Research Article

What Went So Wrong in Economics

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What went so wrong in economics started in 1939 with 'The Hicksian Getaway,' where – after over ten years of debate assuming increasing returns – Hicks asserted decreasing returns as the basis for his competitive frame, dismissing any "useful analysis" of increasing returns. After winning the 1972 Nobel Prize for his 1939 work, Hicks (1977, pp. v-vii) apologized for 'The Hicksian Getaway,' calling it "nonsense" and "an indefensible trick that ruined the 'dynamics' of Value and Capital." After a series of failed attempts to integrate time into production theory, in 1958 Armen Alchian proposed a method to do so with nine propositions showing the relation of time to cost, which Julius Margolis (1960) extended into a horizonal theory of price. Jack Hirshleifer (1962) saw Alchian's (1958) frame as a threat to neoclassical theory, declaring his aim as "rescuing the orthodox cost function." 'The Hirshleifer Rescue' of decreasing returns was seamlessly folded into economics as a 'proof' that decreasing returns was "a general and universally valid law" of economics, according to Alchian (1968). The present paper debunks 'The Hirshleifer Rescue' to show the case for decreasing returns and competition rests on unfounded assertion, especially for all long-run analyses. The paper explores the implications of an increasing returns economy of complementarity and abundance in networks, with a case for efficient cooperation. The claims in Nicholas Kaldor's papers are thus extended into an integral theory of planning horizons, as a formalization of Herbert Simon's notion of bounded rationality. An increasing returns economics is a horizonal economics.

Introduction

Most economists see few problems with economics today, while many outsiders reject this subject as an abject failure due to corporate power abuse and harmful ecological impacts. How might we bridge this gulf of opinions?

We might look back a century to the collapse of Marshall's synthesis (Frisch 1950), starting with John H. Clapham's (1922) paper "On Empty Economic Boxes," which raised questions about how

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economics was done at that time. He argued we couldn't distinguish rising from falling costs in production, attacking the Pigovian classification of firms and industries by increasing vs. decreasing returns. Pigou (1922, pp. 134-35) responded that Clapham's "boxes" should be filled to help "expose the falsehoods of charlatanry..." Robertson (1924, pp. 144, 155-56; also 1930) posed two causes of "falling cost," due to fixed inputs or by invention and organization: "The sole and sufficient explanation... of increasing cost" stemmed from fixed inputs like land, though scarcity rents solved the problem (Knight 1924, Young 1913). Sraffa (1926, pp. 180-82, 194) then related the "laws" of increasing/decreasing return to aggregation and time, with increasing returns tied to narrow product domains and longer runs, supporting a view of firms in industry as "competing monopolies."[3]

Clapham's seminal paper started debates about costs, pricing, time, dynamics, increasing and decreasing returns. In the late 1920s, Alfred C. Pigou issued two papers on cost (1927) and supply (1928) declaring increasing returns as the rule, and calling decreasing returns not "admissible."[4] The ensuing debate focused on how to incorporate increasing returns into economic theory, yielding challenging insights that competition, equilibrium, stability, and many other favored economic conclusions cannot abide. This debate spawned new economics, including work by E.H. Chamberlin (1933), Joan Robinson (1933), John M. Keynes (1936) and many other economists. Some have quoted Wordsworth (1805) on what this moment was like: "Bliss was it in that dawn to be alive / But to be young was very heaven..." The field was open to new ideas, searching for resolution of fundamental issues in a flowering process of learning and growth. This fertile debate abruptly ended in 1939.

'The Hicksian Getaway'

That was the year that John R. Hicks published *Value and Capital* (1942 [1st ed. 1939]). In just a few pages, Hicks (1942, pp. 83-85) rejected increasing returns, saying they could not be developed into useful theory. "This getaway seems well worth trying" though "we are taking a dangerous step..."[5] Hicks then turned his attention to perfect competition, instigating an Age of Denial on increasing returns.[6] Seen in its context, 'The Hicksian Getaway' was a precocious move that committed economics to a terrible lasting error by endorsing decreasing returns. After the end of World War Two, Paul A. Samuelson (1947) published his *Foundations of Economic Analysis* that built the Hicksian frame into an equilibrium model of competition, followed by General Equilibrium (GE) theories by Kenneth J. Arrow, Gerard Debreu, Frank H. Hahn and many others, richly rewarded with Nobel Prizes. This is how an unfounded assertion became a rigid doctrine, with no enduring recognition that 'The Hicksian

Getaway' might be "a dangerous step" or even a costly and tragic mistake.[7] Curiously, even Hicks (1977, pp. v-vii) later apologized for 'The Hicksian Getaway' after receiving his Nobel Prize in 1972 "with mixed feelings" for this 1939 work, calling it "nonsense" and "an indefensible trick that ruined the 'dynamics' of *Value and Capital*."[8] But Hicks' admission came much too late, following a barrage of criticism against GE models,[9] so few noticed this retraction. A closer look at past attempts to bring time into production theory will be informative.

Attempts to Incorporate 'Time' into Production Cost and Pricing

The role of time in economics has been discussed since the field developed. We will start with Frank H. Knight's (1921, pp. 186-87) paper on "Cost of Production and Price over Long and Short Periods," where he explained that "given conditions" depend on the "time period" used, as "different changes take place at different rates..."[10] Knight's "main conclusion" in this paper presages Kaldor's (1934; also 1933-34) argument: "decreasing cost with increasing output is a condition incompatible with stable competition..." But dynamics were mostly shelved in these debates in favor of static constructions. In 1939 – the year of 'The Hicksian Getaway' – George J. Stigler (1939, pp. 305-8, 310-12, 318-21) published a paper on "Production and Distribution in the Short Run," exploring issues of fixed and variable costs, saying they cannot be defined with respect to time alone, because they depend on expectations about future prices and outputs. Stigler rejected short vs. long run notions for "continuous variations in the marginal cost curve from very short periods to full, long-run equilibrium ... defined for an interrelated range of prices." Such a conception, where "the marginal and other cost functions become surfaces" with respect to "a third axis, time," cannot be handled "by the use of plane geometry, since future prices are now important variables."[11] Consequently, any concept of time appended to cost theory would fall short in the face of variant expectations, evolving technology, etc. The notion was far too complex for geometric representation.

John Maurice Clark (1940, pp. 241-43, 246-50), a year later, echoed Stigler's claim in his 'workable' competition paper. Clark explained that "long-run curves, both of cost and demand, are much flatter than short-run curves" which serves "to mitigate ... the effects of imperfect competition." He suggested "the time dimension of these curves" could be analyzed with a third axis. However, due to interfirm repercussions and quality changes, Clark concluded that: "The whole functional relationship is probably so complex as to defy mathematical plotting."[12] Clark closed with a nod to interdependence, saying each of us affects one another in a continuous series of nudges. A proper

recognition of interconnectedness is part of a need for more realistic concepts of economic complexity. Fifteen years later, Clark (1955, p. 459) came back to the time-dimension of cost and demand, calling it still too simplistic for geometric construction, as it "leaves out of account ... that the effect of a given price ... on the volume of sales is a function, among other things, of the length of time ... it has been in effect." He added that these curves are "not fully reversible," that prices interact "with promotion [and] alterations of the product." Clark concludes that: "This complex of variables would overload any possible system of graphic presentation."[13]

Armen Alchian's (1958, pp. 3-21, 25-28) paper traced nine propositions on cost as a means to incorporate time into production in the sort of frame described by Stigler and Clark. Alchian tackled the problem as a relation of firms' "equity cost" to the volume, output rate and time periods of a production run. He argued that equity cost – namely, the impact on company value – was a way to incorporate actual long-term expectational factors into production decisions. Total equity cost (C) is a function of volume (V), output rate (X), production run length (m) and a planning interval (T), such that $\underline{C = C(V, X, m, T)}$. Alchian then transformed that cost relation into the form $\underline{A = A(V, X, T)}$, as V is the sum of X(t) over the interval $\underline{t = 0 \rightarrow m}$, allowing m to be dropped. Thus Alchian's propositions state that equity cost turns on how production runs structure volumes of output in time: more rapid output rates (X) for a given fixed volume (V_o) increase its cost, whereas more time (m, T) reduces its total and marginal costs of production. The key to Alchian's explanation is that a faster X for a given V_o means shortening m (and vice versa). With the key role of time, it is curious that Alchian dropped time (m) from his model. Interestingly, Alchian's model was seen as a threat to orthodox statics, in its suggestion that increasing returns would derive from augmenting V (given X_o) by lengthening m. Whether the marginal impact on equity cost (of raising output rate X for a fixed m_o) would rise or fall was left undetermined, due to Alchian's suppression of m in A(V, X, T). This was, of course, the critical question of increasing vs. decreasing returns, and whether the marginal or average cost curve for a unit of output – given a fixed production run length m_o – would or could turn upwards.

A Brief Introduction to 'Horizonal' Theory

Two years after Alchian's paper, Julius Margolis (1960, pp. 531-32) addressed "sequential decision making under ignorance" where "actions taken today alter tomorrow's information and thereby tomorrow's decisions," so the firm must be concerned not just with short-term profit but also with learning effects.[14] On this frame, Margolis traced the relation of prices to planning horizons in the

proper way, explaining why greater uncertainty will raise both fixed and variable costs along with markups to price (based on demand elasticity), yielding higher prices than would appear with a longer horizon, in its reduction of costs and markups.[15] Farrell's (1960, pp. 560-64) comment on this paper called "traditional theory ... perhaps the most satisfactory analytical tool the economist has yet produced." The "considerable achievements" of "perfect competition theory" offer a context "within which economists should view this specialized and novel research ... as attempts to extend the theory of profit maximization..." What Farrell missed is that profit maximization itself falls short with increasing returns; theories of organization and 'complex systems' supplant this approach with more realistic knowledge assumptions such as Margolis invoked with his planning horizons. One might recall Arrow's (1969, p. 495) remark that a theory of monopolistic competition "is forcibly needed in the presence of increasing returns and is superfluous in its absence." Without increasing returns, perfect competition models suffice; with increasing returns, social relations shift toward complementarity and positive feedback, calling for far more sophisticated theories of cost and pricing that depend on time and planning horizons.

Related themes of entrepreneurial learning had also appeared in Hirsch's (1952) paper on 'progress functions,' further developed by Arrow's (1962, pp. 155-56) paper on 'learning by doing.' Arrow began "with the obvious fact that knowledge is growing in time." Although assuming exogenous technical change is "hardly intellectually satisfactory," Arrow proposed two generalizations: (1) "Learning is the product of experience" and must involve doing; and (2) learning evolves by means of change.[16] These ideas simply extended Alchian's propositions, calling attention to learning and knowledge as a way to include technical change and dynamic complexity into costs. All set the stage for a horizonal breakthrough until 'The Hirshleifer Rescue' stopped this work in its tracks.

'The Hirshleifer Rescue'

That is the intellectual context of 'The Hirshleifer Rescue.' Stigler and Clark had judged time alone as insufficient due to expectations of future prices and the contingencies in all production and pricing, especially in a complex network, so using just time was an oversimplification. Margolis shifted the focus from external to subjective time with his planning horizon, in accord with Robbins' (1934, pp. 15-18) concern with anticipations and "estimates of the future" in his early definition of costs. Alchian's (1958) frame for this approach Hirshleifer (1962) saw as a threat to neoclassical theory. Hirshleifer (1962, pp. 235-38, 246) stated his goal as "rescuing the orthodox cost function," to show

"the classical analysis is consistent and correct." Hirshleifer added that there was "considerable empirical ground" for accepting "that marginal cost eventually begins to rise with proportionate expansion" of the rate and volume of output. Refining Alchian's frame by assuming $\underline{V = m_0X}$ to remove fixed time (m_0) from his analysis, Hirshleifer claimed decreasing returns "does indeed follow from the Alchian postulates."[17] This restriction, with $\underline{V = m_0X}$, tamed the problem enough for Hirshleifer to claim that unit costs will turn up eventually – under his reformulation as $\underline{H = H(V, X, T)}$ – warranting "the powerful logic of the law of diminishing returns." 'The Hirshleifer Rescue' reinforced 'The Hicksian Getaway' in reviving the case for decreasing returns.

Walter Y. Oi's (1967, pp. 590, 594) paper on "The Neoclassical Foundations of Progress Functions" dismissed Arrow's call to include 'technical progress' in theories of growth, seeing progress functions as a dynamic concept with "no place ... in the static analysis of neoclassical theory," except in "the inter-temporal planning of production." Relying on two other writings, Hicks' *Value and Capital* (1942) and Alchian's (1958) propositions as recast by Hirshleifer (1962), Oi concluded that learning, technical change and other horizonal notions can be ignored in neoclassical theory, as such dynamic elements were already in the Hicksian framework – confirmed by Alchian and Hirshleifer – as intertemporal production functions. Because "the neoclassical concept of factor substitution is ... obliterated by turning to progress functions,"[18] Oi rejected this approach, saying "learning, experience and [scale] economies" are already included in our theories of production. The Hicksian model is thus sufficient: "To sum up, a dynamic theory of production along the lines of Hicks provides us with an essentially neoclassical explanation for progress functions.[19] ... To attribute productivity gains to technical progress or learning is, I feel, to rob neoclassical theory of its just due."[20] Recall Arrow's (1969, p. 495) remark that decreasing returns makes any consideration of learning and technical change "superfluous," while increasing returns makes them "forcibly necessary." 'The Hicksian Getaway' and 'The Hirshleifer Rescue' were to prevail, as learning and planning horizons were already embedded in neoclassical statics despite Hicks' rejection thereof. Dynamic concerns were not part of neoclassical theory in its static representations of competitive equilibria.

Decreasing Returns as a "General and Universally Valid Law"

In his subsequent essay on "Cost" for the *International Encyclopedia of the Social Sciences*, Alchian (1968, pp. 319-20), based on Hirshleifer's argument, declaring decreasing returns "a general and universally valid law" of economics, saying that "average cost will, beyond some output rate, begin to

rise persistently and with increasing rapidity..."[21] But this finding conflicts with Pigou and other 1930s arguments for increasing returns. 'The Hicksian Getaway' had just been asserted against a long-prevailing acceptance of increasing returns. Thus, in 1968 – 40 years after Pigou's 1928 paper – economists were relieved to have solved the imbroglio over increasing returns. 'The Hirshleifer Rescue' of equilibrium models seemed to show these static cost curves turning upward (for rising volume and output rates on a fixed horizon), excusing economists from any further heed to increasing returns, learning, growth, technical change or planning horizons in theories of production cost, market demand and the pricing of output. An Age of Denial about increasing returns was thus perpetuated.

Ralph Turvey (1969, pp. 285-88) summarized this series of papers, observing that the "traditional analysis" of fixed and variable factors as a way to distinguish short- from long-run theory "attempts to deal with time – with the length of runs – without adequately incorporating a time dimension." He added that ambiguities in the theory of cost "are dealt with very elegantly by Walter Oi in his recent Hicksian extension of the traditional analysis to a multi-period production function." On this basis, Oi "asserts the existence of two kinds of economies: economies of later delivery and economies of integrated output programs," standing on Alchian's nine propositions. Turvey concluded that the "multi-dimensionality" of marginal costs and time must be included in our theories, especially in the presence of dynamic uncertainty. He said "the definition of marginal cost as the first derivative of cost with regard to output is too simple to be useful," and called for "historical dynamics, not comparative statics."[22]

The ultimate outcome was that 'The Hicksian Getaway' and 'The Hirshleifer Rescue' achieved a status of General Laws. Economists simply accepted neoclassical theory: everyone now knew that average and marginal cost curves turned upward for high enough volumes and output rates. No further regard was paid to increasing returns, at least until a storm of critiques appeared from Martin Shubik (1970), Janos Kornai (1971), E.H. Phelps Brown (1972) and Nicholas Kaldor (1972, 1973, 1975).[23]

"A Winter of Discontent"?

How did mainstream economists respond to these attacks? Hahn (1973) reviewed Kornai's book in "The Winter of Our Discontent," offering a psychological explanation based on age, bitterness and disappointment with the narrow rigor of orthodox economics. Calling Kornai's "one of the few grammatical voices ... amidst [this] noise," he seized "the opportunity to proceed with a coherent

discussion." Hahn called for a sharper focus on "whether General Equilibrium Theory (henceforth GE) is a dead end or not" (which is what Shubik called it), defending this "intellectual experiment" as "of very great practical importance" by clearly showing the specific conditions for a competitive equilibrium are totally unrealistic and false.[24] Hahn (1981, pp. 126-27) criticized the Chicago School for taking the theory of competitive equilibrium "a good deal more seriously" than it deserves, adding that the strongest critiques of GE theory have come from the GE theorists themselves.[25] But Hahn's admission seems a peculiar retreat from pushing equilibrium models as the apex of economics, deeming them 'useful' as a dead end because their very unrealism revealed "what the world would have to look like if [GE were] true" as "the most potent avenue of falsification…" Had that been the original aim of the effort, none would truly object. But these economists saw GE as the *only* acceptable way to frame economic phenomena, in the spirit of Alchian's "general and universally valid law … of diminishing marginal returns" from which any departure – at least in the University of Chicago's graduate program – is "penalized as evincing failure to absorb training."[26]

Arrow (1974, pp. 26-29) made an oblique reference to these controversial issues in his lectures on organization, during this flood of critique, with no explicit mention of increasing returns. He called 'conscience'[27] "essential in the running of society," but as "we cannot know all the effects of our actions on all other people" (due to bounded rationality), we must "limit our … responsibility to others" for "effective action" or "cooperation." He offered his thoughts on social agreements – which conjure up 'The Hicksian Getaway' as a profound error – noting that "agreements are harder to change than individual decisions," especially when many have committed to them. "What may be hardest of all to change are unconscious agreements … whose very purpose is lost to our minds," especially when they "involve much sacrifice and a very great depth of involvement." In the full critical context of the early 1970s, it is hard to believe that Arrow was not referring to decreasing returns. He went on to express stronger concerns that, even when experience shows a need for change, "the past may continue to rule the present" in a manner that "gives rise to the greatest tragedies of history" through a sense of commitment that "reinforces the original agreement precisely at a time when experience has shown that it must be reversed." Whether Arrow is speaking of 'The Hirshleifer Rescue' cannot be known, but his comments surely fit this scenario.[28] This is also at a time when Arrow was supporting the work of Brian Arthur on increasing returns. But the real question here is how open economists are to "recognizing past errors and changing course"?[29] 'The Hicksian Getaway' was a disastrous misstep in the history of 20th-century economics, though it is not yet fully

recognized as such. Hahn had said that the most articulate critics of GE theory are its own architects, of which Arrow was an intellectual leader. As it turns out, 'The Hirshleifer Rescue' of the case for decreasing returns is also incorrect.

Emerging from an Age of Denial

Recall Alchian's (1958) argument that total equity cost C is related to V (production volume), X (the rate of output), m (the production run length) and T (a planning interval), so $\underline{C = C(V, X, m, T)}$. Alchian's nine propositions state that cost depends on how production runs structure volume with respect to speed vs. time: higher output rates (X) for a given volume (V_0) increase its cost, whereas taking more time (m) reduces V_0's cost of production. The key to Alchian's story is that a more rapid X for a given V_0 involves shortening m, inviting Hirshleifer's simplification of $\underline{V = m_0X}$, so V and X shift in the same proportion for any fixed run length m_0. The key to 'The Hirshleifer Rescue' is an argument that – within this frame – marginal cost with respect to output rate X turns upward, justifying "the powerful logic of the law of diminishing returns" which Alchian (1968) later accepted.

Why might all of this matter? The question of how we do economics stands on decreasing vs. increasing returns. An Age of Denial started by Hicks in 1939 is exemplified by Waldrop's (1992, p. 18) anecdote about a luncheon at UC-Berkeley with Brian Arthur's mentors and colleagues. Tom Rothenberg asked his former student about his work. When Arthur answered "increasing returns," they erupted with laughter. The department chair responded that "we know increasing returns don't exist" at which point Rothenberg jumps in with "if they did, we'd have to outlaw them!" And they all laughed. Arthur was crushed that his respected teachers just "couldn't listen."[30]

The justification for the neoclassical argument – the competitive frame based on decreasing returns, substitution and scarcity – stands on 'The Hicksian Getaway' and 'The Hirshleifer Rescue.' Hicks has since retracted his 'getaway' while I found Hirshleifer's 1962 paper to be the only technical argument for an upturning cost curve in the literature of economics, so I scrutinized his reasoning. If Hirshleifer's claim were wrong, if increasing returns were indeed a general long-run truth, equilibrium models are irrelevant (as Kaldor opined) as explanations for more than short-term phenomena. If all long-run cases show increasing returns, no enduring competitive equilibria are "admissible" (Pigou 1928, p. 256; also cf. Knight 1921, Kaldor 1934). A close scrutiny shows that 'The Hirshleifer Rescue' is as unjustified as was 'The Hicksian Getaway.'

Debunking 'The Hirshleifer Rescue'

That Alchian and Hirshleifer removed time (m) from their cost functions based on a relation of volume (V) and output rate (X) raises an issue of framing. As Arrow (1982, pp. 5-7) explained, how we represent any problem matters if "extensionality" cannot be assumed. If reframing alters perceptions and thus decisions, "the framing of the question affects the answer."[31] In a world of perfect knowledge, free attention and full information, the way we express economic concepts should not affect results: extensionality holds. But with incomplete knowledge, limited foresight and bounded rationality – where theory entails selective focus and attention is scarce – how we frame things shapes understanding and may blind us to relevant truths. Some insights stay invisible from a single vantage yet are transparent from some other. Selective focus is also restrictive blindness. The opportunity costs of what we do or how we think are always unknown to us (cf. Jennings 2022b). This is a case for open-mindedness and for pluralistic approaches (Jennings 2007a, 2022a). It is also how we avoid "the greatest tragedies of history" against which Arrow warned, and to favor resilience in our academic outlooks.

If one examines the Alchian-Hirshleifer frame – Alchian's (1968, p. 320) claim that "an increase in ... rate ... [and] volume ... work in opposite directions" along with Hirshleifer's (1962, pp. 235-36) comment that V is a stock and X is a flow while joining them anyway into his H(V, X, T) – one wonders why the two stocks (V and m) were not retained by dropping output flow rate X instead of suppressing m. The variable $\underline{X = V/m}$ (in Hirshleifer's frame) interacts with V in an odd way; restating cost as J(V, m, T) (Jennings 1985, ch. 5; 2015b) unlocks the issue. Instead of fixing $\underline{m = m_0}$ (Hirshleifer), using V = mX to convert Alchian's function $\underline{C = C(V, X, m, T)}$ into my form of $\underline{J = J(V, m, T)}$ allows V to change through m and/or X. Joining V to m and T yields a function based on stocks (with X as the flow removed), and makes time (m) explicit so the expression $\underline{H_t = m+T}$ becomes an agent's time horizon. Hirshleifer's suppression of time screens the impact of run duration on his findings, while framing the issue as $\underline{J = J(V, m, T)}$ allows a view of how Alchian's assertion (that $\underline{A_{xx} > 0}$) rests wholly on temporal length.

Hirshleifer claimed that dH/dX for any m_0 (where X shifts in proportion to V)[32] eventually must rise, because $\underline{d^2H/dX^2 = H_{xx} + 2mH_{xv} + m^2H_{vv}}$ is dominated by $\underline{H_{xx} > 0}$, while the other two negative terms are bounded above by zero (with H_x and H_v positive) as V and X rise together. Hirshleifer based the positivity of H_{xx} on Alchian's $A_{xx} > 0$. But Hirshleifer's d^2H/dX^2 does not limit to positive values as X is

increased without limit, under Alchian's propositions. Furthermore, thinking of $V = mX$ suggests another related advantage of framing with m and not X. A rise in X for a given V_0 – Alchian's version – reduces m. My revised functional form with $J = J(V, m, T)$ allows an increase of V via m and/or X (so dm/dV can appear anywhere on the interval $0 \leq dm/dV \leq 1/X$).[33] Raising X for any V_0 occurs by shortening m, which is obscured in Hirshleifer's version. Time should be placed at the center of focus and not out of view. As Arrow (1982, pp. 5-7) said, framing affects our findings.

Hirshleifer's claim (that d^2H/dX^2 will limit to positive values as V and X rise in proportion for a fixed m_0) requires that J_{vv} turn upward, because $d^2H/dX^2 = m^2J_{vv}$ if $V = m_0X$. Hirshleifer based his claim on the dominant role of H_{xx}, as the negative terms (H_{xv} and H_{vv}) limit to zero as V and X rise. Restating this claim with $J = J(V, m, T)$ is informative. Converting Alchian's $A_{xx} > 0$ into Hirshleifer's version makes $H_{xx} = (m/X^2)(mJ_{mm} + 2J_m) > 0$ which holds at all levels of V and X (with $J_{mm} > 0$ and $J_m < 0$). But this means that H_{xx} for a given V_0 (Alchian's case) gets *smaller* as X increases since m is shrinking as well, implying $J_m < 0$ may dominate as $H_{xx} \rightarrow 0$ when X rises and m shrinks without limit. In any event, reframing the issue as $J = J(V, m, T)$ shows that *dH/dX cannot increase without limit for rising X and V in proportion*.

Hirshleifer argued that d^2H/dX^2 will be limited to positive values. For all X, $H_{vv} = J_{vv} + 2J_{mv}/X + J_{mm}/X^2 < 0$. The higher X gets, the less will be the influence of the last two terms ($J_{mv} < 0$ and $J_{mm} > 0$), which forces J_{vv} to turn *negative* as X increases. If so, $dH/dX = mJ_v$ cannot "begin to rise persistently and with increasing rapidity" for high levels of X and V, which Alchian (1968, pp. 319-20) deemed "a general and universally valid law." As $d^2H/dX^2 = m^2J_{vv}$, neither can Hirshleifer's marginal cost turn upward: the limit (as X and V rise together) of $d^2H/dX^2 < 0$, implying a case for increasing returns.[34] In sum, the higher is X, the more dominant is J_{vv} over H_{vv}, which must be negative for all levels of V, m and X. In the limit, as X rises, $J_{vv} < 0$. Since $d^2H/dX^2 = m^2J_{vv}$, this makes Hirshleifer's proof false. The marginal cost for rising output on a given horizon cannot increase (even 'eventually'); unit cost falls, as A.C. Pigou, Nicholas Kaldor and Allyn Young taught us so long ago.

The suppression of time in the Alchian-Hirshleifer model obscures its role. With a form of $J = J(V, m, T)$, the impact of m on H_{xx} is more readily seen. Why was this specious argument not disproved long ago? My Ph.D. dissertation (Jennings 1985, pp. 99-101; also cf. 2015b), after reviewing a complex version of this disproof, finished the argument thus: "Hirshleifer's 'rescue' does not really follow from Alchian's statements at all"; it "is a *non sequitur*" whose "status reduces to simple assertion"

that "flies in the face of an evident fact: unbounded increasing returns." After a "brief review" of the issue, I said "this grievous mistake" has deferred the inclusion of "learning by doing and technical change into cost and price theory" along with planning horizons as a workable concept of time. "Hirshleifer's central contention could not have been checked very closely," which "carelessness ... is appalling, with how much we rest on this claim."[35]

A Methodological Lesson

This situation invokes a disagreement between Karl Popper (1963) and Michael Polanyi (1958) on the nature of scientific commitment. Recall Arrow's (1982, p. 7) rejection of extensionality: "framing ... affects the answer." How we think can matter in decisions. The first step in the Hirshleifer argument, where $\underline{H_x = -(m/X)\, J_m > 0}$, shows the positivity of H_x stems from declining m (because $\underline{J_m < 0}$ for any given V_o), stressing its pivotal role, meaning this alternative form – that should have been tried – was not considered, as the very first step points to time.

There is a methodological lesson here: Karl Popper (1963) claimed academic integrity rises from the self-policing character of 'conjecture and refutation.' He saw scientific inquiry as self-correcting by attempts to refute what is known,[36] thus guarding our views against denial and dogma. But statements cited already imply an economics resistant to 'refutation' without justifying this stand. Dennis Mueller (1984, p. 160) opined "neoclassical economics reigns supreme, not because it refutes challenges to it, but because it ignores them." The responses that there are "no credible rivals" (Hahn 1973, p. 129) or "no satisfactory alternative to neoclassical theory" (Hart 1984, p. 189) are neither reasonable nor true. Herbert Simon (1979, p. 510), in his 1978 Nobel lecture, responded: "...There is an alternative. If anything, there is an embarrassing richness of alternatives." Peter Earl (1983, p. 121) called Kuhn's (1962) notion that senior scientists must die off for any successful reform an "entirely reasonable" attitude, though it clashes with Popper's self-policing image of science.

Popper's benign depiction should be rejected, due to an intolerant control to enforce neoclassical doctrine.[37] If Popper is wrong about science, his view must be replaced by Michael Polanyi's (1966, pp. 78-79) less fantastic conception of how research is pursued. He argued that science and discovery entail "a passionate commitment to a particular view" which allows scientists to "discover the evidence that supports it."[38] Polanyi's depiction also explains how wrong ideas can gain currency among advocates who guard their human capital against challenge. Rivalries in academics suggest

part of the problem. Maintaining that an Old Guard must die off for any reform is tantamount to admitting that academics is not about learning but devoted to protecting an orthodox view against innovative vitality. The prime directive of any organization – of institutions or intellect – is self-preservation (Selznick 1948, pp. 268-70; Katz and Kahn 1969, pp. 97-98). In rivalrous settings, opposition is the game and victory is the goal. Stubbornly clinging to an orthodoxy is a manifestation of rivalrous systems applied where they have no place, since learning involves complementarity (e.g., cf. Boulding 1962, pp. 133-34; Jennings 2007a, 2022b). The costs of 'The Hicksian Getaway' as wrongly reinforced by 'The Hirshleifer Rescue' are an Age of Denial against the role of increasing returns in all long-term production, and therewith against a proper recognition of complementarity as an overall long-run characteristic of economic relations (cf. Kaldor 1975, p. 348).

A Reformulation of Cost Relations into a Horizonal Theory of Price

The final step for revising 'The Hicksian Getaway' and 'The Hirshleifer Rescue' is a conversion of J(V, m, T) into M(Q, H). The Alchian/Hirshleifer refutation calls for reframing cost and price theory on horizonal grounds, in line with Margolis' (1960) claims. A monopolistic competitive frame with increasing returns is "forcibly needed" and not "superfluous," according to Arrow (1969, p. 495). Stating J(V, m, T) in horizonal terms shall open new views of pricing. The conversion is based on $\underline{Q = V/H_t}$ with $\underline{H_t = m+T}$,[39] where, as $\underline{dm/dT = -1}$ for fixed H_o, marginal cost $\underline{M(Q, H_t) = dJ/dV = J_v(V, m, T)}$. The first partials of $M(Q, H_t)$ are $\underline{M_Q = HJ_{vv}}$ and $\underline{M_H = QJ_{vv} + J_{vm} < 0}$, where the demand curve Q(P) is a function of H_t and thus H* (an agent's planning horizon). Here, J_{vv} and thus M_Q can exceed zero but only if J_{vv} is less than $\underline{-(1/Q)\ J_{vm} > 0}$, implying the upper bound of J_{vv} as Q rises for any H_o is zero, unlike Hirshleifer's claim. If rising costs are "excluded completely" (Pigou 1928, p. 253), increasing returns rule, with $\underline{M_Q < 0}$. If so, the slope of the marginal cost curve (M_Q) is strictly bounded above by $\underline{-(H/Q)\ J_{vm} > 0}$.[40] The general point, as the difference of decreasing from increasing returns is a matter of run length or time (planning) horizons, the sign of J_{vv} is a negative function of H*. For short/narrow horizons, no one rejects decreasing returns; the argument here is that for all longer/broader horizons H*, production occurs with increasing returns. This, in turn, carries many important implications about the role of complementarity in economic relations.

So we end with marginal costs M(Q, H) that may rise in short-run cases but fall in all long run cases with horizonal growth.[41] The time horizon H_t is distinguished from the planning horizon H*. The time

dimension of foresight is subsumed within a knowledge of all aspects (social, physical and ecological) of our radiant impacts. Substituting H* for H_t yields an ethical theory of conscience, what Arrow (1974, p. 27) defined as "a feeling of responsibility for the effect of one's actions on others" (cf. Jennings 2007b). As Herbert Simon (1983, p. 107) put it so well at the close of his *Reason in Human Affairs*, what we must do is to "broaden human horizons so that people will take into account ... a wider range of consequences" which will allow us to live "in a harmonious way with our total environment."[42] These remarks do not denote an economics of substitution, or one upholding acquisitive values; they outline a more benevolent vision on an alternative frame of planning horizons, complementarity and generosity. This is a different story than neoclassical economics supports, that we economists should develop.

The question of where a horizonal economic analysis points is open to further research. The lamentable state in which economics finds itself emerges from an unjustified commitment to decreasing returns supported by 'The Hicksian Getaway' and 'The Hirshleifer Rescue.' Once these obfuscations are replaced by increasing returns, inquiries should open to a diversity of approaches. One developmental direction appears in the pricing decision.

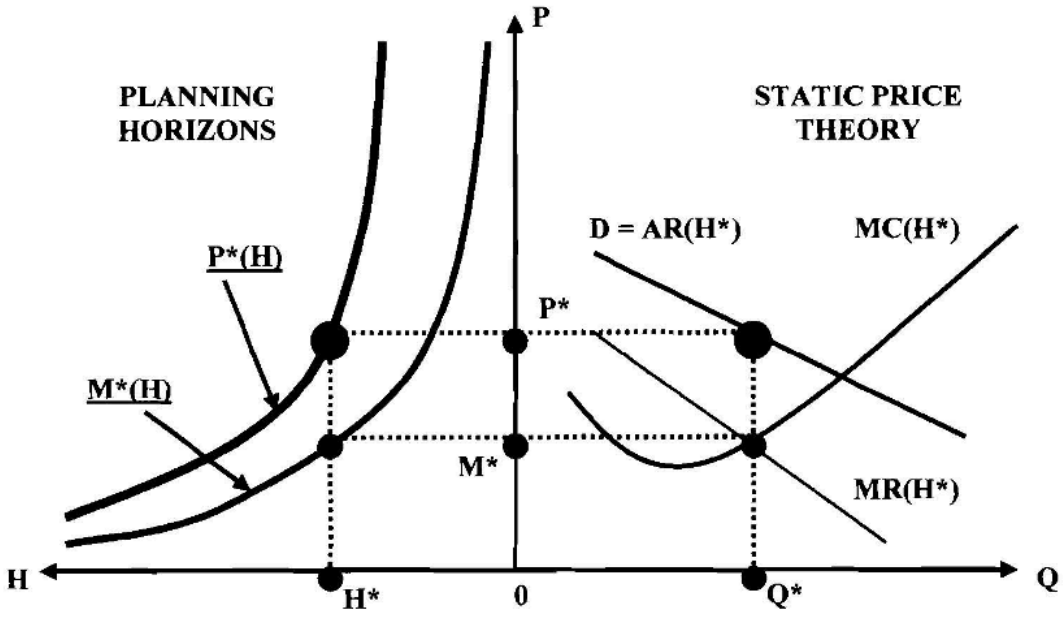

Figure One: Static and Horizonal Pricing

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The first-order condition for a maximum-profit price P* can be expressed as $\underline{P^* = M^* \times E^*}$[43] where all three terms are functions both of Q and H. Given the relationship of P* to H*, any analysis of a pricing decision that does not specify its horizon is simply incomplete. A graphical representation of the horizonal aspects in any individual price is shown in ***Figure One***.[44] But this figure only refers to individual price-setters, acting in isolation. Since we all interact, these connections should be embraced. Further, in network contexts, we cannot use the 'industry' dodge, which packages an institutional answer into how this question is framed with its substitution assumptions. In all such interdependent domains, substitutes balance with complements. We need to address such interactivity.

A Return to Nicholas Kaldor's 1975 QJE paper and the Problem of Interdependence

Fifty years ago, Nicholas Kaldor (1972, 1973, 1975) published three papers endorsing increasing returns that dismissed equilibrium models as "irrelevant" depictions of economic activity. Kaldor (1972, p. 1240) called for "a major act of demolition … destroying the basic conceptual framework" as a means to "make any real progress" in economics.[45] Kaldor (1975, pp. 347-48) tied increasing returns to complementarity, deeming the latter "far more important" than substitution in an economy.[46] These papers were mostly ignored, though they indicated that a nondecomposable balance of substitution with complementarity in networks could serve as a foundation for a complex pricing analysis. Kaldor's papers pointed to the importance of complementarity.

Dealing with Complex Interdependence

In transportation networks (Jennings 1985, 2006), interdependence is characterized by a nondecomposable, complex tangle of substitution with complementarity. One can see this in the difference of parallel lines from end-to-end ties based on travel direction. Imagine four rural towns in a square, linked by four rail lines. Counting clockwise from the NW corner, the towns are ***A, B, C, D***. What is the relation of lines ***AB*** (north) to ***BC*** (east)? Are they substitutes or complements? This is like comparing beer vs. wine to beer and pretzels in a consumer economy, but also with falling costs. For parallel lines – substitution – standard models apply. But end-to-end mergers of complements flip the effects of collusion; complementarity calls for cooperation to internalize positive feedbacks. The

nature of interdependence shapes how economic integration impacts prices. Whether ***AB*** and ***BC*** are rival or joined turns on the direction of travel: between ***B*** and ***D*** they are substitute routes, but between ***A*** and ***C*** they are complements.

With traffic going in both directions, these two routes are inextricably entwined in a nondecomposable tangle (Jennings 2006).

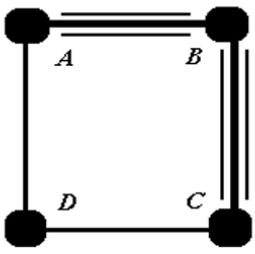

Figure Two

In this situation, individual entities affect others in diverse ways; substitutes have different preferences for pricing when compared to complements. Substitutes seek a higher price, while complements want it reduced. The net effect can be expressed as the difference between the own-profit maximizing price P* and the joint-profit maximizing price P′ for that good within some surrounding group. Think of a compensation process that internalizes pecuniary externalities from the price-setting process (Hicks 1939, Kaldor 1939).[47] The net interdependence of any group with respect to one member thereof, for a pricing decision, becomes $\underline{S_I = P' - P^*}$ which can be either positive (net substitution with $S_I > 0$) or negative (net complementarity with $S_I < 0$).[48] This is a proper method for the aggregation of firms or products. In any transactional context, there is a tangle of both social relations in some sort of balance: substitution calls for rivalry while complementarity wants collusion. Resolving this imbroglio requires a horizonal lens. This scenario unfolds in the following way.

Introducing Horizon Effects

The interdependence of any social system involves just such a balance, in which spillovers of costs and benefits are nondecomposably intertwined. We need to ask how horizon effects (ordinal shifts in planning horizons, private or social) tip that balance. The question has a general answer. If private horizon effects are socially contagious – namely, if private and social horizons shift together in most cases – then horizonal growth will move that balance from substitution to complementarity, while horizonal shrinkage does the opposite in any context: $\underline{dS_I/dH^* < 0}$.[49] A mutual lengthening of horizons shifts our relations from substitution ($\underline{S_I > 0}$) toward complementarity ($\underline{S_I < 0}$).

In this sense, horizon effects mimic complementarity and increasing returns in their economics and welfare results. Such is true even with short-run rising costs (decreasing returns). In the long run,

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horizon effects will matter and interhorizonal complementarity (contagious horizon effects) will have some meaningful implications. Kaldor (1975, p. 348) regarded falling costs as sufficient to make complementarity "far more important" than substitution. But even under decreasing returns, interhorizonal complementarity yields the same result: longer horizons favor relations based on complementarity, shifting efficiency attributes from competition to cooperation.

If so, then as social horizons extend, our institutional systems need to evolve from rivalry toward collaboration to foster economic growth and social welfare. Dogmatic allegiance to competition as efficient rests on substitution; standard neoclassical theory has no relevance to complementary settings: its central propositions are wrong and harmful in such applications. Kaldor's (1975, pp. 347-48) insights on complementarity imply that competition detracts from output, welfare and horizonal growth by yielding and maintaining a self-destructive and dangerous myopic culture. The diverse symptoms of organizational stress due to erroneous models of social structure show in narrow perspectives, fragmentation, disengagement, and other signs of higher-order need deprivation in Abraham Maslow's (1954, 1968) sense of that term (cf. Argyris 1971, McGregor 1971).[50]

The Opportunity Costs of 'The Hicksian Getaway'

Kaldor's 1975 paper was called "What Is Wrong With Economics"; he was not asking a question but making a statement. The present paper does the same; it extends Kaldor's claims into a horizonal framework where planning horizons and horizon effects play a lead role in an argument defined by Margolis as well as by Knight, Stigler and J.M. Clark.[51] The entire economy is driven by horizon effects, for better or worse. A new 'horizonal' understanding would have emerged in the 1940s and 1950s but for 'The Hicksian Getaway,' and from Alchian's 1958 paper but for 'The Hirshleifer Rescue.' These diversions shunted us into decreasing returns suppositions.

Our price system is horizonal, as is the nature of social relations, since $dS_I/dH^* < 0$. Horizonal growth tips our interdependence away from conflicts to concerts of interest, which calls for an institutional shift from rivalrous systems to cooperation to reflect the closer alignment of social linkages. Without such a transformation, horizonal growth is stifled. Competitive frames in complementary settings instantiate a harmful myopic culture of denial exhibiting pathological symptoms of Maslovian need deprivation notable all around us.

One reason for this pattern arises from the nature of horizonal growth. Longer and broader horizons stem from knowledge acquired through education. However, information exchange is a complementary process. Competition is counterproductive in complementary settings, stifling output and learning by denying any open sharing of content. Further, rivalrous educational efforts inculcate a fear of error, so also a fear of learning. This is how competitive frames spawn a myopic culture redolent with denial. Economists' rationality claims displaced a need for Simon's notion of bounded rationality, formalized here as horizonal pricing in network contexts. This is where neoclassical theory went so wrong. The impact of a myopic culture is seen as a source of social ills. The symptoms of higher-order need deprivation and organizational stress due to a wrong competitive model applied in complementary settings show in short horizons, fragmentation, disengagement, materialism, strife and other cultural limitations on social behavior. Such symptoms are not human nature; they reflect how we have framed our social institutions.

Injecting a proper notion of time into economics is only a start. Time horizons are part of planning horizons as an index of bounded rationality. Every decision reflects an agent's planning horizons in the range of imagined projections of outcomes on which we act. Horizon effects – ordinal shifts in conscience – are socially contagious. Interhorizonal complementarity adds a new form of linkage to cross-elasticity measures. We need to understand how horizonal aspects shape our social behavior. Economic growth is driven by horizon effects, not materialistic conceptions. The system moves on cognitive factors based on knowledge. We need a new horizonal economics.

Summary and Conclusions

The 1930s debates were formative. A post-Marshallian synthesis started with Clapham's (1922) seminal paper. Pigou (1927, 1928) then endorsed increasing returns as a universal truth, rejecting decreasing returns as in no way "admissible."[52] The field opened to new ideas in an effort to resolve fundamental lacunae in a flowering process of growth. Assumptions were raised and debated in conversations sweeping through economics. Refining boundaries in the field absorbed economists through those years, until 1939 and the brutal onset of World War II. That interruption was tragic; it ended the discussion and drew attention from all that was learned. Unresolved issues faded from view. After the war we economists sought to move forward, beyond the irresolution of that turbulent time. Hicks (1942 [1st ed. 1939]) pointed the way; then Samuelson (1947) seized the opportunity, as Arrow and friends (1954, 1971) were duly followed by other GE theorists, with many Nobel Prizes bestowed.

The opportunity cost of this selective focal attention offers a challenge to our imagination (Jennings 2022a).

Opportunity costs stay unseen, as the worth of what we forego. Options spurned through choice are Roads Not Taken, forever lost. The theoretical innovations that might have flowed from more realistic conceptions stay unknown. The 'alternative fields' of institutional, ecological, social and cultural economics show how work could proceed with increasing returns (cf. Jennings 2015a, 2022a). Additional books by Schultz (1993) and Arthur (1994) and some edited volumes (Buchanan and Yoon 1994; Heal 1999) suggest additional insights, but the horizonal implications remain largely undeveloped. 'The Hicksian Getaway' and 'The Hirshleifer Rescue' imbued a rigid dogma with a false scientific credential at the expense of further research. The fragmentation of economics is one severe result, due to competitive frames standing on decreasing returns.

Instead of embracing complementarity, increasing returns and network analysis, static constructions still litter the field. Instead of addressing chaotic complexity in its unfolding cumulation, narrow equilibrium models steer us away from pressing concerns. Instead of forcing economists to admit that choice is indeterminate, a positivist definition of 'science' calls prediction the only acceptable test for economic claims (Friedman 1953). Instead of framing conscious awareness into our models of human decision, economists tend to flee from bounded attention into rational expectations, perfect knowledge and full information.[53] Suppositions specify the conditions under which findings apply: any unrealism muffles the applicability of results so derived (Jennings 1968, ch. 1), costing us understanding. This is also a reason why Friedman's (1953, p. 14) claims about unrealistic assumptions impose such a cost on real decisions by distorting our understanding on which we try to make sensible choices.[54]

The world is one of increasing returns save for short-term, partial analyses. Economic constructions standing on decreasing returns cannot be used to guide ongoing decisions; they will squander resources. Assumptions should fit to prevailing conditions for reliable outcomes. Otherwise, we run a risk of 'knowing not what we do.' A good example lies in the errors stemming from 'The Hicksian Getaway' and 'The Hirshleifer Rescue.' And if education is a complementary process, substitution does not apply: competition fails in this setting. Cooperation is needed in the presence of complementarities implied by increasing returns. If the latter will make "complementarity … far more important" than substitution in economics (cf. Kaldor 1975, p. 348), the case for competition collapses.

Rivalries in academics are counterproductive in the presence of complementarities spread throughout education. The failure reaches from theory into our institutional frames. This is the flaw in Friedman's case for unrealistic assumptions. The failure of economics to embrace both forms of interdependence in some sort of balance has shunted our understanding even without including planning horizons (H*). With marginal cost recast as M(Q, H)[55] – where $\underline{M_H < 0}$, and $\underline{M_Q > 0}$ *only for short horizons* which, extending, turn $\underline{M_Q < 0}$ – the case for increasing returns and complementarity is confirmed. Interhorizonal complementarity also reinforces such claims.

Your planning horizons interact directly with mine: horizon effects spread contagiously. When I become more predictable in my decisions, you can plan better too; we are all disturbance terms in each other's environments. If I 'lose my cool' and my confidence in what I know – or if my environment grows less stable – the shrinking of my horizons will likely influence yours. Horizons shift together; private horizon effects induce similar social effects. The complementarity of horizon effects appears in many realms unexplored by economists. These are but a few indications of novel research opportunities stemming from planning horizons and their economic effects.

The persistence of substitution and decreasing returns – of 'The Hicksian Getaway' and 'The Hirshleifer Rescue' – will offer reasons why departures are needed. Horizonal economics will open new realms of economic effects (Jennings 2016ab). There is work to be done to repair our false suppositions, to revise 'habits of thought' (Veblen 1898) and some very long-held beliefs. So once again, by instigating a new conversation – with open minds and a thirst to learn – will there be another formative moment in economics to come? One can only hope...

Footnotes

[1] Almost 50 years ago, Nicholas Kaldor (1975) published a paper entitled "What Is Wrong With Economics." There was no question mark at the end of his title. Kaldor was not asking a question; he was making a statement. There is no question mark at the end of the title for this paper either, which extends Kaldor's 1975 arguments. The mathematical footnotes to follow come from Jennings (2015b).

[2] Nicholas Georgescu-Roegen 1970, p. 9.

[3] For some of the additional participants in the 1930s debates, cf. Harrod 1930, 1931, 1933; Austin Robinson 1934; Schumpeter 1928; Shove 1928, 1930, 1933; Sraffa 1926, 1930; Viner 1931 and Young 1928, but this is just a selection from a large number of papers.

[4] Pigou (1927, p. 193) said that "it is *impossible* for production anywhere to take place under conditions of increasing costs." Consequently, on p. 197, Pigou concluded that "*cases of increasing costs ... do not occur*." A year later, writing on "An Analysis of Supply," Pigou (1928, pp. 252-53) reinforced this view in even stronger terms than before:

> *...An increase in ... scale ... in general diminishes the average (and marginal) costs of the equilibrium firm... ...The law of decreasing supply price ... is not merely formally possible, but is likely... ...In actual life an industry ... cannot conform to the law of increasing supply price ... Therefore ... the law of increasing supply price ... is excluded. From a cosmopolitan point of view it is excluded completely.*

The implication, for Pigou, on p. 256, was that "supply price cannot ... increase with increases of output. Hence ... only the laws of constant or decreasing supply price ... are admissible."

[5] Hicks' entire statement on increasing returns is well worth including. Hicks (1942, pp. 83-85) said that: "It seems to be agreed that this situation has to be met by sacrificing the assumption of perfect competition" for some model of competing monopolies. Hicks continued:

> ...yet it has to be recognized that a general abandonment of the assumption of perfect competition ... must have very destructive consequences for economic theory. Under monopoly the stability conditions become indeterminate; and the basis on which economic laws can be constructed is therefore shorn away. ... It is, I believe, only possible to save anything from this wreck – and it must be remembered that the threatened wreckage is that of the greater part of general equilibrium theory – if we can assume that the markets confronting most of the firms with which we shall be dealing do not differ very greatly from perfectly competitive markets. If we can suppose ... that marginal costs do generally increase with output at the point of equilibrium (diminishing marginal costs being rare), then the laws of an economic system working under perfect competition will not be appreciably varied in a system which contains widespread elements of monopoly.

Then, with a refreshing honesty absent today in too much economics, Hicks sought to justify his "get-away":

> *...This get-away seems well worth trying. We must be aware, however, that we are taking a dangerous step, and probably limiting to a serious extent the problems with which our subsequent analysis will be fitted to deal. Personally, however, I doubt if most of the problems we shall have to exclude for this reason are capable of much useful analysis by the methods of economic theory.*

[6] Cf. note 30 below.

[7] For just one example, Melvin Reder (1982, pp. 17-19) described Chicago's graduate program – while quoting Hicks (1942, pp. 84-85) as the basis for "the authority of neo-classical price theory in general" – in the following way:

> Especially repugnant ... is the suggestion that price and marginal cost (...) may vary independently ... [under increasing returns or monopolistic competition – FBJ] ... Whatever their merits, such suggestions undermine the authority of neo-classical price theory... Let me elaborate: initiation to the Chicago sub-culture is through a rigorous training program in which failure is to many a distinct possibility, and placement in a well-defined pecking order a concern of all. Success is achieved by mastery and application of certain tools and concepts to obtain correct answers... Correct answers must conform to definite criteria ... answers that violate any maintained hypothesis of the paradigm are penalized as evincing failure to absorb training.

This seems to describe a process of indoctrination, not one of educational learning. Nobel Laureate Wassily Leontief (1982, p. 105), reacting to Reder's description, excoriated the "leading economics departments" for their "tight control" over junior faculty members:

> *How long will researchers working in adjoining fields ... abstain from expressing serious concern ... about the splendid isolation in which academic economics now finds itself? That state is likely to be maintained as long as tenured members of leading economics departments continue to exercise tight control over the training, promotion and research activities of their younger faculty members and, by means of peer review, of the senior members as well. The methods used to maintain intellectual discipline in this country's most influential economics departments can occasionally remind one of those employed by the Marines to maintain discipline on Parris Island.*

[8] After receiving a Nobel Prize in 1972 for his work on Value and Capital, Hicks (1977, pp. v-vii) said he accepted this honor "with mixed feelings" as it was "work which I myself ... have outgrown. ...

> What I now think of Value and Capital is the following. The 'static' part ... opened up ... exciting [vistas]; so it was difficult when writing not to exaggerate their importance. Thus it was that ... I so preposterously exaggerated the importance of the perfect competition assumption, declaring that its abandonment would involve the "wreckage ... of the greater part of economic theory." ... In spite of all that has since happened to that particular piece of theory – the further elaborations at the hands of Samuelson, of Debreu and of so many others... – the time came when I felt that I had done with it. But what I really regretted was that it had played so large a part as it did in the ... 'dynamic' part of Value and Capital. ... Where I ... went wrong was in my attempt to represent ... equilibrium ... [by treating decisions simultaneously with their effects], so that an equilibrium could be reached. That however was nonsense. ... It was this device, this indefensible trick, which ruined the 'dynamic' part of Value and Capital. It was this that led it back in a static, and so in a neoclassical, direction. Since then ... I have endeavoured to avoid the relapse into statics [and] to keep my thinking more securely in time, concerning myself with processes...

[9] Cf. note 23 below.

[10] Knight's (1921, pp. 186-87) full statement is worth reviewing; it reflects the best thinking about time during this important period:

> Great difficulties are met with in stating a clear and straightforward exposition of price theory because ... the given conditions or data of the problem are so different according to the length of the time period which the explanation takes into account. ...
>
> ... The essential fact in economics is that different changes take place at different rates, that for certain time periods certain aspects of the situation may be assumed to remain unchanged, while for longer periods some of these will undergo change. The data or given conditions are different when different periods of time are under consideration.

After reviewing the difference of *ceteris paribus* from *mutatis mutandis*, Knight took up another "phase of the problem" of short vs. long run theory in terms of issues of scale:

> If it is true that a small output would naturally be produced by primitive methods while a larger one would justify a more elaborate organization with greater efficiency, it may well seem that the case is one of decreasing costs. ... A correct treatment of cost in relation to output should plot a complete cost curve for each method separately, extending from zero output up to one of indefinite magnitude... The significant part of the figure presents, therefore, not a curve of decreasing costs, but a series of curves of increasing costs at different levels. ... The substance of the matter is ... that if more efficient methods ... are available, the number of organizations in the industry will be reduced until all are on the most efficient scale.

[11] A fuller excerpt of Stigler's (1939, pp. 305-8, 310-12, 318-21) statement might be useful here:

> ...one cannot uniquely define fixed and variable costs with reference only to time periods. At least two additional circumstances must be considered, the existing cost-price relationships and the anticipated movements of prices and outputs. ... This line of reasoning leads directly to the conclusion that time must be an implicit variable which affects the form of the production function. There is not a short run and a long run; rather there are continuous variations in the marginal cost curve from very short periods to full, long-run equilibrium. The foregoing list of considerations ... emphasizes the fact that short-run marginal cost curves form a rather extensive genus, each species of which is appropriate to a particular set of assumptions about technology and anticipations. ... Finally, once short-term alterations of plant are admitted, it is impossible to draw short-run cost curves with reference only to time periods. Each such cost curve is now subject to restrictions, not directly of time, but rather of a set of prices. The cost curves are defined for an interrelated range of prices... It is possible to assume that such changes are continuous, and then a complete presentation (for any given set of price anticipations) involves a third axis, time, and the marginal and other cost functions become surfaces. ... but whether alterations of plant are continuous or discontinuous, it is no longer possible to handle the problem of the rate or extent of alteration by the use of plane geometry, since future prices are now important variables.

[12] Here is a fuller reflection of Clark's (1940, pp. 241-43, 246-50) excerpted remarks on this subject:

> ...I should like to point to certain ways in which long-run forces serve to mitigate the seriousness of the effects of imperfect competition. These considerations center largely in the proposition that long-run curves, both of cost and demand, are much flatter than short-run curves... ...In the field of imperfect competition ... these matters of degree are the essence of the problem. ... To develop the full importance of this it is necessary to take account of the time dimension of these curves... One feature of this relationship might be expressed as a skewed surface or contour-map in which the vertical dimension measures price... What we may call the west-east dimension would represent the length of time during which a given price-relationship remains in effect; and the north-south dimension would represent physical volume of sales... The intersection of the surface with any vertical north-south plane would be a demand-schedule representing the sales under various price differentials, each being assumed to remain in effect [over] a length of time represented by the distance of the plane from the west end of the diagram, where time equals zero. These curves would grow less steep from west to east. The horizontal contour-lines would be growth-curves (positive or negative) each representing the increasing effect with time of a given price-differential on volume of sales. Such a surface would, however, represent only a beginning of analysis. Action by one producer would provoke responses by others... Changes in quality are ... not represented. ...The whole functional relationship is probably so complex as to defy mathematical plotting.

[13] A slightly more complete excerpt of what Clark (1955, p. 459) said is here:

> A timeless two-dimensional demand curve of the conventional sort leaves out of account the fact that the effect of a given price, or price differential, on the volume of sales is a function, among other things, of the length of time during which it has been in effect. ... This time dimension ... means, among other things, that the effect of a given price on sales volume depends on the previous price or price situation, and that the curve is not fully reversible.
>
> ...The active variable is better described as a price policy than a price, and acts jointly with promotion... Similar comments apply to alterations of the product and moves in the area of sales promotion. This complex of variables would overload any possible system of graphic presentation. A family of three-dimensional surfaces – the third dimension

being time – with a different surface for each initial price or price situation, would still be a simplification.

[14] Or what I have come to denote in my work as 'horizon effects,' which are ordinal changes in (private and social) planning horizons.

[15] What Margolis (1960, pp. 531-32) specifically said was this:

> ... The greater the uncertainty of marketability, the shorter will be the planning horizons and the greater will be the allocated costs per year. Therefore the greater the uncertainty, the greater will be the variable costs because of a reluctance to commit the firm to best processes and the greater will be the fixed costs because of a shortening of the planning horizon.
>
> The implications of the above are that the greater the ignorance of the market the higher will be the estimate of the costs and the more inelastic the estimate of demand. What price should a firm charge if it has hopes of later expanding its market? The higher the price the greater the expected short-run profits and the greater the sacrifice of expected information about the mass market. The lower the price the more information it gains about the future market possibilities. ...

[16] Arrow (1962, pp. 155-56) stated these two empirical generalizations in this way:

> *(1) Learning is the product of experience. Learning can only take place through the attempt to solve a problem and therefore only takes place during activity.*
>
> *(2) ...Learning associated with repetition ... is subject to sharply diminishing returns. ... To have steadily increasing performance, then, implies that the stimulus situations must themselves be steadily evolving rather than merely repeating.*

[17] Hirshleifer's (1962, pp. 235-38, 246) full conclusion was stated in this way:

> Alchian asserts quite broadly that nothing can be derived from his or any other accepted postulate about the shape of [the marginal cost curve]. If true, that would be unfortunate, since we have considerable empirical ground for confidence in the one crucial property of the classical marginal cost [curve] – that marginal cost eventually begins to rise with proportionate expansion of [rate and volume of output]. ... Happily, it

> can be shown that this property does indeed follow from the Alchian postulates (with a weak addition), so that we can justify the accepted shape of the marginal cost curve in the orthodox theory of the firm within Alchian's model.

[18] George J. Stigler (1951, pp. 140-44), for example, represented the process of firms' growth with respect to factor substitution by simply asserting separability and substitution over complementarity of productive functions in the following manner:

> *For our purpose it is better to view the firm as engaging in a series of distinct operations.... The costs of these individual functions will be related by technology.... Certain processes are subject to increasing returns... other[s]... to diminishing returns... Our... assumption, that... the functions are independent, is... important. Actually, many processes will be rival... Other processes will be complementary... If, on balance, the functions are rival, then usually the firm will increase its rate of output of the final product when it abandons a function; and I think that this is generally the case.*

Alternatively, Richard R. Nelson (1981, pp. 1053-55) explored the growth implications of factor complementarity in this way:

> *If factors are complements, growth is superadditive... The growth of one input augments the marginal contribution of others. Where complementarity is important, it makes little sense to try to divide up the credit for growth, treating the factors as if they were not complements. ... [It is like] dividing up the credit for a good cake to various inputs. ... In short, there are not neatly separable sources of growth, but rather a package of elements all of which need to be there.*

[19] Recall Hicks' retraction of his 'getaway,' in which he called it "an indefensible trick that ruined the 'dynamics' of *Value and Capital*."

[20] Oi (1967, pp. 590, 594) stated his full conclusion in the following way:

> In order to deduce these propositions, Alchian and Hirshleifer both appeal to learning, experience and economies which derive from not having to rush production plans. Notice, however, that if these writers had adopted a Hicksian intertemporal production function and [my] two theorems ... all nine propositions are seen to be logical consequences of my modified dynamic theory of production. ... To sum up, a dynamic theory of production along the lines of Hicks provides us with an essentially neoclassical

explanation for progress functions. ... To attribute productivity gains to technical progress or learning is, I feel, to rob neoclassical theory of its just due.

[21] Alchian (1968, pp. 319-20) expressed it thus:

> A general and universally valid law is that for every volume of output there exists an output rate beyond which the marginal cost with respect to rate always increases. This is commonly called the law of diminishing marginal returns with respect to output. ... Joint proportional increases in both the rate and the volume (over the given interval of production) will of course raise total costs. The effect on the cost per unit of product is not predictable except for "high" rates of output. ... [This situation] involves an increase in the rate of output as well as in the volume. These two work in opposite directions... The rate effect will dominate as programs with higher rates are considered. ...Average cost per unit of volume can be decreasing for small outputs. But as larger outputs are considered, the average cost will, beyond some output rate, begin to rise persistently and with increasing rapidity...

[22] A fuller statement of Turvey's (1969, pp. 285-88) conclusions is here:

> The fact that some of the propositions can be based either on the intertemporal planning of production or on learning and experience does not, as Oi recognizes, involve any contradiction. No general statement can be made about their relative importance. What does emerge in general terms is the importance of the time dimension and the resulting multi-dimensionality of marginal-cost concepts. ... When uncertainty concerning demand is coupled with uncertainty in production, cost minimization ceases to be a simple concept. ... This review of a number of contributions to cost theory makes it clear that the definition of marginal cost as the first derivative of cost with regard to output is too simple to be useful. Both cost and output have time dimensions, and both may be subject to uncertainty. ...A cost analysis which is to be useful in decision-making needs to be historical dynamics, not comparative statics.

[23] The 1970s started with Martin Shubik's (1970, pp. 405, 413-14) "frankly partisan and ... biased view" in which he condemned the Hicks/Samuelson equilibrium model as suffering from "a pervading sense of sterility" and "an overpowering aura of specious generality." He opined that: "The very

power and elegance of Hicks' analysis may have set the subject back as far as it set it forward." However, as Shubik cast the point: "*An exploration of a dead end can be extremely useful if we realize that it is a dead end, and why it is so.*" He expected "that a new microeconomics is about to emerge" which he characterized as "mathematical-institutional-political economy." The next year, Janos Kornai (1971) published *Anti-Equilibrium*, a frontal assault on mathematical economics and equilibrium, making a largely unsuccessful effort to introduce systems theory. E.H. Phelps Brown's (1972) Presidential Address before the Royal Economic Society on "The Underdevelopment of Economics" started out decrying the paucity of economic contributions to "the most pressing problems of the times," and called for "removal of the traditional boundary between ... economics and the other social sciences." The next barrage came from Nicholas Kaldor's (1972, 1973, 1975) three papers about which we will have more to say.

[24] Hahn (1973) expressed his argument in this manner:

> ... When the claim is made – and the claim is as old as Adam Smith – that a myriad of self-seeking agents left to themselves will lead to a coherent and efficient disposition of economic resources, Arrow and Debreu show what the world would have to look like if the claim is to be true. In doing this they provide the most potent avenue of falsification of the claims. ... Such work is of great practical significance...
>
> Kornai regards GE "as useless as a real science theory." Since throughout he adduces empirical evidence to refute this theory, I take it that he really means that it is false as a theory of what the world is like. But then it cannot but be a "real science" achievement to have formulated a two-hundred-year-old tradition so sharply as to enable such an unambiguous verdict...

[25] Hahn (1981, pp. 126-27) gave another revealing justification for his work on general equilibrium models:

> *The theory itself has often suffered a good deal from its friends. Some friends – in what might be called ... "Chicago" economics – have taken the theory in practical applications a good deal more seriously than at present there is any justification for doing. Paradoxically they are rather hostile to its abstract foundations, yet are happy to put a great deal of weight on them. ...*

> *The enemies, on the other hand, have proved curiously ineffective and they have very often aimed their arrows at the wrong targets. Indeed, if it is the case that today General Equilibrium Theory is in some disarray, this is largely due to the work of General Equilibrium theorists, and not to any successful assault from outside.*

Another revealing admission was made by Hahn (1981, p. 129) defending GE Theory from attacks on it during the 1970s:

> *... There are no credible rivals in answering the particular questions which General Equilibrium analysis has posed. (On the other hand, as I argue below, these questions may be too narrowly and academically based.) ...*
>
> *The ease with which so much current critique of General Equilibrium analysis can be countered is potentially dangerous. For as I said at the outset, the citadel is not at all secure and the fact that it is safe from a bombardment of soap bubbles does not mean that it is safe.*

[26] Cf. Reder (1982, p. 19), but also cf. Leontief (1982, p. 105), as both are quoted in note 7 above.

[27] I often define 'conscience' as synonymous with 'planning horizons' as a measure of 'wits' in our decisions, which defines how much of the range of spreading consequence stemming from what we do is properly anticipated before we set these radiating effects in motion.

[28] Here is how Arrow (1974, pp. 26-29) expressed these concerns in his own published words:

> We must limit our sense of responsibility to others to have any effective action at all. ... One's social, one's political attitudes, for example, must always reflect a certain degree of compromise with one's individual point of view. ...No social action is possible at all without some element of cooperation and ... agreement. ...
>
> ... It may really be true that social agreements ultimately serve as obstacles to the achievement of desired values... The problem is that agreements are typically harder to change than individual decisions. When you have committed not only yourself but many others to an enterprise, the difficulty of changing becomes considerable. ... What may be hardest of all to change are unconscious agreements, agreements whose very purpose is lost to our minds. Some commitments are to purposes which involve much sacrifice and a very great depth of involvement. ... Even if experience has shown the unexpectedly undesirable consequences of a commitment, the past may continue to rule the present. ...

> This thinking ... gives rise to the greatest tragedies of history, the sense of commitment to a past purpose which reinforces the original agreement precisely at a time when experience has shown that it must be reversed. ...We must always keep open the possibility of recognizing past errors and changing course.

[29] Especially cf. the beautifully sensitive and revealing comments by Tannenbaum and Hanna (1985, pp. 99-103, 108-15, 118-21) on the psychology of 'hanging on' and 'letting go' as a means of moving on and instituting a needed change. They offer three reasons why this subject is often ignored by organizational theorists:

> *As psychoanalyst Ernest Schachtel insightfully explains: "The anxiety of the encounter with the unknown springs ... from the person's fear ... that without the support of his accustomed attitudes, perspectives, and labels he will fall into the abyss or flounder in the pathless... Letting go of every kind of clinging opens the fullest view... But it is this very letting go which often arouses the greatest amount of anxiety. ...*
>
> *In conclusion, ... it is puzzling (...) that so little attention has been given ... to ... the need to hold on – together with the related facilitation of letting go and moving on. ...This avoidance has ... at least three fundamental reasons to explain it... **First**, there is a culturally embedded fear and reluctance to explore elements in the preconscious or unconscious self... And yet consciousness raising is an essential step in dealing with the need to hold on. ... **Second**, there is the culturally grounded and pervasive fear of feelings (...), particularly of their expression. Most individuals are fearful of their own feelings, and they are threatened by and not sure how to cope with the feelings of others. ... And yet, the re-experiencing of earlier childhood events, together with associated feelings ... is also an essential step in dealing with the need to hold on. **Third**, there is the need to mourn... To mourn means to face death ... in order to make a rebirth possible. ... Our intuitions lead us to the possibility that the avoidance by managers and change agents of the need to let go ... is in part, at least, related to a deep fear that involvement in these processes would bring them too close to a confrontation with their own mortality.*
>
> *In closing, we can only leave the reader with a gnawing dilemma. ...The area to which we have just given our attention is a seriously neglected one... ...Efforts directed at deep change often fail or fall short of desired results because the need to hold on and its working through seem to be so persistently avoided. At a time in history when the demands for change constantly*

impinge on organizations, this avoidance carries with it most serious consequences. … At present, we have little wisdom to offer as to how this dilemma can be resolved. But we do have faith that, with an increasing and more pervasive understanding…, it will be resolved in the best interests of all participants in organizational life.

[30] The full description of this moment by Waldrop (1992, p. 18) is provided here:

> So there they had all been, sitting down to sandwiches at the faculty club. Tom Rothenberg, one of his former professors, had asked the inevitable question: "So, Brian, what are you working on these days?" Arthur had given him the two-word answer just to get started: "Increasing returns." And the economics department chairman, Al Fishlow, …stared at him with a kind of deadpan look. "But – we know increasing returns don't exist." "Besides," jumped in Rothenberg with a grin, "if they did, we'd have to outlaw them!" And then they'd laughed. Not unkindly. It was just an insider's joke. Arthur knew it was a joke. It was trivial. Yet that one sound had somehow shattered his whole bubble of anticipation. He'd sat there, struck speechless. Here were two of the economists he respected most, and they just – couldn't listen. …

[31] A more complete version of Arrow's (1982, pp. 5-7) conclusion in this paper is stated below:

> A fundamental element of rationality, so elementary that we hardly notice it, is, in logicians' language, its extensionality. … It is an axiom [of economic rationality] that [a] change in description leaves the decision unaltered. The cognitive psychologists deny that choice is in fact extensional; the framing of the question affects the answer.

[32] The difference between Alchian's use of V as the sum of X(t) over m, and Hirshleifer's $\underline{V = m_0X}$ is specified by the LeChatelier Principle, which says that $\underline{A(V, X, T) \leq H(V, X, T)}$ as the latter relation is subject to another constraint not on the former, all other things equal. If we keep this in mind, then the difference between the two formulations of $\underline{V = f(X)}$ is indeed trivial and immaterial.

[33] When $\underline{dX/dV = 0}$, any increase in V is achieved by increasing m (such that $\underline{dm/dV = 1/X}$). When $\underline{dX/dV = 1/m}$, an increase in V is wholly through X, with $\underline{dm/dV = 0}$, which is Hirshleifer's case (Jennings 2015b).

[34] We simply compare four cost formulations. The one Alchian offers to us is $\underline{C = C(V, X, m, T)}$. On the assumption that $\underline{V = mX}$, we can translate Alchian's formulation into: $\underline{A = A(V, X, T)}$. Hirshleifer's

version shall be expressed as $H = H(V, X, T)$ with $V = m_0X$, and my reformulation is: $J = J(V, m, T)$. The first thing to show is how Alchian's proposition that $A_{xx} > 0$ (with $V_0 = mX$) can be restated thus:

$$d^2A/dX^2 = A_{xx} = m^2/X^2\, J_{mm} = C_{xx} - 2m/X\, C_{xm} + m^2/X^2\, C_{mm} + m/X^2\, C_m > 0. \quad (1a)$$

Note the formulation of $A_{xx} = m^2/X^2\, J_{mm}$ gives strong indications that the positivity of A_{xx} stems from a decline in m and has little or nothing to do with extensions of X. This is also implied by the fact that $J_m < 0$ where $A_x = - m/X\, J_m > 0$. It is noteworthy that $C_{xx} > 0$ is not required by $A_{xx} > 0$. As long as $2m/X\, C_{xm} - m^2/X^2\, C_{mm} < m/X^2\, C_m < 0$, then $C_{xx} < 0$ is possible as long as:

$$2m/X\, C_{xm} - m^2/X^2\, C_{mm} - m/X^2\, C_m < C_{xx} < 0, \quad (1b)$$

while $d^2A/dX^2 = A_{xx} > 0$. It is worth noting that $C_{xx} < 0$ is a sufficient condition for increasing returns (where $d^2H/dX^2 = m^2J_{vv} < 0$). Now we look at Hirshleifer's claim that $d^2H/dX^2 = H_{xx} + 2mH_{xv} + m^2H_{vv}$ limits to H_{xx} as V and X grow large in proportion. Hirshleifer's version of d^2H/dX^2 can also be expressed in the form of J and C thus:

$$d^2H/dX^2 = H_{xx} + 2m\, H_{xv} + m^2\, H_{vv} = m^2\, J_{vv} = C_{xx} + 2m\, C_{xv} + m^2\, C_{vv}, \quad (2)$$

assuming that $V = m_0X$. The reason that $2mH_{xv} + m^2H_{vv} < 0$ as X and V rise in proportion is that the higher is X, the less is m_0/X for a given $V = m_0X$ [cf. Equations (1ab) just above]. This is why $2mH_{xv} + m^2H_{vv}$ will limit to zero as X increases for given m_0, and it has nothing to do with upturning cost for $V = m_0X$! The positive sign of J_{vv} is simply asserted, not proven. Now we show how increasing returns ($J_{vv} < 0$) does not conflict with Alchian's statements as reflected in equation (1a) above, for any and every value of V and X. By placing Hirshleifer's frame into Alchian's setting, i.e., where $V_0 = mX$ so $dm/dX = - m/X$, we find that:

$$d^2H/dX^2 = H_{xx} = A_{xx} = m^2/X^2\, J_{mm} = C_{xx} - 2m/X\, C_{xm} + m^2/X^2\, C_{mm} + m/X^2\, C_m > 0. \quad (3)$$

But this expression has nothing to do with the sign of J_{vv}. The positivity of H_{xx} and A_{xx} is from $J_{mm} > 0$, from cutting m when $V = V_0$: it does not commit to rising cost (from any new V for a given m_0), which is set by the sign of J_{vv} (which will likely be less than zero).

[35] A more complete presentation of this conclusion as stated in Jennings' 1985 dissertation is here:

> *[We have shown] nothing less than the following fact: that Hirshleifer's 'rescue' does not really follow from Alchian's statements at all! ... Hirshleifer's constant m will make $dm/dX = 0$.*

Holding dm/dX strictly negative makes $J_{vv} < o$ a necessary and sufficient condition for there to be some constant dV/dX between o and m for which $d^2H/dX^2 < m^2J_{vv} < o$. Since Alchian's version leaves room for $C_{xx} < o$, a stronger requirement than needed for $J_{vv} < o$, Hirshleifer's argument is a non sequitur, even without the LeChatelier limit on A_{xx} once $V = mX$ is assumed. Its status reduces to simple assertion, which flies in the face of an evident fact: unbounded increasing returns…

A brief review is in order. Alchian's original goal was to offer a dynamic concept of cost. In his paper he makes an ordinal contrast of rate vs. time of production. He neither intended nor offered a statement on absolute changes in marginal cost; $A_{xx} > o$ for any fixed volume of output because it is cheaper to add a unit after the learning is done (through m) than by increasing output rate (widening X) while entrepreneurial skills are still growing! Nothing at all is implied about whether the latter will lead 'eventually' to an upturn in marginal or average costs. The strangest thing is that Alchian also accepted Hirshleifer's proof.

The upshot of this grievous mistake is that any incorporation of learning by doing and technical change into cost and price theory has been deferred. The point lies in fifty [now over 80!] long years during which we have painted a 'well-behaved' world, forestalling development of our conceptions in the direction of proper behavioral science. 'Hicksian getaways,' even redeemed, were supplanted by sanctions of rate over volume as justification for upturning cost. The limits of Hirshleifer's central contention could not have been checked very closely. The carelessness thereby implied is appalling, with how much we rest on this claim. After all, the error is not well-concealed to any skeptical eye. Its impact stretches well beyond sight, if his proof has diverted attention from learning. We cannot doubt that it has.

[36] What Popper (1959, pp. 278-79; 1963) said was as follows:

Science is not a system of certain, or well-established statements… We do not know: we can only guess. … But these marvelously imaginative and bold conjectures or "anticipations" of ours are carefully and soberly controlled by systematic tests. Once put forward, none of our "anticipations" are dogmatically upheld. Our method of research is not to defend them, in order to prove how right we were. On the contrary, we try to overthrow them. Using all the weapons of our logical, mathematical and technical armoury, we try to prove that our

anticipations were false – in order to put forward, in their stead, new unjustified and unjustifiable anticipations, new "rash and premature prejudices," as Bacon derisively called them.

[37] Cf., e.g., note 7 above.

[38] Polanyi's (1966, pp. 78-79) fully persuasive argument was presented in this way:

I have spoken of the excitement of problems, of an obsession with hunches and visions that are indispensable spurs and pointers to discovery. But science is supposed to be dispassionate. There is indeed an idealization of this current today, which deems the scientist not only indifferent to the outcome of his surmises, but actually seeking their refutation. This is not only contrary to experience, but logically inconceivable. The surmises of a working scientist are born of the imagination seeking discovery. Such effort risks defeat but never seeks it; it is in fact his craving for success that makes the scientist take the risk of failure. There is no other way. Courts of law employ two separate lawyers to argue opposite pleas, because it is only by a passionate commitment to a particular view that the imagination can discover the evidence that supports it.

[39] I am indebted to Robert G. Wolf, a former colleague at Tufts, for suggesting this conversion to me after one of my presentations.

[40] Jennings (1985, pp. 101-6). Here is a brief sketch of the technical argument. First, I assume the partition of H between production (m) and planning (T) periods is made to minimize cost such that: $J_m = J_T$ with $dm/dH = 1 - dT/dH$ and $dm/dT = -1$ (for any given horizon H_o). Then marginal cost M(Q, H) is the first derivative of $J = J(V, m, T)$ with respect to V for any H_o, i.e.: $M(Q, H) \equiv J_v(V, m, T)$. The first partials of M(Q, H) can then be stated thus:

$M_Q = H J_{vv}$ and $M_H = Q J_{vv} + J_{vm} < 0$. (4)

J_{vv} can be greater or less than zero, reflecting rising or falling marginal costs of producing Q or V for a given H_o. However, if $J_{vv} > 0$, it has to be less than $-1/Q J_{vm} > 0$ as well, to keep $M_H < 0$. This suggests that the limit of J_{vv} as Q gets large cannot be far above zero, in contradistinction to Hirshleifer's claim. Although the case for rising cost per unit, $M_Q > 0$, rests solely upon unfounded assertions – at least on purely technical grounds (as opposed to horizonal long- vs. short-run issues already discussed) – the signs of M_Q and J_{vv} remain undetermined functions of H. More relevant is that the slope of M(Q, H) with respect to Q is a function of both Q and H, where $dM/dQ = M_Q(Q, H)$ for a given horizon. The impact of horizon effects on M(Q, H) is a part of this story, where (for a given $V = V_o$):

$dM/dH = M_H + M_Q\, dQ/dH = M_H - Q/H\, M_Q < 0$. (5)

The marginal cost curve may turn upward (despite the absence of evidence and theoretical ground for the view), although – if true – rising cost is attributed to the effect of short horizons and not to production technology. And rising cost – when occurring at all – is tightly constrained; to keep $M_H < 0$, M_Q must be less than $- H/Q\, J_{vm} > 0$, so as Q rises for some H_0, M_Q will likely decline. The basic truth remains that the difference between decreasing and increasing returns is horizonal, i.e., one of short vs. long run planning horizons.

[41] An interesting research application would be to determine the horizonal tipping point for any given production technology at which decreasing returns transform into increasing returns as the slopes of the cost curves shift downward with horizonal growth.

[42] Herbert Simon (1983, p. 107) expressed these conclusions far more eloquently thus:

> *Reason... is instrumental. It can't select our final goals... All reason can do is help us reach agreed-on goals more efficiently.... It would be quite enough to keep open for our descendants as wide a range of alternatives as our ancestors left for us... In accomplishing [this] more limited goal, will an appeal to enlightened self-interest suffice?... Success depends on our ability to broaden human horizons so that people will take into account, in deciding what is to their interest, a wider range of consequences. It depends on whether all of us come to recognize that our fate is bound up with the fate of the whole world, that there is no enlightened or even viable self-interest that does not look to our living in a harmonious way with our total environment.*

[43] This whole analysis can be derived – if done properly – from Alchian's (1958) nine propositions on cost, despite the erroneous effort by Hirshleifer (1962) and its acceptance by Oi (1967) and Alchian (1968): cf. Jennings (1985, ch. 5; 2015). Formally, $M^* \equiv MR = MC$ at Q* (the maximum profit level of output), with $E^* \equiv [\varepsilon^*/(\varepsilon^*+1)]$ where $E^*>1$ because $-\infty < \varepsilon^* < -1$ [and here, by definition, we have this $\varepsilon \equiv dlnQ/dlnP \equiv (dQ/Q)/(dP/P)$, the elasticity of demand, which can be thought of as the percentage response of Q to a one-percent increase in P]. The whole expression can be derived very simply by substitution from the definition of MR as dR/dQ (where $R \equiv PxQ$) with respect to Q or P, which can be written simply as $P = MR \times [\varepsilon /(\varepsilon+1)]$, yielding $P^* = M^* \times E^*$, where the asterisk (*) denotes the level actually chosen as best by an agent. The horizonal outcome is summarized thus: $dM^*/dH < 0$ with $d^2M^*/dH^2 > 0$; $dE^*/dH < 0$ with $d^2E^*/dH^2 > 0$; so $dP^*/dH < 0$ and $d^2P^*/dH^2 > 0$. If so, then for $g \equiv$

dlnQ/dt, the growth rate of sales, $dg^*/dH > 0$ with $d^2g^*/dH^2 < 0$ (cf. Margolis 1960, Jennings 2008a, 2015b). The overall relation of P*, M* and E* to H* is revealed in ***Figure One*** above.

[44] Cf. Jennings' (2012a, pp. 15-17) *Figure Two* for a more comprehensive version of this graphical microeconomic analysis.

[45] Kaldor's (1972, p. 1240) full statement in this paper is worth including here:

> *... In fact, equilibrium theory has reached the stage where the pure theorist has successfully (though perhaps inadvertently) demonstrated that the main implications of this theory cannot possibly hold in reality, but has not yet managed to pass his message down the line to the textbook writer and to the classroom. ...Without a major act of demolition – without destroying the basic conceptual framework [of orthodox equilibrium economics] – it is impossible to make any real progress.*

[46] Kaldor's (1975, pp. 347-48) QJE paper developed the argument into some more of its clear implications:

> *The theory of general equilibrium ... starts from the wrong kind of abstractions and therefore gives a misleading ... impression of the nature and the manner of operation of economic forces. ...Economic theory regards the essence of economic activities as an allocation problem... This means that attention is focused on what are subsidiary aspects, rather than the major aspects, of the forces in operation. The principle of substitution (as Marshall called it) ... is elevated to the central principle... This approach ignores the essential complementarity between different factors of production ... or different types of activities ... which is far more important for an understanding of the laws of change and development of the economy than the substitution aspect.*

Also cf. note 18 above for another two views of substitution vs. complementarity of productive factors and their ramifications.

[47] Cf. Hicks (1939) and Kaldor (1939), both of whom proposed a compensation process based on demand or supply elasticities.

[48] Our measure of 'net interdependence' in any group I with respect to member j is a combinatorial $S_I = \Omega s_{i \neq j}$, where compensation $s_{i \neq j}$ to or by each i≠j member is: $s_{i \neq j} \equiv (Q_{i \neq j}/Q_j) \cdot (M_{i \neq j}^* - P_{i \neq j}^*) \cdot [\varepsilon_{ij}^*/(\varepsilon_j^*+1)]$, whose sign is that of the cross-elasticity of demand for i with respect to j, $\varepsilon_{ij} \equiv$

$dlnQ_{i\neq j}/dlnP_j$, where own-elasticity of demand for j is $\varepsilon_j^* \equiv dlnQ_j/dlnP_j < -1$. Then $P_j' = P_j^* + S_I$, as explained above.

[49] Cf. note 48 above. If $P_j' = P_j^* + S_I$ for a group I of firms, where S_I is the difference between the compensated (joint-profit maximizing) P_j' and the P_j^* set independently of its pecuniary impact on the other ($i\neq j$) firms' profits. S_I operates as a measure of net substitution with respect to any one member in an interactive group. Interhorizonal complementarity means $dH_{i\neq j}^*/dH_j^* > 0$. If so, then $dS_I/dH_j^* < 0$: an increase in H_j^* yields – through its contagious effects on $H_{i\neq j}^*$ – a shift of S_I away from substitution (in which $S_I > 0$) favor of complementarity (where $S_I < 0$). For any $i\neq j$ element of S_I, namely $s_{i\neq j} \equiv (Q_{i\neq j}/Q_j) \times (M_{i\neq j}^* - P_{i\neq j}^*) \times [\varepsilon_{ij}^*/(\varepsilon_j^*+1)]$, an extension of H_j^* will likely reduce the magnitude of both $Q_{i\neq j}/Q_j > 0$ (as a weighting scalar) and $(M_{i\neq j}^* - P_{i\neq j}^*) < 0$, while increasing own-elasticity $(\varepsilon_j^* < -1)$ and thus the negative magnitude of $|(\varepsilon_j^*+1) < 0|$, while the cross-elasticity (ε_{ij}^*) is shifted away from substitution $(\varepsilon_{ij}^* > 0)$ toward complementarity $(\varepsilon_{ij}^* < 0)$, so making $d\varepsilon_{ij}^*/dH_j^* < 0$ as well. So regardless of the sign of S_I (as an aggregation of $s_{i\neq j}$ across any group I around member j), $dS_I/dH_j^* < 0$: a mutual lengthening of planning horizons shifts our relations away from substitution in favor of complementarity (in virtually all economic contexts). Also, the notational difference of H from H* is that H is the general concept while H* denotes the planning horizon that was chosen and thus embedded in a particular decision.

[50] Part of the point is about the harmful effect of authoritarian organization on cooperation. Management theorists suggest a relation between conflict and time perspectives in hierarchical organizations. As Simon (1960, p. 204) put it, "organizational form must be a joint function of human characteristics and the nature of the task environment" where: "Hierarchy is the adaptive form for finite intelligence to assume in the face of complexity." But the emphasis is on teamwork: cooperation, not competition, allows systems to work, grow, and thrive in changing contexts. As Simon (1960, p. 210) put it: "Man does not generally work well with his fellow man in relations saturated with authority and dependence, with control and subordination... He works much better when he is teamed with his fellow man in coping with an objective, understandable, external environment." Interhorizonal complementarity means that treating adults like children will bring immature responses. In such settings mature people exhibit pathological signs of "frustration, failure, short time perspective and conflict." These symptoms of human need deprivation will lead to organizational fragmentation through "competition, rivalry, ... hostility and ... a focus toward the

parts rather than the whole" (Argyris 1971, pp. 262-63, 268-69). When a wrong model is used to design an institutional incentive structure, we should expect to find pathological symptoms of organizational stress. Such symptoms seem familiar; they infuse social relations. All this suggests that dominant traits of our economic culture result from organizational stress stemming from improper institutional systems, expressing psychological signs of ill health including conflict, competition, materialism, myopia and disruption of effort. Why is this occurring?

As Simon outlined the issue in a more specific context: "A design representation suitable to a world in which the scarce factor is information may be exactly the wrong one for a world in which the scarce factor is attention" (Simon 1981, p. 167). Here we have a similar problem of organizational structure resting on substitution assumptions imposed on complementary settings, signaling conflicts, short horizons, immaturity and disengagement. All these symptoms of a myopic culture reflect a deep pathology in our social systems. We must learn to cooperate where we continue to compete, creating conflict out of thin air. Abraham Maslow (1954, 1968) offered some insights in his stages of human development: basic consumption demands (shelter, food, clothing, etc.) are materialistic in nature, that – once met – summon forth higher-order, less tangible needs. This implies that human relations shift away from substitute goods to complementary yields as we mature and grow. If so, our institutions should also evolve away from competition toward cooperation, or this social advance is stifled due to higher-order need deprivation; this is a likely source for these symptoms of organizational stress.

> *The deprivation of needs has behavioral consequences. ... The man whose needs for safety, association, independence or status are thwarted is sick, just as surely as he who has rickets. We will be mistaken if we attribute ... passivity, or ... hostility, or ... refusal to accept responsibility to ... inherent 'human nature.' These forms of behavior are symptoms of illness – of deprivation of ... social and egoistic needs.*

McGregor (1971, pp. 310-11) went on to explore the connection to rampant consumerism and materialism in modern cultures:

> *...the fact that management has provided for these physiological and safety needs has shifted the motivational emphasis to the social and egoistic needs. Unless there are opportunities at work to satisfy these higher-level needs, people will be deprived, and their behavior will reflect this deprivation. ... People will make insistent demands for more money under these*

> *conditions. It becomes more important than ever to buy the material goods and services which can provide limited satisfaction of the thwarted needs. Although money has only limited value in satisfying many higher-level needs, it can become the focus of interest if it is the only means available.*

A central theme of horizonal theory is that our relations are complementary: competition is not just stifling output of intangibles such as information and knowledge but also narrows planning horizons, spawning a myopic culture, revealing insidious symptoms of higher-order human need deprivation. But these horizon effects cannot be seen without a horizonal theory; the flip side of selective focus is a restrictive blindness. Standard economics seems unable to see these phenomena. One can imagine a much different culture founded on an understanding of complementarity that fosters and encourages horizonal growth with better effects on human health and happiness.

[51] Cf. notes 10-13 and 15 above.

[52] Cf. note 4 above.

[53] As Nicholas Georgescu-Roegen (1967, p. 104) observed, after quoting Mitchell's and Schumpeter's critiques of economic abstraction:

> *Standard economics, by opposing any suggestion that the economic process may consist of something more than a jigsaw puzzle with all its elements given, has identified itself with dogmatism. And that is a privilegium odiosum which has dwarfed the understanding of the economic process wherever it has been exercised.*

Polanyi (1958, pp. 186 and 26-27) compared this syndrome to "the continued invention of a game in the very course of playing [it]." This is another aspect of the need to supplant Popper's story with that of Polanyi, who saw science as an inherently personal search:

> *...We have seen that the kind of tacit powers by which we commit ourselves to any particular statement operate in various elaborate forms throughout the realm of human knowledge, and that it is this personal coefficient alone which endows our explicit statements with meaning and conviction. All human knowledge is now seen to be shaped and sustained by the inarticulate mental faculties which we share with the animals. This view entails a decisive change in our ideal of knowledge. The participation of the knower in shaping his knowledge, which had hitherto been tolerated only as a flaw – a shortcoming to be eliminated from*

> *perfect knowledge – is now recognized as the true guide and master of our cognitive powers. We acknowledge now that our powers of knowing operate widely without causing us to utter any explicit statements; and that even when they do issue in an utterance, this is used merely as an instrument for enlarging the range of the tacit powers that originated it. The ideal of a knowledge embodied in strictly impersonal statements now appears self-contradictory, meaningless, a fit subject for ridicule. We must learn to accept as our ideal a knowledge that is manifestly personal.*

[54] The Chicago argument draws from and rests upon a cynical view of theory as "instrumental" and devoid of realistic content. Indeed, as already noted, Friedman (1953, p. 14) trumpets the virtue of "unrealistic assumptions" as an integral part of any theory's significance: "...in general, the more significant the theory, the more unrealistic the assumptions... To be important, therefore, a hypothesis must be descriptively false in its assumptions." The framework is easily ridiculed in the absence of full understanding, for its acceptance of falsity in economics. Boland (1979, p. 522) declares, supporting the view, that "Friedman's essay is an instrumentalist defense of instrumentalism. ... The repeated attempts to refute Friedman's methodology have failed ... because instrumentalism is its own defense and its only defense." As Boland (1979, pp. 509, 512; also 1980) put his argument in somewhat more detail:

> *Instrumentalists consider the truth status of theories, hypotheses, or assumptions to be irrelevant for any practical purposes so long as the conclusions logically derived from them are successful. ... This is because any analysis of the sufficiency of a set of assumptions begins by assuming the conclusion is true and then asks what set of assumptions will do the logical job of yielding that conclusion. ... Friedman argues that the falsity of the assumptions does not matter if the conclusions are true.*
>
> *...Instrumentalists ... think they have solved the problem of induction by ignoring truth... ... They do not begin their analysis with a search for ... true assumptions but rather for ... useful (i.e., successful) conclusions. ...The instrumentalist's argument is concerned more with ... sufficiency of ... assumptions than with their necessity. This is because any analysis of the sufficiency of a set of assumptions begins by assuming the conclusion is true and then asks what set of assumptions will do the logical job of yielding that conclusion.*

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[55] M(Q, H) is almost always defined for ‘given’ input prices, to make cost a *technical* function translating inputs to output.

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