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OPENING THE GATES TO PLATO'S HEAVEN

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ABSTRACT

Substance is rivalrous and form is non-rivalrous (in the sense that information can be shared without diminishing one's own). The recipe to "open the gates to Plato's Heaven" is by minimizing the role of rivalrous substance and maximizing the role of non-rivalrous form. This creates a whole series of different processes, positive feedback processes, vicious or virtuous circles, cumulative circular causality, and increasing returns phenomena, which are analysed in this paper.

KEYWORDS: Substance and form; rivalrous and non-rivalrous, increasing returns, self-enforcing processes; positive feedback processes

INTRODUCTION

The Ancient Greeks were on to something when they thought of the world in terms of Form and Substance (Ainsworth 2020). Everything combines Form and Substance. At one extreme, one might imagine some uni-form or form-less substance "prior to" the substance taking on the variety of forms that we see. And one can certainly imagine forms without substance. Those are the Forms or Ideas that populate Plato's Heaven. Examples of pure forms are the objects of mathematics such as the number thirteen and the equilateral triangle. Plato's Heaven is a spatial metaphor that is only a metaphor. Abstract objects, ideas, or forms take up no space and have no location; they are everywhere or nowhere depending on how one uses the metaphor. What we find in the world of space and time is always substance that partakes some form, or, dually, forms that have been realized in some substance.

The ubiquity of form has been recently reemphasized not only in the educational proves but in social sciences as the non-rivalrousness of knowledge, information, and ideas. Unlike normal rivalrous goods (substance), the information or knowledge that one person "consumes" does not deprive others of the same. This is often illustrated by Thomas Jefferson's candle-lighting metaphor.

> If nature has made any one thing less susceptible than all others of exclusive property, it is the action of the thinking power called an idea, which an individual may exclusively possess as long as he keeps it to himself; but the

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> moment it is divulged, it forces itself into the possession of every one, and the receiver cannot dispossess himself of it. Its peculiar character, too, is that no one possesses the less, because every other possesses the whole of it. He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine, receives light without darkening me. That ideas should freely spread from one to another over the globe, for the moral and mutual instruction of man, and improvement of his condition, seems to have been peculiarly and benevolently designed by nature, when she made them, like fire, expansible over all space, without lessening their density in any point, and like the air in which we breathe, move, and have our physical being, incapable of confinement or exclusive appropriation. (Jefferson 1984 (1813), 1291)

But the idea of the non-rivalrousness of ideas goes back at least to Plato's Heaven where all can participate in the same forms, one not excluding the other. Augustine (354-430), who "Christianized" Neo-Platonism, expressed the idea in one of his sermons.

> The words I am uttering penetrate your senses, so that every hearer holds them, yet withholds them from no other. Not held, the words could not inform. Withheld, no other could share them. Though my talk is, admittedly, broken up into words and syllables, yet you do not take in this portion or that, as when picking at your food. All of you hear all of it, though each takes all individually. I have no worry that, by giving all to one, the others are deprived. I hope, instead, that everyone will consume everything; so that, denying no other ear or mind, you take all to yourselves, yet leave all to all others. (Quoted in Wills 1999, 145; Original at Augustine n.d., Sermon 187.2)

It is useful to conceptually differentiate the pure non-rivalrousness of knowledge from the low cost of dissemination. The information revolution results in part from the great strides made in modern technology in reducing the costs of processing and disseminating information. But any material embodiment or encoding of information is still strictly speaking rivalrous. As an overdue notice from a library attests, two people in different places cannot use the same book at the same time. As the waiting time to download from the Internet attests, electronic packets on telephone networks are still rivalrous and can lead to congestion effects. It is only immaterial ("disembodied") knowledge, information, ideas, concepts, functions, forms, and other abstract objects of thought that are purely non-rivalrous.

Philosophers from Plato onwards have struggled with the best way to talk about the objects of thought that are "in the mind" (e.g., the abstract objects of mathematics such as numbers and geometric figures) since, by assumption, they do not exist as (rivalrous) material objects.1 The number thirteen is

represented by the numeral "13" written on this page and describes the number of characters in the English word "non-rivalrous" but the number itself is not identified with any material embodiment. It is the number as an abstract concept that can be shared in a purely non-rivalrous way. We can all use the number thirteen without diminishing each other's or anyone else's use of the number. Disembodied knowledge is non-rivalrousness; it is the process of embodying knowledge in people (learning) and things (application) that is costly in time and resources.

When non-rivalrousness is understood in terms of the mental or intentional content that is "shared" when we communicate and understand one another, then it is seen to be independent of truth and falsity. We can all share the idea of pigs that fly without there being any truth to the notion. Misinformation is as non-rivalrous as information. The low cost of information transmission allows rumors, true or false, and expectations, founded or unfounded, to rapidly spread and add volatility to many social mechanisms.

Increasing Returns Processes

Processes driven by knowledge and information tend to exhibit self-reinforcing dynamics which might be encountered as positive feedback processes, vicious or virtuous circles, cumulative circular causality, and increasing returns phenomena.2 These vicious and virtuous circles (cumulative circular causation) run through the literature of development economics3 as well as economic theories that feature increasing-returns processes, from the early work of Young (1928) and Kaldor (1978) through the recent work on strategic complementarity, the new growth theory emphasizing endogenous knowledge-related self-amplifying processes, and network economics. The most important attribute that lends itself to self-reinforcing processes is the scarcity-defying expansiveness or non-rivalrousness of forms.

It has long been a commonplace to recognize the importance of knowledge, particularly technological knowledge, in production. Instead of seeing knowledge as another factor of production along side the traditional trinity of land, labor, and capital, Kenneth Boulding (1978) proposed the taxonomy of knowledge (know-how) together with matter and energy (or following Einstein, matter-energy). Adam Smith's account in The Wealth of Nations of the mutual reinforcement between the specialization of labor and the extent of the market was a knowledge- related increasing returns process. Alfred Marshall said that "although nature is subject to diminishing returns, man is subject to increasing returns

Knowledge is the most powerful

engine of production; it enables us to subdue nature and satisfy our wants." And John M. Clark said that "knowledge is the only instrument of production that is not subject to diminishing returns." The matter might be clarified by considering two extreme types of processes: one constrained by scarce resources and the other driven by scarcity-defying knowledge (See box: Techniques that can Spread like Fire).

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For instance, whenever the substance or material part of a process is not scarce, then self- replicating4 or self-reinforcing forms can multiply or "snowball" freely in an increasing returns process ("The more, the merrier").5 Eventually, some limitation of rivalrous substance will set in and the growth processes will level off and diminishing returns may take hold. Other processes may be constrained by rivalrous substance to a greater degree and exhibit diminishing returns from the beginning. That is why extractive industries with limited high-grade ore deposits or agriculture with limited fertile soil will show strong diminishing returns.

Box 1: Techniques that can Spread like Fire.

Suppose that a caveman and a cavewoman each discover a new way to make fire. The caveman's technique involves using a special material, such as flint stones, and very little know-how (hitting the stones together). The cavewoman's technique involves common and readily available materials, such as wooden sticks, and a lot of know- how (techniques of rotating a stick at high speed to generate frictional heat). The material-constrained technique might spread quickly as long as the special flints were available but the deposits of quality flints might soon run out. As the technique was more widely used, diminishing returns would set in. The know-how constrained technique would take some investment in time and energy to learn the methods. But due to the non-rivalrousness of knowledge, the knowledge-based method could spread throughout the population while the material-based method would be limited by the supply of the rivalrous high-quality flints. The knowledge-based technique would spread in a self- reinforcing manner exhibiting the properties of increasing returns; the more who used it, the more who could learn the method and the more improvements that might also be made.

Processes driven by knowledge with little material requirements, such as speaking, reading, and writing a language or doing arithmetic, can spread throughout the population without showing signs of exhaustion or diminishing returns. For instance, the more who use a certain language in a region, the more others will be motivated to learn and the easier it will be for them to learn.

Thus, the knowledge-acquisition "industry" of education has spread throughout the world with material resources and social taboos being the primary limitations. Most industries involve some mixture of resource-constrained processes and knowledge-driven processes. Roughly speaking, the more an industry is knowledge-based using readily available materials (e.g., producing computer chips out of sand), the more the industry will display the properties of increasing returns. The contrast is summarized in Table 1.

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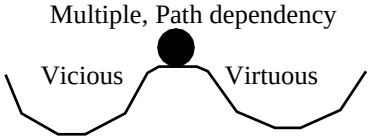
Table 1	Economics of Material Resources	Economics of Intellectual Resources
Resources	Physical materials	Information, knowledge, ideas
Multiple Use	Rivalrous	Non-Rivalrous
Exclusivity of Use	Excludable	Non-excludable (once public)
Nature of Goods	Private	Public
Typical Returns	Decreasing	Increasing
Processes	Negative feedback or self-limiting to restore equilibrium.	Positive feedback or self-reinforcing. Vicious & virtuous circles.
Table 1	Economics of Material Resources	Economics of Intellectual Resources
Equilibria	Unique, Stable 	Multiple, Path dependency 
Jumps	Nature does not make jumps. (Marshall)	Nature does make jumps. (Rosenstein-Rodan)
Changes	Marginal adjustments to return to equilibrium.	Non-marginal "Big push" to escape vicious circle. Non-marginal "Big pull-back" to stop unraveling from a virtuous circle.

Self-Fulfilling Prophecies6

Many self-reinforcing social processes are driven by expectations that will tend to confirm themselves. Fads, fashions, and bandwagon effects drive much of our "cultural" life where a celebrity is like a "nationally advertised" brand that is "well known for its well-knowness."7 (See box: The Image-making Business) These processes, driven by information or misinformation, are particularly important in the financial sector. Bubbles, euphoria, panics, and runs can drive financial market trends with only a loose connection to the ex-ante underlying fundamentals. If enough depositors believe that a bank is in trouble or if enough security and currency traders believe a country faces an imminent crisis, then events may unfold to fulfill those prophecies.8 If enough people think a certain type of painting or other collectible is "valuable," then indeed it will have a market value. Money itself is perhaps humankind's most important self-fulfilling prophecy. If enough people think a certain currency has value, then it does.

The same type of information and expectation-driven dynamics can occur in society quite independently of the market. In education, if teachers have particularly low or high expectations for a certain subpopulation, then they may act accordingly and tilt outcomes in that direction. A individual's own self-confidence and self-esteem–or lack thereof–can function in the same manner. Similar vicious circles perpetuate dependency relationships in the development process. The experts judge that their

pupils are not yet ready for self-direction or autonomy and thus should remain in tutelage–and yet as long as the pupils remain in tutelage, the prediction will tend to be self-fulfilling.9

Box 2: The Image-making Business

"The Graphic Revolution has given advertisers--like news-makers, celebrity-makers, tour agents, movie directors, do-it-yourself photographers, and each of us in a thousand new ways—an unprecedented power to make things 'true' The successful advertiser is the master of a new art; the art of making things true by saying they are so. He is a devotee of the technique of the self-fulfilling prophecy." (Boorstin 1962, 219)

Self-Enforcing Conventions and Network Economics

Information failures in market transactions often involve asymmetries in quality information between the buyer and seller; the seller knows much more about the quality of the commodity, or the lack thereof, than the buyer. The use of weights, measures, and other standards is one of the devices developed by humankind to help equalize the information on both sides of a transaction. Standards can be seen as a type of public good that is available to benefit everyone. The introduction of standards provides examples of information-related self-reinforcing or positive feedback processes that arise from network externalities.

Network economics provides the strongest source of recent interest in knowledge-related increasing returns processes.10 These processes tend to restructure markets into "winner-take- all" markets. (See box: Winner-Take-All Markets) The increasing returns aspect of network connections is easily seen by considering a network with a connection between every pair of members (e.g., a telephone network). If there are N members, then a new member will add N new links to the system so that the extra benefit of new member will tend to increase with the size of the network (ignoring congestion effects).11

Conventions might spread over a network on a voluntary basis through a self-reinforcing or auto-catalytic process. Each trader who adopts a certain set of standards adds some potential external benefit to the network of traders already using that standard. In a network of traders, diverse standards have a "Tower of Babel" effect of raising transactions costs. The use of the decimal system of Hindu-Arabic numerals, the QWERTY layout for keyboards, the use of the metric system for international science, and the use of English as the lingua franca of international business are examples of standards that spread on a voluntary basis. More recently, Tim Berners-Lee's conventions for URLs, HTTP, and HTML have turned the internet into the phenomenon of the World Wide Web. Once adopted on a wide scale, the cost of changing standards causes the existing standards to "lock in" and be self-reinforcing (the fact that a standard is used is the reason to continue using it).

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Box 3: Winner-Take-All Markets

The communications revolution has aggravated the development of winner-take-all markets. Before television, there was more of a market for face-to-face cultural and sporting events. The best entertainers or sports figures can only be in one physical place at a time so there were plenty of opportunities for the second-best, and lesser performers. But with the communications revolution and the non-rivalrousness of information, the best performers can at least electronically be "everywhere at the same time" so the market for talent moves towards

Box 4: Decimal Time: A Failure of Lock-In

After the French Revolution, the new metric system for weights and measures locked in for the non-English-speaking world and for international science, but the simultaneous attempt to decimalize time was a complete failure.

"The legislation was introduced in 1790; commissions were appointed for weights and measures on the one hand and time on the other. Both were adopted. Decimal time beginning with year one from September 22, 1794 and the 12 months of thirty days each: *Vendémiaire, Brumaire, Frimaire, etc.*, weeks of 10 days was adopted partly to break down the Christian system of Sundays and holy days. It lasted only ten to twelve years. Decimal time with 10 hours of 100 minutes each per day survived far less–failing to survive for two years " (Kindleberger 1983, 389-90)

Conclusion: From the Transmission of Substance to the Propagation of Form What are the principles behind the dizzying array of examples of self-expanding and auto- catalytic processes? My premise is that while all processes combine form and substance, the more a process becomes form-based—minimizing the role of substance—the more the non- rivalrousness of form gives rise to the self-expanding and auto-catalytic properties.

The dramatic improvements in communications that gave rise to the modern ICT revolution resulted from technological changes that changed communications so as to minimize the transmission of rivalrous substance in favor of the propagation of non-rivalrous form. Both types have long been present. Communication by spoken language or visual signals uses the propagation of form (modulated waves in air or line-of-sight signals using light waves) but the invention of writing allowed communication over greater distances, out of earshot or line-of- sight, by the transmission of substances (written messages). Sound recordings and photography gave other ways to communicate by the transmission of substances (records, tapes, and photos). But the invention of telegraphy, telephony, radio, television, and fiber optics reasserted the superiority of communication by the propagation of form (waves in electro-magnetic fields).

The recipe to increase the self-expanding nature of processes is to "open the gates to Plato's Heaven" by minimizing the role of rivalrous substance and maximizing the role of non-rivalrous form.

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Appendix: More on Self-Reinforcing Processes

Vicious and Virtuous Circles

In the informal literature, self-reinforcing processes are often called "vicious circles"12 or "virtuous circles" depending on whether the outcome is considered undesirable or desirable.13 Vicious and virtuous circle models are used in both a dynamic and a static way. For instance, a "vicious circle" might be a dynamic self-reinforcing downward spiral, or it might be a static low- level equilibrium locked in by a circular pattern of causality requiring a "big push" to break out of the equilibrium. Vicious and virtuous circles can also have positive or negative externality or spillover effects to create similar or opposite circles in the neighborhood. For instance, a virtuous circle of city growth might have a positive "spread effect" in a suburban neighborhood and a negative "backwash effect" in a nearby rural area.14 The imagery of vicious and virtuous circles is prominent in the recent literature15 on social capital and trust (See box: Virtuous Circles of Social Capital). Social capital and trust are "moral resources"16 that display the self- reinforcing qualities of increasing with use (or decreasing from disuse). Trust leads to more trust, but it also works in reverse. Distrust can remove the opportunity to build trust and can lead to self-fulfilling distrustful behavior on the part of others.

Box 5: Virtuous Circles of Social Capital

"Stocks of social capital, such as trust, norms, and networks, tend to be self-reinforcing and cumulative. Virtuous circles result in social equilibrium with high levels of cooperation, trust, reciprocity, civic engagement, and collective well-being. These traits define the civic community. Conversely, the absence of these traits in the *un*civic community is also self-reinforcing. Defection, distrust, shirking, exploitation, isolation, disorder, and stagnation intensify one another in a suffocating miasma of vicious circles. This argument suggests that there may be at least *two* broad equilibria toward which all societies that face problems of collective action (that is, *all* societies) tend to evolve and which, once attained, tend to be self-reinforcing." (Putnam 1993, 177)

The Matthew Principle: The Rich Get Richer, the Poor Get Poorer

Gunnar Myrdal has probably done the most to popularize the notion of the vicious circle in the economic development literature particularly to account for persistent and increasing national and international inequality. Positive feedback means that some deviation or tendency is reinforced (rather than curtailed as in negative feedback or decreasing returns) so the process "snowballs" until it meets some countervailing force. For developing countries, processes of "catching up" or "falling behind" can be respectively accelerated or aggravated (at least in relative terms). These divergence dynamics are sometimes called the "Matthew Principle" or "Matthew Effect" (Merton 1973) after the Biblical reference: "For to everyone who has will more be given, and he will have abundance; but from him who has not, even what he has will be taken away." (Matthew 25:29) The "rich get richer" and the "poor get poorer." "Them that has, gets." (Kelly 1994, 469) A virtuous circle and a vicious circle operate to drive the dynamics of divergence in opposite directions. The vicious circle leads to a low-level equilibrium and the virtuous circle to a high-level equilibrium. There is a "critical mass" in

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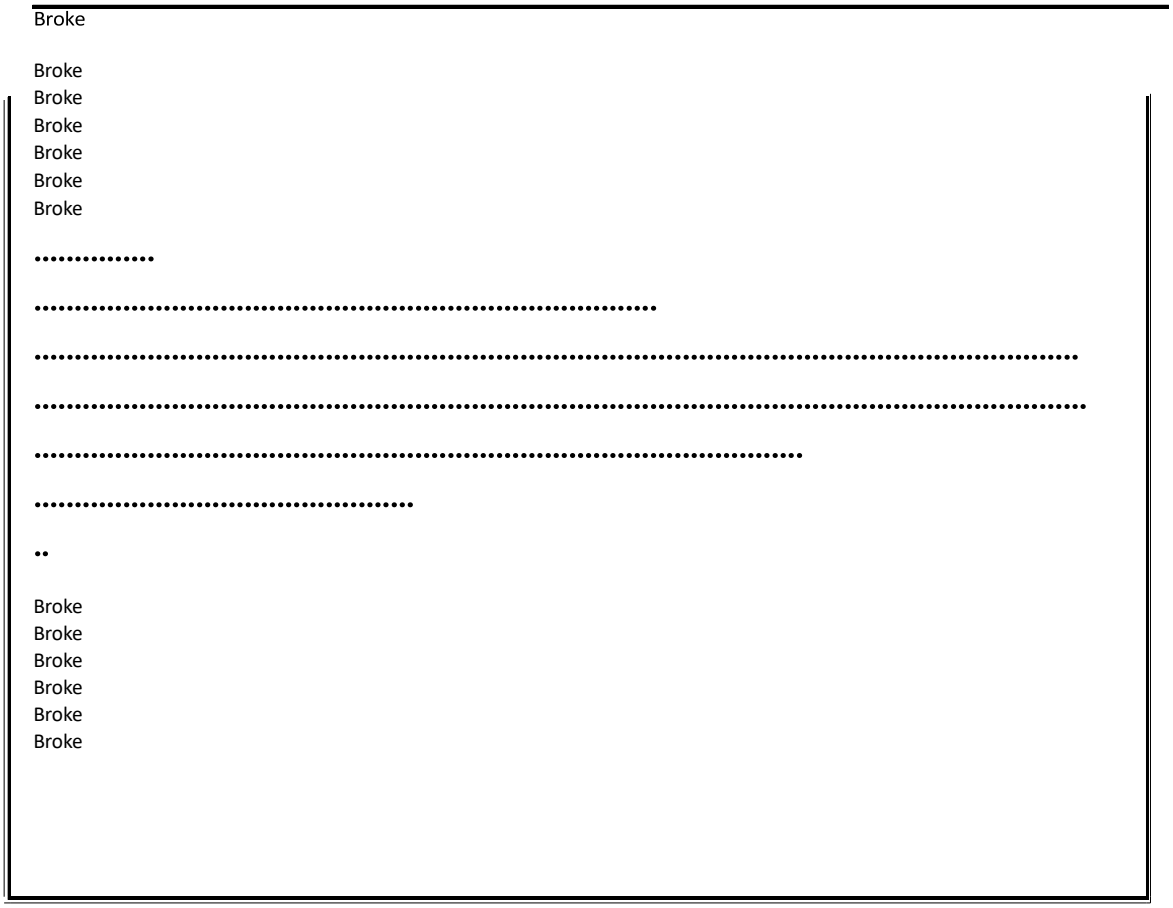
between. To get out of the trap of the low-level equilibrium, a "big push" of coordinated action is needed to achieve the critical mass so that the virtuous dynamics will take hold and drive to the high-level equilibrium.

Box 6: Polya's Urn: Modelling the Matthew Principle

One simple model of a self-reinforcing process is Polya's Urn. (See Chung 1974) An urn contains red balls and black balls. The probability of randomly drawing a red ball is equal to the number of red balls divided by the total number of red and black balls. Suppose that after a ball is drawn, it is placed back in the urn along with one or more balls of the same color (to "one who has will more be given"). Then the probability of drawing a ball of that color has increased on the next drawing and the probability of drawing the other color has decreased. Then one might also take away an equal number of the other balls to keep the total number constant (so "from him who has not, even what he has will be taken away" until one of the balls "goes broke"). To add more types of balls, it would be best to use numbers rather than colors (so there would be so many 1-balls, 2-balls, and so forth up to N-balls, instead of red and black balls). These urn schemes can be modeled on computer spreadsheets. Neighborhood effects can be added taking the probability of drawing an n-ball as the average of the number of n-1, n, and n+1 balls divided by the total number of balls (where the N-balls are taken as "next door" to the 1- balls). In such a circle or ring of location



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