel unnecessary and uneconomic drilling in order to protect individual leases. This results in a direct benefit to the land and royalty owner, who share in none of the operating expenses but are concerned solely with the maximum production that can be obtained in the shortest possible time while the lessee has the financial risk and numerous other obligations to consider.³⁷

The implied covenants foster other breaches of private property. Royalties received by the government are a percentage tax on the *gross proceeds received by the lessee* in the sale of the extracted resource. Royalty receivables, as investment assets, generally cannot appreciate in value at a rate equal to that on alternative investments. The landlord government's interests are based on maximizing gross market values whereas the lessee's interests are based on the lease's ability to maximize an estimated *net present value* as represented by Hotelling rents.³⁸ The

³⁶ Murray Rothbard. 1998 [1982]. *Ethics of Liberty*. New York, NY: New York University Press, pp. 71-72.

³⁷ Samuel H. Glassmire. 1935. *Law of Oil and Gas Leases and Royalties*. (Saint Louis, Missouri: Thomas Law Book Company) pp. 210-211.

³⁸ On the implications of choosing gross rather than net values in production decisions, see Ludwig von Mises. [1951] 1953. *Socialism: An Economic and Sociological Analysis*, pp. 145-152).

gross value of the lease may be static or declining while Hotelling rents may be appreciating. This fact means that royalty receipts can only be maximized by leasing sanctions that foreclose any speculative delay in exploration and development on the part of lessees. Obviously, landlord governments always have a vested interest in expedited recovery of the resource. For this reason, leases of government lands universally foreclose speculative timing on the part of lessees and quash any hope on the part of the investing lessee that Hotelling rents can be maximized.

If, in the lessee's judgement, the rate of appreciation of Hotelling rents exceeds the highest alternative return obtainable on alternative investments, delay in development and production represents the most efficient management of the resource. Hotelling rents, *as net present value*, are, in principle, reckonings of return on investment contingent upon the ability to engage in entrepreneurial speculation.³⁹ Market change and uncertainty mean that Hotelling rents can only be maximized through the lessee's ability to speculate. This ability requires property rights necessary to choose the timing of production and all investment activities preceding production itself. In other words, total Hotelling rents generated during the entire production period depends upon the ability of lessees to change in the timing of exploration and production in response changes in the resource market. A related feature of entrepreneurial judgement emerges in the fact that the temporal allocation of production costs such as depreciation charges will tend to be subjective and contingent of the lessee's entrepreneurial conjectures and attitudes about market uncertainty. *Aside from the fact that governments have no legitimate claim to the royalties, the upshot of this additional assault on property rights is that royalty receipts accruing to the landlord government are only a remote approximation of true Hotelling rents that could emerge if property rights of the lessee-developer were respected.*⁴⁰

III. Robert Solow's Expansion of Hartwick's Rule: Its Breaches of Method and Ethics

In attempting to formulate his own views of intergenerational equity, Robert Solow was influenced greatly by John Rawls' *Theory of Justice* but, unlike Rawls, focused more specifically on the role of natural-resource management. By focusing on natural resources, Solow saw an opportunity to apply John Hartwick' investment rule and employ it as a paradigm for a governmental attempts to achieve intergenerational equity. Hartwick's investment rule was tied to Hotelling rents accruing to landlord governments in the form of royalty receipts paid by

³⁹ While not focusing on the implied covenants, Professor Stephen McDonald observes the following: "The optimum time-distribution of production is defined for one point in time only. It changes as its determinants change from point to point in time. In particular, it changes with every change in current and expected costs and prices. Thus, continuously maximizing net present value (continuously conserving) *requires flexible adjustments* in the time-distribution of production as the economic values reflecting sacrifice and gains of satisfaction (costs and prices) change over time." Stephen McDonald. 1971. *Petroleum Conservation in the United States: An Economic Analysis*. Baltimore, MD: Johns Hopkins University Press, pp. 83-84. McDonald may actually believe the 'the optimum time distribution of production' is an objective, measurable reality. In a market in which equilibrium is assumed one could make such a postulate, but, in the real world, such an assumption would be absurd. But market change requires entrepreneurial judgement, or, in other words, 'speculation.'

⁴⁰ John Brätland. 2001. "Economic Exchange as the Requisite Basis for Royalty Ownership of Value Added in Natural Gas Sales." *Natural Resources Journal*. 41(3), p. 694.

private lessees. *To this extent, the process by which Hotelling rents are accrued is at least partially anchored in private property and a process of economic calculation.* Economic calculation is assured in the investment and marketing activities of private lessees extracting resources from government lands. But no such calculational base exists in Solow's application of Hartwick's investment rule. While Solow saw Hartwick's investment rule as a paradigm, he used it more as a metaphor in defining an expanded governmental role in the maintaining and repairing an aggregate resources base inclusive of a very broad definition of environmental resources. One would not be exaggerating to say that Solow sees the world as one colossal exhaustible resource to be managed collectively by individual generations for the benefit of all future generations that will ever exist. Private property plays no particular role in assuring intergenerational equity, which means that the praxeological nature of investment and resource depletion is ignored. Moreover, private rights of property function as no particular barrier to the governmental confiscation of property necessary to intervene in the name of intergenerational equity. In other words, the so-called 'savings' necessary to implement Solow's investment agenda is acquired through confiscatory taxation. Hence, Solow's attempt to apply Hartwick's Rule in addressing Rawlsian concerns harbors breaches of both method and ethics.

A. Methodological Breaches Implicit in Solow's *Two Theoretical Propositions*

While the Hartwick Rule is a paradigm for Solow, he contrives two theoretical propositions from ideas credited to John Hicks focusing on issues of capital and income.⁴¹ In his book, *Value and Capital*, John R. Hicks stated: "We ask, not how much a businessman does receive in the current week, but how much he would be receiving if he were getting a standard stream of the same present value as his actual expected receipts. That amount is his income."⁴² This return is the income yielded to the individual through his *ownership* of a 'capital asset.' As described by Hicks, sustainable income suggests a 'capital asset' or assets yielding a return over time. Hick's stated purpose in offering this definition was to convey a definition of what businessmen "can consume without impoverishing themselves."⁴³ In other words, this definition of income for the businessman would be sustainable indefinitely. Sustainable income for the individual businessman will be net of the expenditure of resources required for the maintenance of those assets yielding the income return. To the extent that the actor avoids these expenditures, capital is consumed but to the degree that additional maintenance expenditures are made that assure an increase in sustainable income, the individual has been engaged in acts of 'saving.'⁴⁴

These ideas of Hicks have relevance and legitimacy in the context of an individual human being making decisions about income, consumption, savings and the maintenance of capital. But

⁴¹ John R. Hick. 1946. *Value and Capital*. Oxford, U.K.: Oxford University Press, Chapter 14. One should also note an excellent discussion of these issues by Ludwig von Mises. See: Ludwig von Mises. [1949] 1998. *Human Action*, pp. 260 - 264.

⁴² John R. Hick. 1946. *Value and Capital*, Chapter 14.

⁴³ John R. Hick. 1946, Chapter 14.

⁴⁴ Ludwig von Mises. [1949] 1998. *Human Action*, p. 261.

Robert Solow seeks to apply these concepts to the presumed ‘decision making of a nation’ or a generation of people. In other words, Solow is engaging in the same ‘hypostatization’ that plagued Hartwick’s approach to intergenerational equity.⁴⁵ The underlying premise in Solow’s thinking is that resources can be managed at an aggregate level to achieve goals that are defined in aggregative terms. His earlier explorations into the neoclassical theory of growth provide a classic example.⁴⁶ His treatment of intergenerational equity provides another. This fact is made evident in the way Solow intends to apply these ‘Hicksian perspectives’ on consumption and income to an entire economy as an aggregate whole. It is in this latter context that Robert Solow develops his two theoretical propositions for investment in furtherance of intergenerational equity. The following passages are quoted at length to more thoroughly note the scope of his errors in understanding the issue of intergenerational equity for society as a whole.

The first tells us [that] at each instant, net national product indicates the largest consumption that can be allowed each year if consumption is never to be allowed to decrease. ... the maximum level of current consumer satisfaction that can be sustained forever. ... The economy’s net national product in any year consists of public and private consumption and public and private investment. ... The components of investment have to be valued. That is where the ‘rightness’ of prices comes in. ... the right prices will make full allowance even for the distant future, and will even take account of how each future generation will look at its future. ... This story makes it obvious that everyday market prices can make no claim to embody that kind of foreknowledge⁴⁷ (emphasis added).

Solow's first theoretical proposition purports to establish a quantifiable relationship between net national product and the maximum portion of aggregate income that can be consumed during a particular time period without jeopardizing consumption that can be enjoyed by future generations. But Solow does not have conventional consumption in mind in talking about NNP. He is including, for example, the services yielded by environmental assets and a broad gamut of things not traded in conventional markets. But this seems to mean that requisite investment must be based on a type of imputation. Hence, in evaluating the investment necessary to achieve intergenerational equity, Solow rejects the use of market prices because of their presumed inaccuracy and imperfections. Instead Solow advocates the use of theoretically correct prices or *shadow prices* that make appropriate allowance for ‘the distant future’ in assessing the legitimate level of productivity.

⁴⁵ Ludwig von Mises. 1978 [1962]. *The Ultimate Foundations of Economic Science*, pp. 78-79.

⁴⁶ Robert Solow. 1956. “A Contribution to the Theory of Economic Growth.” *Quarterly Journal of Economics*. 70(1), pp. 65-94.

⁴⁷ Robert Solow. 1992. *An Almost Practical Step Toward Sustainability*, p. 16. Solow goes on to press the point about ‘correct prices’ by noting “*everyday market prices can make no claim to embody that kind of foreknowledge*. Least of all could the prices of natural resource products, which are famous for their volatility, have this property; but one could entertain legitimate doubts about other prices, too. The hope has to be that a careful attempt to average out speculative movement and to correct for other imperfections [such that] ... adjusted prices might serve as a rough approximation of theoretically correct ones.”

In his second theoretical proposition, Solow enunciates what he sees as the relationship between net national product and a broadly defined capital stock, namely that the former is an interest return on the latter.

The *second* theoretical proposition ... *Properly defined and properly calculated, this year's net national product can always be regarded as this year's interest on society's total stock of capital. ... NNP at any instant can be represented as that same stock of capital multiplied by an unchanging discount rate.* It is absolutely vital that 'capital' be interpreted in the broadest possible sense to include everything, tangible and intangible, in which the economy can invest or disinvest, including knowledge. And the interest rate that capitalizes the net national product will generally be the real rate of discount implicit in the whole story. Investment and depletion decisions determine the real wealth of the economy, and each instant's NNP [net national product] appears as the return to society on the wealth it has accumulated in *all forms*⁴⁸ (emphasis added).

Robert Solow claims to have gained a deep insight by interpreting these two theoretical propositions in conjunction with each other. For example, in Solow's first principle, NNP (net national product) is seen as the highest attainable 'consumption' that can be achieved by a generation from a given stock of capital as it exists at any particular moment in time. *But in his second principle, this same NNP is interpreted as the product of the 'stock of capital' and the 'unchanging discount rate.'* He concludes that if one goal of economic policy is to make investment and depletion decisions this year in a way that does not erode 'sustainable income,' it must simultaneously be a program of investment that maintains the 'broadly defined capital stock.'⁴⁹ "The neat interpretation of allowable consumption as the interest on an initial patrimony or resource endowment seems quite appropriate. It is a reminder of the old fashioned obligation to 'maintain capital intact.'"⁵⁰ These thoughts of Solow's reveal a number of related methodological errors that are examined in the following pages.

1. 'Properly redefining NNP' through 'theoretically correct shadow prices'

Clearly the matter of a 'corrected net national product' is intended to play a central role in Solow's formulation. The error committed with respect to this issue has two facets. The first facet revolves around the legitimacy of the concept of net national product (NNP) as the term is used in common economic parlance. And the second facet arising in Solow's analysis bears upon the adjustments that he presumes to make by employing 'theoretically correct' prices or

⁴⁸ Robert Solow. 1992. *An Almost Practical Step Toward Sustainability*, p. 17. Robert Solow credits Martin Weitzman with this idea. See Martin Weitzman. 1976. "On the Welfare Significance of Net National Product in a Dynamic Economy." *Quarterly Journal of Economics*, Volume 90, pp. 156-162.

⁴⁹ Robert Solow. 1992. *An Almost Practical Step Toward Sustainability*, p. 17.

⁵⁰ Robert M. Solow. 1986. "On the Intergenerational Allocation of Natural Resources." *Scandinavian Journal of Economics*. Volume 88(1) p. 72; reprinted in John Pezzey and Michael A. Toman, p. 75.

shadow prices. Unfortunately, the concept of net national product is illegitimate even in a market-based system with calculational foundations. On the emptiness of the concept of NNP, Ludwig von Mises observes

.... it is nonsensical to reckon national income or national wealth. As soon as we embark upon considerations foreign to the reasoning of a man operating within the pale of a market society, we are no longer helped by monetary calculation methods. The attempts to determine in money the wealth of a nation or of the whole of mankind are as childish as the mystic efforts to solve the riddles of the universe... If a business calculation values a supply of a commodity at \$100, the idea is that it will be possible to sell it or to replace it against this sum. If a whole entrepreneurial unit is estimate at \$1,000,000, it means that one expects to sell it for this amount. But what is the meaning of the items in a statement of a nation's total wealth [or income]? What is the meaning of the computation's final result? ... The businessman can convert his property to money but a nation cannot.⁵¹

One of the principal motives for Solow's pretence that NNP is a legitimate measure of the something is that intergenerational equity, in its modern sense, is implicitly aimed at some type of intertemporal redistribution of 'welfare' between generations. The concept of NNP lends power to the illusion that something can be 'divided up' and managed in such a way that intertemporal transfers can be centrally managed.⁵² Elsewhere Mises employs even more withering language to suggest the emptiness of the idea behind the NNP or national income concept and the implicit 'redistributionist' agenda behind its use.

The concept of national income entirely obliterates the real conditions of production within a market economy. It implies that it is not the activities of individuals that bring about the improvement (or impairment) in the quantities of goods available, but something that is above and outside these activities. This mysterious something produces something called 'national income,' and then a second process 'distributes' this quantity. The political meaning of this method is obvious.⁵³

But Solow would modify the invalid NNP to address still broader purposes. To attain these broader purposes, Solow presumes to adjust its content by employing theoretically correct shadow prices. Shadow prices are generally defined as "an imputation of value of a commodity or service which has no market price ... that may be calculated reflecting the marginal

⁵¹ Ludwig von Mises. [1949] 1998. *Human Action*, p. 218.

⁵² This notion is one of the central themes of a paper by Murray Rothbard. See Murray Rothbard. 1997 [1961]. "The Fallacy of the Public Sector." *The Logic of Action Two: Applications and Criticisms from the Austrian School*. Cheltenham, UK: Edward Elgar Publishing Ltd, pp.171-179. This paper is reprinted from *The New Industrial Review*(Summer 1961) pp.1-3.

⁵³ Ludwig von Mises. 1978 [1962]. *The Ultimate Foundations of Economic Science*. Kansas City: Sheed, Andrews and McMeel, Inc., p. 85.

opportunity cost or the marginal value of their use as inputs.”⁵⁴ Unfortunately, the latter two concepts have no objective reality and are always subjective. Hence, shadow-price concept is operationally empty. This grossly apparent error only tends to highlight the critical importance of private property and monetary exchange in arriving at legitimate market prices. But one of the gigantic blind spots in the economics of intergenerational equity is its nearly total failure to address private rights of property. By ignoring private property rights, all activities within the economy appear to be candidates for a ‘market-failure designation.’ Of central importance is the fact that private property empowers the property owner and confers rights to choose uses to which property is put. *The central issue bears upon the ways in which the institution of private property creates incentives and imposes costs that prevents wasteful uses of what is owned.* In being able to choose desired uses and impose a cost upon other parties seeking the services of scarce resources, the owner has the ability to define its scarcity.

Whether a good is scarce or plentiful from this stand point depends on the wishes of the owner of that good. ...Whether a particular good will be scarce or plentiful relative to potential use then depends on how much property that good’s owner demands for it; the question of how best to produce something cannot be answered outside of the framework of a property rights system for determining what factors are available (attainable) for its production. Indeed the availability of factors in an economic sense plays a role in determining what should be produced in the first place⁵⁵ (emphasis added).

Ownership imparts a social signal of scarcity in the use of resources that shadow prices or theoretically correct prices cannot replicate. Hence, Solow’s prescribed use of shadow prices to correct NNP and provide guidance for establishing the true productivity of alternative investments only compound the absurdity of his proposal.

Solow imputes another meaning to NNP that reveals additional errors: “*net national product measures the maximum level of current consumer satisfaction that can be sustained forever*” (emphasis added).⁵⁶ In responding to this observation, one must first acknowledge that NNP is an aggregation. What is anyone able to say about aggregate consumer satisfaction based upon a meaningless aggregate? The answer is: ‘nothing.’ It would seem that Solow is guilty of the presumption that interpersonal comparisons of utility are possible. All interventionists are trapped by the uncomfortable reality that utility does not exist and that value, in all circumstances, can never be more than a subjective ranking of alternatives made by individual human beings. Hence, welfare inferences of whatever stripe are necessarily empty. There is no legitimate policy inference that can be drawn with respect consumer satisfaction and the aggregate number purporting to represent net national product or national income. But equally important is the fact that the actions determining the breakdown between consumption and what is to be saved for capital investment are praxeological in nature and can only be made by private

⁵⁴ David Pearce. 1992. *The Dictionary of Modern Economics*. Cambridge, Massachusetts: The MIT Press, p. 391.

⁵⁵ Dan Mahoney. 2002. “Ownership, Scarcity, and Economic Decision Making.” *The Quarterly Journal of Austrian Economics*. 5 (1): p. 43.

⁵⁶ Robert Solow. 1992. *An Almost Practical Step Toward Sustainability*, p. 16.

entrepreneurs attempting to arrive at rational uses of private property. This latter issue is addressed in the following section.

2. ‘Broadly defined capital’ as vain intent to reckon incommensurable things

In his commitment to applying the Hartwick approach to intergenerational equity, Solow believes that a nation should invest an amount equivalent to some sort of broadly-defined economic reckoning of resource depletion. In Solow’s view, attaining this goal solves the Rawlsian problem for the nation and simultaneously achieves the Rawlsian objective of assuring the highest possible level of welfare for the least well-off generation. But in Solow’s assessment, this result also achieves the highest feasible constant level of utility given the economies initial stocks of capital and resources. But Solow’s so-called resource base is much broader than that assumed by Hartwick in his formulation of an intergenerational investment rule. Solow repeatedly emphasizes that the capital stock must be defined on the broadest possible basis. But the ‘broadly-defined capital stock’ to which Robert Solow makes reference is an aggregation of disparate things that defy any coherent, rational reckoning.

Nonetheless, Solow advances the notion that “the same approach [reference to the Hartwick Rule] can be applied to environmental assets. ... The environmental case is more complex, because even a stylized model of environmental degradation and rehabilitation is more complex than a model of resource depletion. The principle is the same, but the execution is even more difficult.”⁵⁷ Solow is able to make such a statement because he is implicitly assuming that some sort of valuation is imputable for these heterogeneous ‘things.’ This apparently is the stage at which Solow intends to apply ‘theoretically correct shadow prices.’ With the use of these shadow prices Solow apparently intends to establish some sort of commensurability that could serve as a guide for public policy on intergenerational equity. With shadow prices, Solow presumes to be able to make welfare inferences for future generations and to make judgements on what type of ‘broadly defined capital stock’ will assure future generations a constant level of consumption, ‘broadly defined.’

It is striking that Solow embraces a totally erroneous view of capital and is oblivious to the fact that outside of the institutions of property and monetary exchange, there can be no calculational basis for maintaining capital intact. As noted earlier, capital itself is a praxeological concept. If one were to employ the Misesian definition in which capital is the net dollar equivalent of all assets committed to a particular undertaking at a defined moment in time, this amount would presumably be the starting point for the construction of a capital aggregate. If one could legitimately assume general equilibrium, free of the realities of uncertainty and change, an aggregation of such individual reckonings of society’s ‘capital stock’ would have some claim to legitimacy.⁵⁸ But capital is a matter of judgement and action directed toward the attainment of future net return. “It is a product of reasoning, and its place is in the human mind. It is a mode of looking at the problems of acting, a method of appraising them from the point of view of a

⁵⁷ Robert Solow. 1992. *An Almost Practical Step Toward Sustainability*, p. 19.

⁵⁸ Israel Kirzner. 1966. *An Essay on Capital*. New York, NY: Augustus Kelley Publishers, p.121.

definite plan.”⁵⁹ Mises stresses the fact that capital calculation is necessarily undertaken by individual entrepreneurs -- not by society as a whole. Entrepreneurs make their plans in uncertain and evolving market environments. The planning process of entrepreneurs requires judgement and foresight. The future is not known and is not predetermined in any way implying that the appraisal of capital or the assessment of the worth of a business is always a matter of judgement on the part of the entrepreneur. “Capital is always accumulated by individuals or groups of individuals in concert, never by the *Volkswirtschaft* or society.”⁶⁰ Hence, the concept of capital only has coherence and logical meaning within the context of an entrepreneurial plan. Moreover, this kind of planning is only possible in a market economy in which capital maintenance is reckoned in market prices emerging in arm’s length exchange between property owners.

But what of all the additional things that Solow would bring into his broadly defined capital stock? While the preceding comments are a legitimate criticism of Solow’s methodology, they do not address what are clearly his broader concerns of intergenerational equity. Solow would somehow agglomerate incommensurable things into his broadly defined capital stock. Nonetheless, capital and its depletion cannot be a type of metaphorical aggregate as it seems to emerge in Solow’s grand plan. Capital cannot be defined in terms of broad inclusive aggregates of tangible or intangible things that may or may not yield benefits to populations or generations as a whole. In his intent to aggregate all of these ‘useful and vital things,’ it is odd to note that in Solow’s world, there is virtually no mention of individual property owners engaged in market exchange. Capital itself must first be private property. Its depletion or depreciation must be a private, subjective reckoning employing the tool of economic calculation. The existence of capital must involve a personal commitment of privately owned resources to uses consistent with entrepreneurial objectives. If one of the numerous things that Solow would include in the capital stock is to become legitimate capital, it must be privately owned and made an integral part of entrepreneurial plans. Private property and monetary exchange allow the owner of capital to make *rational* decisions about the use and maintenance of privately owned capital goods. It is through this private stewardship of private property that resources are bequeathed to the future.

However, some ‘resources’ may not be owned and may appear to be used in a way that fosters environmental damage, nuisance or change that may appear inconsistent with what some would view as intergenerational equity. In these cases, concerns of intergenerational equity can only be assured by policies that (a) foster a stricter enforcement of existing rights of private property, (b) facilitate original appropriation of un-owned resources in the Rothbardian sense described above,⁶¹ or (c) make possible privatization of resources currently held by governments. Concerning environmental issues that arise in the context of intergenerational equity, properly defined rights of private property are essential because implicit in the concept of private property is the concept or tort protection from damage perpetrated by the actions of others. These

⁵⁹ Ludwig von Mises. [1949] 1998. *Human Action*, p. 511.

⁶⁰ *Ibid.*, p. 513.

⁶¹ Rothbard, 1970, pp. 78-79.

protections provide assurance that actions are based on a reckoning of cost inclusive of any possible advertent or inadvertent damage that may be done to the property owned by other people.

3. 'The unchanging rate of discount' in Solow's second theoretical proposition

In Solow's second theoretical principle, *NNP is interpreted as the product of the properly defined 'stock of capital' and the 'unchanging discount rate.'* Presumably Solow is making reference to the mythical social rate of discount that plays such a central and popular role in much of interventionist economics. Only this latter rate is ever viewed as being 'unchanging.' The idea of a social rate of discount is premised on the notion that there is a rational basis for social discounting of the future that deviates from market rates of interest. But does the idea of a constant social discount rate have any praxeological legitimacy? Before proceeding further, one should first be clear that the very subject of social discount rates is premised on society acting as a collective. Note the rationale for using a social discount rate offered in a leading dictionary of economics: "individuals' collective behavior toward the future differs from their behavior as individuals."⁶² Is there any legitimate embodiment or example of 'collective behavior'? At one point, Solow actually acknowledges that "generations do not make decisions; families, firms and governments do."⁶³ Yet the entire thrust of Solow's discussion seems to suggest that generations of people are the actors making investment decisions requisite to the achievement of 'equity for future generations.' For Solow, generations inherit "a capital stock, in the very broad and inclusive sense that matters. In turn, each generation makes consumption, investment and depletion decisions."⁶⁴ But the maintenance of this broadly defined capital stock becomes the responsibility of a generation of people acting in some sort of collective to avoid 'high-consumption' and to live up to the ethic of intergenerational equity. "A concern for intergenerational equity implies a bias toward investment...enough investment to keep the broad stock of capital intact."⁶⁵

As noted above, Ludwig von Mises has expended some effort to debunk this notion of collective action and collective behavior: "society is not an entity in itself. ... but awareness of this fact does not justify dealing with social relations as if they were something else than relations, or with society as if it were an independent entity outside or above the actions of individual men."⁶⁶ An unchanging *social* rate of discount would need to be based on an unchanging rate of time preference on the part of individual members of society. But time preferences can change and do change just as all preferences are subject to change. Clearly a social rate of discount does not

⁶² David Pearce. 1992. *The Dictionary of Modern Economics*, p. 398.

⁶³ Robert Solow. 1992, p. 17.

⁶⁴ Robert Solow. 1992, pp. 17-18.

⁶⁵ Robert Solow. 1992, pp. 17-18.

⁶⁶ Ludwig von Mises. 1958. *Theory and History: An Interpretation of Social and Economic Evolution*. London, UK: Jonathan Cape, 251-252.

and cannot exist in any legitimate sense.

Solow and other theorists cast the analytical problem not as an intertemporal tradeoff between benefit enjoyed today versus benefits enjoyed in the future. Rather, in the case of intergenerational equity, the relevant tradeoff is between the benefits enjoyed today by a current generation of people and the benefits enjoyed in the future by another generation of human beings. Hence, theorists presume the problem cannot be viewed simply as a matter of maximizing expected net worth, as would be the case with a private investment decision. Intergenerational equity seems to call for an egalitarian treatment of generations with the logical inference to be drawn being that any positive discount rate implies an asymmetry between present and future generations.⁶⁷ Nonetheless, as emphasized above, intergenerational equity, to the extent that the phrase has any legitimate meaning, is contingent upon the ability of individuals to secure and even expand the rights of private property for the people currently living. Clearly, the idea of a social rate of discount, in the sense meant by Robert Solow, is antithetical to that end since its use is implicitly premised upon governmental use of private property.⁶⁸

Solow is under the sway of “collectivist dogma” in being unable to accept the notion that tradeoffs between the present and the future must be made by individual human beings dealing with scarcity and the need to make a rational reckoning of the uncertain future returns that may be achievable through acts of saving.⁶⁹ Personal acts of saving are at the heart of whatever provision is made for future generations. Capital goods are a reflection of this provision for the future and emerge in acts of saving in which individuals forsake consumption in the present in exchange for the prospect of a net return in the future. In reckoning this tradeoff, people generally place a higher ranking on what can be ‘consumed’ or enjoy in the present over what one can be availed in the future. In other words, people have a positive rate of time preference. But for each individual, this ranking is subjective and is reflective of personal time preference and judgements of uncertainty associated with the passage of time. Willingness to save is

⁶⁷ Not surprisingly, Solow is not entirely clear on what he really thinks about this issue. After defining a properly adjusted NNP as a product of the unchanging discount rate and the properly defined capital stock, he offers the following observation:

You may wonder why I allow discounting at all. I wonder too: no generation should be favored over any other. The usual scholarly excuse -- which relies on the idea that there is a small fixed probability that civilization will end during any little interval of time -- sounds farfetched. We can think of intergenerational discounting as a concession to human weakness or as a technical assumption of convenience (which it is).

Robert Solow. 1992. *An Almost Practical Step Toward Sustainability*. Washington, D.C.: Resources for the Future, p. 20.

⁶⁸ The market rate of interest, or the ordinary rate, has a definite calculational foundation that is consistently ignored by Solow. The ordinary rate only becomes a useful expression of *economic scarcity, uncertainty and time preference* in an economic environment in which property rights of individual human actors are secure and in which market exchange is indirect – that is, supportive of monetary exchange.

⁶⁹ Ludwig von Mises. 1958. *Theory and History: An Interpretation of Social and Economic Evolution*, pp. 250-256.

contingent on an expectation that the individual will be availed of some premium sufficient to reverse rankings arising from a positive time preference. In other words, a future dollar plus the expectation of some sufficient large premium or return is preferred to the dollar in the present. This premium is sufficient to induce the individual, cognizant of uncertainty, to become a net supplier of present goods and net demander of future goods. But to the extent that ordinary interest is a manifestation of human action, it can never be unchanging as Solow seems to suggest. As conditions change or as personal preferences are altered, ordinary interest must also change.

B. Ethical Breach Implicit in Solow's Investment Rule

The breaches of ethics in Solow's treatment of intergenerational equity arise from the contravention of property rights implicit in the state's acquisition of resources. Like Hartwick's prescriptions for intergenerational equity, Solow's agenda involves acquisition of revenue by the state for which the state has no ethically legitimate claim. For example, "*the split between private and public investment has to be made in essentially political ways*, like the split between private and public saving"⁷⁰ (emphasis added). With this statement, Solow has stepped off the ethical precipice. Centralized management of resources is to be introduced through a process of property predation undertaken by democratic governments. The acting agent is not the individual property owner attempting to rank different courses of action in the uses of his property. Rather, the acting agent is the government acting as a proxy for the generation. Governments make decisions in the name of society for the benefit of current and future generations. Obviously, these actions are not anchored or grounded in private rights of property. The terms 'saving' and 'investment' take on a meaning quite alien to secure rights of private property. These euphemisms of 'saving' and 'investment' actually refer to governmental theft through taxation; "... theft is theft, whether taken by one man against another, or by a group, or even by a majority of people within a given territorial area. The fact that a majority might support or condone an act of theft does not diminish the criminal essence of the act or its grave injustice."⁷¹ Hans-Hermann Hoppe has trenchantly commented on the role of such theft in the context of presumably 'beneficent state intervention.'

Whatever any given state does in terms of positively evaluated contribution to society, and however great or small the extent of such contributions might be; whether the state provides for. ... society's infrastructure, money, steel or peace; or even if it does all of these things and more, it would be completely fallacious to enumerate all of this and leave it at that. *What must be said in addition is that the state can do nothing without the previous noncontractual expropriation of natural owners.* Its contributions to welfare are never an ordinary present, even if they are given away free of charge, because something is handed out that the state does not rightfully own in the first place. *If it sells its services at cost, or even a profit, the means of production employed in providing them still must have been*

⁷⁰ Robert Solow. 1992. *An Almost Practical Step Toward Sustainability*, p. 20.

⁷¹ Murray Rothbard. 1998 [1982]. *Ethics of Liberty*, p. 164.

appropriated by force. And even if it sells them at a subsidized price, aggression must continue in order to uphold the current level of production. ... It must be stressed that the state rests on an institutionalized appeal to motivational energies that people in their private lives would regard as criminal and accordingly would do everything to suppress⁷² (emphasis added).

Moreover, as noted above at several points, Solow's proposed use of an unchanging discount rate is a further assault on property rights. Scarcity necessarily implies that the rate of discount can never be administered at a rate below the market rate of interest as some theorists seem to suggest. To impose a lowered discount rate would mean that the rationing device of private property would no longer fully operative since such a rate could only be applied by a government having obtained resources through taxation or other type of taking. The notion that a lowered social discount rate should be employed in the name of intergenerational equity would also imply a public policy in which the time preferences of individual human beings would be overridden and private rights of property would necessarily be less secure.

IV. Concluding Comments

John Rawls outlined an interventionist investment 'ethic' intended to enhance the welfare of the 'least favored' generation. But John Hartwick and Robert Solow devise Rawlsian agenda intended to assure at least a 'constant level of consumption' for each generation but treat this goal very differently. Hartwick views consumption in more traditional terms as a goal achievable by government reinvestment of Hotelling rents which are supposedly reflected royalty receipts. On the other hand, Solow views 'consumption' in much broader terms to include benefit of what some would label environmental resources.

Hartwick's methodological errors include: (1) the assumption that Hotelling rents are an objective magnitude reflected in royalty receipts when, in reality, these rents are a subjective entrepreneurial reckoning that can only be made by property owners; (2) his assumption that the user cost associated with Hotelling rents are an external cost borne by society as a whole when, in fact, user cost is privately borne by property owners and serves as a private inducement for capital replacement; (3) the treatment of generations as actors when in fact only individual human beings act; (4) his use of aggregate production functions and his defining the capital stock as an aggregation of physical things; and (5) his injunction that Hotelling rents be invested in reproducible capital when in fact capital is never reproducible but only replaced on the bases of entrepreneurial judgments concerning the future of markets.

Ethical breaches in Hartwick's analysis arise from the fact that governments generally do not have a legitimate property claim to nationalized lands nor the royalties generated from these lands. Land ownership can only arise initially through acts of original appropriation. The collection of royalty revenues by governments is in fact a theft of private property. The additional ethical breach is that the leasing institutions employed by governments to collect royalties are a further assault on property rights, destroying any assumed equivalence between

⁷² Hans-Hermann Hoppe. 1989. *Theory of Socialism and Capitalism: economics, Politics and Ethics*. Boston, Massachusetts: Kluwer Academic Publishers, p. 164.

royalty receipts and what would otherwise be Hotelling rents.

Robert Solow's theoretical propositions for public policy on intergenerational equity evince the following methodological breaches: (1) NNP is itself a meaningless aggregation and even more of an absurdity when 'corrected' with theoretically correct shadow prices; (2) theoretically correct shadow prices are empty because they are reliant of the imputation of opportunity cost -- an epistemological impossibility; (3) Solow's 'broadly defined capital stock' agglomerates incommensurable that ignores the central importance of calculational reckoning behind any legitimate concept of capital; (4) the unchanging social rate of discount is premised on an interventionist political agenda; it has no legitimate existence beyond or apart from the interest rate of time that emerges in free markets; hence, it is subject of changes as preferences change; and (5) like Hartwick, Solow mistakenly treats society or generations as actors; these 'social aggregations' exist only in actions of individuals.

Ethical breaches found in Solow's prescription are similar to those found in Hartwick's analysis. They revolve around assault of private property. Specifically, the revenue required to maintain Solow's 'broadly defined capital stock' will, in effect, be confiscated private property in the form of tax receipts. To this extent, Solow's interventionist agenda is an illegitimate assault of private rights of property.