COMPETITION IN THE COMMUNICATIONS SECTOR: CAN UNPREDICABLE SYSYTEMS BE REGULATED?

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Nothing more certain than uncertainties
Fortune is full of fresh variety
Constant in nothing but inconstancy.

Richard Barnfield (1574-1627)[1]

I. Introduction

Who is responsible for the fact that competition did not thrive in the communications sector? Unless you can believe in a giant conspiracy theory that involves virtually every elected official, countless staffers, agency heads, civil servants, and industry leaders in dozens of countries, the answer may be "no one." It certainly did not work out the way many people thought it would, but is that somebody's *fault*? Or was the real mistake a failure to manage expectations?

During the 20th Century experts in many fields came to the conclusion that when many forces are at work on a system it tends to get very complex and essentially unpredictable. Some have even concluded that in complex organizations unintended consequences are virtually inevitable.[2] This was not easy to accept for people (particularly in western cultures) who had spent hundreds of years trying to describe and

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[1] From *Sonnet*, 1607.
[2] Charles Perrow, *Normal Accidents: Living With High-Risk Technologies*, New York: Basic Books, 1984.

predict the world with mathematical accuracy. But it has become an article of faith for many (but not all) practitioners in disciplines from physics to economics. It remains a difficult concept for business managers and policy makers who want to believe that their actions will lead to predictable outcomes. But the unanticipated outcomes of competition policy are now too frequent and too important to ignore. It is time to seriously reconsider our assumptions about the processes we are trying to regulate and the process of regulation itself.

Both the communications sector and the world it operates in are getting more complex all the time. This complexity is caused in large part by the fact that people and businesses are more closely linked to each other both physically and virtually through transportation and communication networks. Being connected to more people and more places means there are more forces that you can affect and that can affect you. And the more forces at work, the more complex the system becomes. As we will see, if this increased connection is "tightly coupled" then the opportunities and dangers in any part of the world are felt almost instantly in many places around the globe. The "environment" we all live in is influenced by the interaction of economic, political, and social forces from areas as remote as the highlands of Afghanistan, Scotland and Western China. Any change in the mix of forces at work (e.g., political, economic, military) will move the system, but in essentially unpredictable ways, and often (as we have seen so often in recent years) in ways that are the opposite of those intended.

For example, towards the end of the last Century many concluded that more *competition and trade* was the answer to economic problems around the world. But almost as soon as new treaties and laws were put in place to encourage this new competition (through privatization and liberalization), a wave of *cooperation* began in many sectors of the world economy that resulted in the highest level of consolidation those sectors have ever seen. The more that individual governments and global organizations tried to promote competition, the more cooperation seemed to take place. In the short term, competition did appear in many industries, but then, when the firms had been weakened by the fierce intraindustry competition, new challenges appeared in the form of competition from other industries and a downturn in the economy. The result was fewer resources for all the competitors, plummeting stock prices, and a wave of bankruptcies followed by the development of giant, multinational entities.

Nowhere was this pattern more evident than in the networked industries (communications, transportation and energy) that were opened up to competition (in some cases reopened) for the first time since the end of the 19^{th} Century. After the introduction of this new wave of competition, many large communications companies merged to make even larger ones and they became more diversified in their interests: Telephone companies often became some of the largest owners of wireless communications networks and, in some countries, of cable systems. Broadcast and print companies around the world saw unprecedented consolidation of ownership. In many of these cases, control of the communications assets went to people or firms in countries outside of where the assets were located. The communications sector began to look as if it might evolve into several large organizations, with much multinational and interlocking ownership that could acquire or destroy any competition and then ignore the concerns of the governments who had often made their growth possible through generous subsidies for things like research and development.

While it is dangerous to make any definitive analysis of this on-going process, it is possible that one of the real problems was a failure to fully understand how an increasingly complex and interconnected world would confound our expectations.

II. Scope of This Paper

This paper reexamines some of the basic assumptions we have come to rely on in regulating competition in networked industries like communications, including assumptions about the predictability of these systems and how unpredictability affects competition and cooperation. This paper does not advocate or vilify any political idea or administration. In any case, political administrations are often more different in rhetoric than they are in practice. The ideas here will be useful whatever the current political realities or economic situation.

Nor is this an exercise in a particular economic theory. Economics is, for all its faults, an excellent starting place for analysis of competition policy. It has been used, with varying degrees of success, in most of the important policy debates on this topic. But there are as many points of view in economics as there are in politics, all of which have some currency around the world. An examination of political and economic forces is necessary but not sufficient to find a new way to deal with this problem. Ideas from just one or two disciplines will not be enough. Particularly when the exact nature of the problem and what we want to accomplish are not immediately clear.

A multidisciplinary approach is necessary but it will not be easy. Most disciplines continue to believe that they "own" the best way to look at the universe or human systems and talking to other disciplines would be a waste of time. Fortunately, many disciplines have, independently, begun to study complex systems. For example, ideas from general systems theory and biology have produced important clues (although none offers unqualified *answers*) about the causes and effects of competition and cooperation in business firms and whole industrial sectors.[3] One of the great philosophers of science, Charles Sanders Peirce, called this borrowing of metaphors from other disciplines "abduction" and described how it can be used to creatively form a new explanatory hypothesis.[4] The borrowed metaphors here should not be interpreted as wholesale incorporation of them into competition policy, but as clues for forming new ideas about regulating competition in communications industries.

Any clues from these new fields will deliver a bonus: they will not depend on any current political or economic point of view. However, they may be consistent with one or all of these points of view. This means that the ideas developed here can be applied in many countries, with many different political and economic realities. The ideas do not need to be applied the same way everywhere in order to be helpful. In the short term,

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[3] P.H. Longstaff, *The Communications Toolkit*: *How To Build Or Regulate Any Communications Industry.* MIT Press: Cambridge MA (2002). Chapter 4.

[4] See, generally, C.S. Peirce, *Collected Papers of Charles Sanders Peirce, vol. 5: Pragmatism and Pragmaticism*, ed. C. Hartshorne and P. Weiss. Harvard University Press: Cambridge MA (1934).

different applications will almost certainly be the case. If some sort of policy making at a global level is ever contemplated, ideas (or models) that are outside any particular political or economic system will be useful.

One thing is clear: both business competition and the government regulation of it are interlinked *processes* that operate over time. Any attempt to deal with them must take this temporal aspect into account. Neither the communications business not the governments that regulate it will ever stop evolving. The relative power of important stakeholders (both in government and in the various industries) is a key ingredient in the making of competition policy in all countries so this is likely to remain a *political* process. And the constantly shifting degrees of power for those stakeholders in their "home" and "adopted" countries means that the economic and political forces that drive or inhibit competition will make competition regulation a *complex political process*. On the business side, the development of competition and cooperation in any industrial sector is a complex *economic and social process.* Varying levels of resources available at any given place and time will mean that today's competitors may evolve into tomorrow's cooperators and vice versa.

Thus, we have an unpredictable political system trying to regulate an unpredictable business system, which is (in turn) trying to influence the political system. And neither the political system nor the business system typically recognizes the temporal aspects of the situation. They assume that the actions they take at one point in the process will have the desired effects and then the process will *stop*.

Here is what is predictable from all this: the process will continue and the communications sector (and all the stakeholders) will continue to evolve in ways that are essentially unpredictable over the long term. So we should just give up? No, but we do need change our ideas about what is possible and redefine "success." If you promise constituents or shareholders that you can "fix" a problem in the system and that it will stay fixed, you are setting yourself up for "failure." There is a better way.

III. Predictability: Past and Present

Until the early 20th Century the apparent universal predictability of mathematics and Newtonian physics led many disciplines to assume that if you could just reduce a system to its basic forces and compute how those forces interacted, you could predict anything. This is known as "reductionism" and it offered a reassuring view of the power of human beings in the world: if we can just figure any system out to the point where we can reduce it to an equation, we can predict it and control it. But by the end of the 20th century, scientists in many disciplines had found truly unpredictable systems. The study of all these systems has given chaos and complexity theories their current forms.

The discoveries about complex systems in the scientific community did not escape the notice of philosophers and their discipline underwent a similar change. Until the 20th century, most of Western philosophy continued to search for the true nature of the universe in something unchanging and with universal application. But from Plato's "forms" to Descartes' "method," each search ended in failure as the limits of the knowable were expanded. This led many to recall the ideas of Aristotle, who abandoned the idea of universal forms and embraced the idea of the potential embodied in each individual and each species. In this he foreshadowed Charles Darwin's ideas about evolution and reality as a *process* rather than a fixed state of affairs. Karl Marx is said to have perceived the evolution of human societies. Many philosophers, including Kierkegaard and the Existentialists, concluded that existence is always in the process of developing. Instead of a search for the keys to a system where things can be predicted, the goal (for many disciplines) had changed to looking for right point of view from which to observe the process. And even that goal came under fire from the Postmodernists who insist there is no right viewpoint and only diversity is essential. All of this work made suspect any theory that claimed to be universal in its application. That was not good news for ideologues of any stripe, but was particularly bad news for any form of authoritarianism.[5]

Both the lawmakers in modern democracies and the mangers of modern businesses have often ignored philosophers and scientists in favor of those who present Cartesian graphs with anticipated trends based on mathematical formulas. It is comforting to pretend that economic, political, and social systems are predictable. But this belief in predictability leads to one of the more regrettable spectacles in modern democratic politics and corporate governance: when the system does not perform as predicted, someone is assumed to have made an error. This leads to the all too familiar practice of finding a scapegoat who can be sacrificed to show that the problem has been "fixed." And, because nobody wants to be the one sacrificed, all will turn a blind eye to the problem or even falsify records to hide the problem – until the problem gets too big to hide and everyone runs for cover. In the meantime, the wrong people have either benefited or been inadvertently hurt. It would be better for everyone if the general understanding about and expectations for complex systems could change.

The ideas about complex systems were not developed by any one field and were not accepted overnight. Indeed, they remain controversial in some disciplines and in their application to some issues. These new ideas are referred to by many names and there are no bright lines between them. These names include complexity theory, chaos theory, complex adaptive systems, general systems theory, nonlinear systems, self-organizing systems, and far-from-equilibrium systems. Most scholars would agree that complex systems are different from chaotic ones. The latter are systems that have become unstable or turbulent due to the buildup of small perturbations in the forces working on them. For example, water running in a pipe will become turbulent or chaotic at certain velocities. The former are systems that often operate under very simple rules but exhibit unpredictable or surprising behavior when several forces interact in the system.

Systems are said to become "complex" when they have intricate interdependencies among their various parts and many variables operating at the same time. Examples of complex systems include the human metabolic system, the world's

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[5] For an extended discussion of these ideas, see, F. Davis Peat, *From Certainty to Uncertainty: The Story of Science and the Ideas of the Twentieth Century,*" Washington, D.C.: John Henry Press (2002).

weather, and the spread of disease in a population. Complex systems are generally nonlinear, that is, the effect of adding something to the system (an infected person or the air disturbed by a butterfly flapping its wings) may diffuse unevenly throughout the system because the other components of the system are not evenly distributed, or the force doing the distribution is not equally strong throughout the system.[6]

Think of throwing a handful of buttons on the floor and then connecting them in various ways: some are connected by heavy steel bars, others are connected by cotton string, magnets connect some, and others are connected only by dotted lines on the floor. All the red buttons are connected to each other and some of the red buttons are connected to blue buttons. Most (but not all) of the blue buttons are connected to one yellow button while all of the red buttons are connected to another yellow button. This group of buttons is sitting on top of an active earthquake area. Could you predict what will happen to any one of the blue buttons if an earthquake hit its vicinity or someone pulled the string at one of the yellow buttons?[7]

These systems have another surprising property: adding something that can be duplicated may cause a shift in the total system that is greater than the amount added. For example, sending a rumor about a company via email to a friend in that company only adds one piece of information to that company's information system. But, because many agents (employees) in the company are connected via email, the piece of information multiplies in the system as each employee sends it to many others. The information will multiply in the system because the agents are interconnected in a network.

Complex systems are *adaptive* or a said to *evolve* when individual agents operate independently and change their behavior in response to forces in their environments via feedback. In some systems the agents can "learn" from each other when some agents obtain more resources and their actions are copied by other agents. In systems where the

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[6] For work on these ideas being done in the EU, see, e.g., *Control of Comlex Systems*, Karl J. Astrom (Editor), Springer Verlag (2000).

change is not learnable (for example, it is a mutation in how the organism is built) it can become prevalent in succeeding generations because agents who have changed will leave more offspring. For example, a mouse with better hearing is more likely to survive the presence of foxes in her environment and will leave more offspring than other mice. Over many generations these offspring will also leave more offspring and gradually the number of mice without the acute hearing will decline. The mouse population will have adapted to this opportunity through positive feedback (the system rewards better hearing with more offspring). Systems that evolve over time are called Complex Adaptive Systems. Animal species (including humans) are made up of individual agents and the species will evolve to adapt to changes in their environment.

> In Complex Adaptive Systems there are often many participants, perhaps even many kinds of participants. They interact in intricate ways that continually reshape their collective future. New ways of doing things – even new kinds of participants – may arise, and old ways – or old participants – may vanish. Such systems challenge understanding as well as prediction. These difficulties are familiar to anyone who has seen small changes unleash major consequences. Conversely, they are familiar to anyone who has been surprised when large changes in policies or tools produce no long-run change in people's behavior.[8]

German scientist Dietrich Dorner has given us another way to visualize complex systems.

> …we could liken a decision maker in a complex situation to a chess player whose set has many more than the normal number of pieces, several dozen, say. Furthermore, these chessmen are all linked to each other by rubber bands, so that the player cannot move just one figure alone. Also, his men and his opponent's men can move on their own and in accordance with rules the player does not fully understand or about which he has mistaken assumptions. And, to top things off, some of his and his opponent's men are surrounded by a fog that obscures their identity.[9]

Some modern legal scholars have suggested that limited predictability can be found in game theory. This "theory" is actually a group of hypothetical games in which the players are expected to maximize their individual outcomes. Some games seem to

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[7] This is an adaptation of the "Buttons and Strings" metaphor used by Stuart Kaufman to explain complex systems in *At Home in the Universe: The Search for the Laws of Self Organization and Complexity*, New York: Oxford University Press (1995), pp. 55-58.

[8] Robert Axelrod and Michael D. Cohen, *Harnessing Complexity: Organizational Implications of a Scientific Frontier,* The Free Press: New York (1999), p. xi.

[9] Dietrich Dorner, *The Logic of Failure: Recognizing and Avoiding Error in Complex Situations*, New York: Metropolitan Books (1996).

offer clues about what makes individuals cooperate or defect in their interactions with others. Others games may give policy makers and judges some guidance on important issues such as tort reform. These games reach their limitations when the game gets too big or has too many players with insufficient information to make their "moves" predictable.[10]

All this seems to imply that the focus for regulating a complex system should not be on trying to make each and every part of it predictable but on dealing with (or managing) the unpredictability and unintended consequences. This means a shift in both the focus of effort and expectations for competition policy.

IV. The Communications Sector as a Complex System

All the communications industries are increasingly linked together by their need to compete for several scarce resources, principally the time, attention and money of consumers. Indeed, some have predicted that they will all "converge" into one industry.[11] Although convergence is not *a fait accompli*, it is undeniable that increased competition has made all the formerly distinct industries look hungrily at each other's customers. At the same time, they are linked to many other systems such as equipment and content suppliers as well as many layers of government. The more that globalization links these industries and their agents to each other, the more complex the system becomes.

The worldwide communications sector has at least two layers of agents: the consumer layer and the provider layer.[12] These agents constantly adapt to changes in the technological, regulatory and business forces in their own layer and, over time, to changes in the other layer. Computers contribute to the system's complexity because the

[10] See, e.g., Douglas G. Baird, Robert H. Gertner and Randal C. Picker, *Game Theory and the Law*, Harvard University Press: Cambridge MA. (1994).
[11] For the forces pushing the industry together and pulling it apart, see P.H. Longstaff, *The Communications Toolkit*: *How To Build Or Regulate Any Communications Industry.* MIT Press: Cambridge MA (2002). Chapters 7 and 8.
[12] See, Robert Axelrod and Michael D. Cohen, *Harnessing Complexity: Organizational Implications of a Scientific Frontier*, New York: Free Press (2000).

widespread adoption of digital coding has broken down many of the technical and geographic barriers that formerly separated distinct industries such as publishing and computing. Computers also increase the speed at which information moves in the system, allowing individual agents to change strategies and tactics much faster. The system is made even more complex by a divergence in time frames: as communication sector evolves faster, other processes (policy making, business formation) move relatively more slowly and have difficulty keeping up with the changes.

What might the communications sector become? Many fear that the new competition in communications services will evolve so that they will all travel through one Big Pipe (either cable or telephone) to a Big Box in the home that functioned as computer and television (and connected to many other appliances) that delivered the Big Messages of a few multinational entertainment producers. And these services would be provided by Big Companies that had roots in many countries but allegiances to none. It is clear that increased competition does not necessarily bring diversity among the competitors, at least not in the long run.

V. Regulating an Unpredictable System

This discussion must begin with a question that many will assume is self-evident: What does it mean to "regulate" a system? If we look at this process outside of the governmental and management systems where most of us operate, and think like engineers for a minute, we see that regulation is a process that is set up to keep a system within acceptable limits. Think of the "regulator" on a boiler that provides steam heat to a building. It regulates the steam pressure inside the boiler by releasing some of it if the pressure exceeds safe levels. Or, closer to home for most of us, think of the thermostat that regulates the temperature of your home or office. The thermostat sends a signal to the furnace (or air conditioner) to turn itself on when the air temperature gets out of an acceptable range. The thermostat does not control the temperature – it controls the heating/cooling systems reaction to changes in the temperature. It has two functions. First, it gathers information about the current temperature in the room using a sensing device. Second, if that information indicates that the system is outside the acceptable parameters, it sends a signal to the machines that will add hot or cool air to the room until it senses that the temperature has come back to within those acceptable parameters.

The ordinary thermostat does not *predict* the temperature in the next minute – it does not know when someone will open a door and let cold air into the room but it can *adapt* the heating system to this event. Thermostats gather information from the environment and then use that information to form a *feedback loop* that tells the furnace to turn on or off. Feedback loops are standard stuff in engineering systems that must adapt to changing conditions. They work well when the parameter of the system you want to regulate is easy to measure (like temperature). In Section VII we will come back to the idea of feedback.

Not all systems are so simple. But just because some systems are complex, that does not mean they are unmanageable or ungovernable. The management just takes different forms and makes different assumptions.[13] Where we have come to expect certainty we are now (sometimes reluctantly) accepting the necessity of dealing with uncertainty. But it is easier, especially in times when things are going well, to claim that your system is operating just the way you *planned for it* to run.

In fact, management theorists have begun to use these ideas about unpredictability and complexity. In 1990, Peter Senge published what would become one of the more influential business books of the late twentieth century. He saw systems theory as a way to create "learning organizations." But he knew it wouldn't be easy.

> Business and other human endeavors are also systems. They, too, are bound by invisible fabrics of interrelated actions, which often take years to fully play out their effects on each other. Since we are part of that lacework ourselves, it's doubly hard to see the whole pattern of change.[14]

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[13] Id. See, also, Robin Wood, *Managing Complexity: How Business Can Adapt and Prosper in the Connected Economy,* London: The Economist Association with Profile Books (2000).

[14] Peter Senge, *The Fifth Discipline: The Art and Practice of Learning Organizations*. Doubleday: New York (1990), p. 7. For earlier work in the same vain, see, Chris Argyris, *Integrating the Individual and the Organization.* Wiley: New York (1964).

Senge set out to destroy "the illusion" that the world is created by separate, unrelated forces and to develop understanding of *dynamic complexity* where cause and effect "are not close in time and space and obvious interventions do not produce the expected outcome."[15] Subsequent writers, such as Robert Louis Flood, have expanded on this idea and repeated the warning against reductionist thinking in complex situations.

> An 'A caused B' rationality is a source of much frustration and torment in people's lives. If a difficult situation arises at work, then an "A causes B' mentality sets up a witch-hunt for the person or people who caused the problem.[16]

The 'Blame Game' may be helpful for immediate emotional or political purposes but it seldom fixes the real problem. Most experienced lawmakers and business leaders already suspect the unpredictability of the system(s) they operate in. But they can't bring their suspicions into the open because they fear this will be seen as a less than honest "excuse" for the unintended consequences of their actions. Or, when bad things happen, leaders often fear that they have just misjudged something or did something wrong – and that would mean they can be *blamed*. In truth, they may have done everything right but could not predict (because no one could) the effect their actions would have on the system. This does *not* mean that there are no incompetent business people and regulators – and their actions will always be one of the things that make this an unpredictable system. But it is time to admit that these systems cannot be "engineered" in advance by omniscient leadership. Leaders may find that they accomplish their goals not by building organizations (and the rules that govern them) based on predictions, but by building organizations (and the rules that govern them) based on adapting to the unpredictable.

VI. Tightly/ Loosely Coupled Systems and Network Science

Like the system of variously connected buttons described in Section III, most systems have connections that vary in their strength. This has been observed in living systems (at the cellular, organism and group levels) as well as nonliving and human-engineered systems. Understanding the strength of coupling in a system can help devise

[15] Ibid. p. 364.

regulatory or management responses to perceived challenges. It should be noted that any insights gained from viewing a system in this way DOES NOT increase the ultimate predictability of complex systems. But these insights may give those trying to manage such systems new ideas about how to nudge them in the desired direction or keep them within the desired parameters.

Although Robert Glassman wrote about loosely and tightly coupled systems in biological systems, he saw that the concepts he developed could be applied to many organizations. In fact, his ideas have been applied to military organization,[17] organizational development,[18] cooperation among business firms,[19] and many other fields.[20] Glassman described the fundamental process of organization this way: "as soon as the relation between two entities A and B becomes conditional on C's value or state, then a necessary component of "organization" is present.[21] He then noted that the strength of that relationship (whether it is loose or tight) is important to understanding how the system reacts to stimuli. A number of similarities in loosely coupled and tightly coupled systems have been identified and used to help understand (even if they can't always precisely predict) these systems.

Tightly coupled organizations are those where any change in one component (individuals or subsystems) of the system will engender an immediate response from the other component(s). Any organization that requires an organization-wide rapid adjustment to new conditions is likely to be tightly coupled. A system could be tightly coupled if its components share many variables or the link between the variables is very

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[16] Robert Louis Flood, *Rethinking The Fifth Discipline: Learning Within the Unknowable*, Routledge: London and New York (1999), p. 84.

[17] Scott Snook, Friendly Fire: The Accidental Shootdown of U.S. Black Hawks Over Northern Iraq, Princeton, NJ: Princeton University Press (2000).

[18] John W. Meyer and W. Richard Scott, *Organizational Environments: Ritual and Rationality*, Beverly Hills CA: Sage (1983).

[19] Marc J. Dollinger, "The Evolution of Collective Strategies in Fragmented Industries," *Academy of Management Review*, 1990, Vol. 15, No. 2, pp. 266-285.

[20] For a comprehensive review, see, J. Douglas Orton and Karl E. Weick, "Loosely Coupled Systems: A Reconceptualization," *Academy of Management Review*, 1990, Vol. 15, No.2, pp. 203-223.

[21] Robert B. Glassman, "Persistence and Loose Coupling in Living Systems," *Behavioral Science*, Vol. 18, pp. 83-98 (1973) at p. 84. For an excellent overview of these ideas, see, Karl E. Weick, "Educational

strong. Engineered systems with automatic controls are said to be tightly coupled (if A happens then B is the automatic and immediate response). These systems often have very tight feedback loops that control all variables – this is sometimes described as a "feedforward" or "planning" system. The device called a "Watt's governor" is an engineering example because it "regulates" a variable by responding to minute changes and thereby exerting almost continuous control. Since anything that effects one part of a tightly coupled system will affect all parts, these systems are often unstable because the individual parts are not able to adjust to maintain their local stability. These systems are not associated with persistent behavior because they adjust as a unit to changes in the environment.

Loosely coupled systems are those where the components have weak enough links that they can ignore small perturbations in the system. A home thermostat is a more loosely coupled system than the Watt's regulator since it will not respond to minute changes in air temperature with minute changes in the operation of the furnace. Instead, it waits until a certain deviation from the desired temperature is detected before it sends a signal to turn on the furnace.

The components of a loosely coupled system are said to have more independence from the system than tightly coupled components since they can maintain their equilibrium or stability even when other parts of the system are affected by a change in the environment. The components of loosely coupled systems are also better at responding to local changes in the environment since any change they make does not require the whole system to respond. Thus, if innovation or localized response to particular problems were a goal then loosely coupled systems would seem to be in order. A more tightly coupled system could lead to premature convergence on a solution since all the components would be responding more or less in unison. However, if the goal is *standardization* across the entire system, then a tight coupling of the entire system (including all subsystems) is more likely to yield the right outcome. *Interoperability* of

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Organizations as Loosely Coupled Systems," *Administrative Science Quarterly*, March 1976, Vol. 21, pp. 1-19.

equipment or personnel is more appropriate for some organizations. In such organizations the components are not identical to other components of the system but are flexible and can work with many different components. Interoperability probably requires some tight coupling between subsystems and the larger organization, but it would allow the subsystems to be more loosely coupled.

Large organizations with several levels of subsystems may have some that are tightly coupled and others that are more loosely coupled. This allows local areas of stability when a subsystem is relatively independent of (or loosely coupled to) the larger organization or to other subsystems. This has implications for the adaptation of the larger organization because this process can only take place as fast as the most loosely coupled component. The temporary or partial independence of one or more components will slow down (or change) the process. This is an important insight for executives and regulators who must make predictions about the ability of a merged organization to develop "synergies" that result in higher profits or lower costs. For example, if one unit of the newly merged company is a film production company (they are famous for being loosely coupled internally) and it must be coupled with a telephone company (they are equally famous for tight internal coupling) the result may be a slower adaptation process than the telephone culture is accustomed to. If the telephone firm becomes unstable after it has become more tightly coupled to the film company, the latter will become unstable as well. At this point the film company is likely to seek a more loosely coupled relationship – or even a break in the relationship.

Large organizations can maintain stability (loose coupling) at a higher level or among various subsystems by having a special subsystem that deals with perturbations in variables that would upset other parts of the organization. In human political systems police and military forces are an example of subsystems that deal with problems (crimes or attacks) that affect parts of the system before those problems can affect the entire system. These special systems are often tightly coupled within themselves since they must often deal instantly and cohesively with situations that are dangerous to themselves and to others. The strength of the coupling within an organization can also change over time and in the face of new challenges. If an industrial organization that is loosely organized must deal with a security problem it is likely to develop tight coupling for this purpose if it must respond to the problem as a unit. This explains why governments typically allow competitors to cooperate in times of national crisis – particularly in the communications sector where they are a key element of local security information gathering and dissemination. Loose coupling might have some security advantages for a system if a problem (e.g., intruder, contamination) can be isolated in one (or a few) subsystems that are not tightly coupled to others.

There are a number of other instances where the strength of coupling within or between organizations can been identified and this information can be used to manage or regulate these systems.[22]

Adequate Resources

An organization may become loosely coupled if the individuals or subunits have resources that are more than adequate to meet their demands. They do not need to act as a team to get what they need. If governments want parts of their communications sector to act independently (e.g., eschew the urge to merge) they should look at whether there are adequate resources in the system to support the current organizations. If resources to individual companies are reduced (due to a falling economy or more firms trying to compete for the same amount) then one could expect some to form of tighter coupling relationships.[23]

Slow Change

An organization is probably loosely coupled if, no matter what new rules are applied, things do not change. This may indicate that the individuals or subsystems are effectively independent of the rule-maker. The rule-maker would need some reward (or, perhaps a punishment) to make the relationship tighter between its actions and those it seeks to

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[22] The examples of loose coupling are taken from Weick, note 23, at p. 5.

[23] Similar ideas about cooperation have been developed in biological systems. These systems can give many other clues about the nature of competition and cooperation that would be useful in competition

regulate. If a CEO of a newly merged company made new rules regarding preferential treatment for fellow units but the units were slow to change, this would indicate that the corporate headquarters is more loosely coupled to the subunits than it thinks. This loose coupling might be seen as a good thing if conditions at corporate headquarters become unstable.

Slow/Weak Spread of Influence

An organization may be more loosely coupled than it appears if, although it is highly connected, influence (the impact of a part on the whole) spreads weakly or slowly. Consider again the button system that has connections of many strengths and lengths. If the connection between two button is a tight one (e.g., they are connected by a rigid steel rod), then any influence on one will be felt immediately on the other and any other buttons that are tightly connected to them. If there is one button with many connections it may not be able to have as much effect on the whole system if those connections are loose (e.g. they are made of single strands of human hair). A modern multinational communications firm that is horizontally and/or vertically integrated may look like it is a tightly coupled monolith (and maybe a tightly coupled monopoly). But looks may be deceiving – both to regulators and shareholders. A large company that has loosely coupled subunits will not have fast or strong impact on its customers. Another firm that may not be as large may be more tightly coupled to its customers and its influence will spread more quickly or more strongly than larger, more loosely coupled organizations.

It should be noted at this point that there is a new (and growing) body of work that looks at the connections between things that can be graphed as a network. This has gained popularity as the "small world" problem. It asks why most people on the earth seem to be separated from each other by only 6 other people, or six degrees of separation. This body of work, originally done in a branch of mathematics known as graph theory, is being examined by researchers all over the world in many disciplines including political science, biology, sociology, and computer science. The strength of the bonds in these

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regulation and business management. See, P.H. Longstaff, *The Communications Toolkit: How to Build or Regulate Any Communications Business*, Chapter Four, Cambridge, MA: MIT Press (2002), Chapter 4.

networks has begun to be studied and there is some indication that it is an important part of the whole picture.[24] But the impact of this work on complex systems is still in the formative stages. Duncan Watts, one of the original researchers in this area, has this to say:

> What can the science of networks tell us about the properties of complex systems, and especially their strengths and weaknesses? The honest answer, unfortunately, is not too much – yet. It is important to recognize that, despite 50 years of percolating in the background, the science of networks is only just getting off the ground.[25]

But Watts thinks this work has already given important insights that are consistent with the ideas expressed in this paper. In particular, he believes that, "…in connected systems, cause and effect are related in a complicated and quite often misleading way."[26] This seems to be evidence that any simplistic form of the Blame Game is inappropriate in these types of systems. This is an area of study that should be watched closely by everyone trying to manage or regulate complex networked systems.

VII. Feedback for Regulating Competition

Two organizations may be loosely coupled to one another if one cannot perceive the actions of the other and thus cannot respond to them. If a firm does not know what actions its competitors are taking (e.g., lowering prices to largest customers) it cannot respond to them by lowering its own prices. If firms can not accurately perceive the actions of government regulators because those actions are not transparent, or if broad discretion is given to enforcement officials, then the various firms in that sector are likely to be loosely coupled to government and may respond more slowly and with less predictability to government actions. Failure of perception would also result from failure to develop or maintain appropriate feedback loops within the system that lets regulators

[24] See, e.g., Albert-Laszlo Barabasi, *Linked: The New Science of Networks*, Cambridge MA: Perseus Press (2002); Mark Buchanan, *Nexus: Small Worlds and the Groundbreaking Science of Networks*, New York: W. W. Norton (2002), pp. 34-47.
[25] Duncan Watts, "Unraveling the Mysteries of the Connected Age," *The Chronicle of Higher Education*, Feb. 14, 2003. at http://chronicle.com/free/v49/i23/23b00701.htm
[26] Id.

know when the system has evolved beyond acceptable parameters. These loops are typically established by procedures such as reporting requirements and/or inspections.

The problem is that we often confuse feedback with the mere two-way slinging of data. In engineering terms this is just trading "signals." Real feedback allows those receiving it to know what's going on.[27] You can send a lot of data without sending any real knowledge about what you're doing (read almost any report filed with a corporate headquarters or a government agency). But unless each subunit really understands what the other subunits are telling them, they cannot respond to them appropriately and unintended consequences for the larger organization are almost inevitable.[28]

It is NOT a matter of more data! Both business and government have spent billions of dollars on all kinds of new communications technologies that increased by several orders of magnitude the amount of data exchanged. Wasn't better "communications" among subunits one of the main goals of all those management information systems? There are more signals but there is not more understanding of those signals mean. Responding to a request for information with undigested data or in jargon that is unintelligible outside your own subunit is worse than a waste of time because it gives the *illusion* of knowledge. Yet it is common within and between subunits and organizations because the failure to send real information (let alone share knowledge) actually accomplishes several goals: it preserves the unit's power (information *is* power), it reduces the chance of second-guessing about operating decisions, it makes it less likely that you will be blamed for any bad things that happen with regard to this information.

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[27] Positive feedback amplifies fluctuations in a system while negative feedback enables the system to correct fluctuations that may be harmful. Both are used in business management and government regulation.

[28] Harvard's Anthony Oettinger began talking about the importance of context long before the Post Modernists. He has (for almost 40 years) been trying to get communications business leaders and government policy makers to understand the difference between *Knowledge and* what he calls *Cow* (data) and Bull (context). *See,* Anthony Oettinger, "A Bull's Eye View of Management and Engineering Information Systems," *Proceedings of the Association for Computing Machinery*, Philadelphia, PA, 1964, and, "Knowledge Innovations: The Endless Adventure," *Bulletin of the American Society for Information Science and Technology*, December/January 2001, Vol. 27, No. 2, pp.10-15.

The regulation of competition is *not* like the home thermostat "regulator" that gets feedback from the environment and uses that data to turn the furnace on an off when the temperature is outside acceptable parameters. In competition policymaking and its enforcement there is often very little feedback. The statutes (which theoretically set out the acceptable parameters of business actions) are extremely vague, the court decisions interpreting them struggle to set precedent, and the signals about possible levels of enforcement coming from government are often confusing and change with each administration. There is almost no data collected on a routine basis to measure what is supposed to be "regulated" (the level of competition in any industry) in order to signal the system to increase or decrease that competition. The feedback loops that would move information to the people who can turn it into knowledge and tweak the system *are almost entirely missing*.

VIII. Defining the Acceptable Parameters and Putting it All Together

Once a system of feedback is set up to move the appropriate information, somebody has to define the acceptable parameters in which the system can operate before some regulatory mechanism is engaged – when the system says "ouch" and moves to a different position with respect to a firm or an industry. For regulatory agencies these parameters are set by legislation, by directives from the executive office, and by judicial review of their actions. Competition policy in many countries is said to regulate the following parameters[29]:

- *Economic Efficiency*
- *Consumer Welfare,* including *Lowest Price, Highest Quality, Most Diversity (of Products/Services and of Vendors)*
- *Distribution of Wealth*
- *Innovation*
- *Stability*

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[29] See, Phillip Areeda, *Antitrust Law*, Boston: Little, Brown & Co. (1996); W. Kip Viscusi, John M. Vernon, and Joseph E. Harrington, *Economics of Regulation and Antitrust*, 3rd Edition, Cambridge MA: MIT Press, 2000.

In media regulation these parameters are also said to include related concepts such as pluralism, cultural diversity, and consumer choice.[30]

These parameters are not always all achievable at any moment in any particular industry. Sometimes it is necessary to choose less economic efficiency in order to get more vendors. At other times more innovation trumps the need for stability. This makes competition regulation a complex process indeed. A similar problem would arise if we were to build an atmosphere control system for our homes (to replace the thermostat described above) that would control heat, humidity, dust, bacteria and smell. If you raise the temperature the air will hold more moisture but that may encourage the growth of certain bacteria – this would create an odor and trigger more deodorizer. In the atmosphere control system, as in competition regulation, all of the parameters can feed back on each other, making adjustment (or regulation) of the system very tricky and maybe unpredictable. To make matters even more complicated, the people who live in the house (like the people who regulate competition) may have different ideas about what parameters are the most comfortable and the most affordable.

A political consensus on the acceptable parameters of competition within the economy generally or within a particular industry is not easy to come by. But even if one were to be worked out, the measurement of these parameters is far more difficult than measuring things like temperature and humidity. How do you measure the amount of competition in an industry? Regulators have employed a variety of tools to determine when the acceptable parameters have been reached. These include "body counts" (how many firms are competing), market share (how many of the potential customers does each firm have), and entry barriers (how easy is it for new firms to enter this business). Unfortunately, they are not well-defined concepts and their application is often difficult

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[30] See, e.g., *European Union Competition Policy: 2001 Report on Competition Policy*, European Commission Directorate-General for Competition. Luxembourg: Office for Official Publications of the European Communities, 2002, at p. 68 See, also, http://europa.eu.int
See, also, Herbert Ungerer, "Media in Europe: Media and Competition Law" Conference on Media in Poland by the Polish Confederation of Private Employers, Warsaw, 13 February, 2002; "Alternative models for future regulation", Pierre-André BUIGUES, Olivier GUERSENT, Jean-François PONS – at Regulating network utilities: the European experience, Oxford University Press (2001).

in new situations. The data about these parameters is difficult to get and to organize and the context for interpreting the data is often entirely lacking or confusing.

For example, if you are counting the number of firms in an industry, how do you count the number of firms that have many different products or slightly different products? This is not a trivial problem in the communications sector. What is a "telephone" service these days? The answer will be critical for defining the "market" for that service and the competitive effect of "bundling" several functions. This author has previously suggested that data about these firms be reorganized within a new context that describes what they do and not what they used to do. This is an example of how looking at the problem of regulating competition could benefit from looking at it as a system and a process that keeps changing. What we need now are things that are the really basic building blocks of the system. In the communications sector these building blocks come from Information Theory because it describes the basic functions of all communications industries (senders, receivers, channels, encoding, noise, messages, etc.). This allows us to analyze different types of firms (e.g., cable and telephone) who are performing the same function in the communication process.[31]

Once we get a clear view of what we want to accomplish we can then add the idea of loose/tight coupling to this new way of looking at the sector. For example, knowing that a channel is tightly coupled to the encoding process or the message would help to set acceptable parameters for competitive (or cooperative) activity involving firms involved in (or proposing to be involved in) tight coupling of those building blocks. It would also give some clue about whether a regulation is more likely to inhibit innovation, as it would in tightly coupled organizations or where the industry is tightly coupled to government.

If stability is the most important goal, then tight coupling in the form of horizontal integration (e.g., owning many radio stations) might bring financial stability (efficiency) in the short run. But any ill wind will affect all the subunits of this type of firm, and it will be less likely to be able to respond to local challenges. On the other hand, tight coupling among firms who are brought under one corporate umbrella will allow ideas and innovations to spread more quickly than if they were loosely coupled – they are, however, less likely to generate those innovations internally.

Some communications industries have historically been more tightly coupled to government than others. For example, most of these firms depend on government agencies to fund the R&D that gives them access to the innovative new technologies they will use to gain new customers or market share. Some channels depend on government assets (spectrum, right-of-way) for their very existence. The tighter the coupling, the more likely that any ill winds that hit these channels will also hit government and visa versa. There is, therefore, some reason to expect that government is more likely to be able to influence competition goals (such as low consumer price) in tightly coupled situations. Looser coupling could make this goal more difficult to achieve.

In addition, the more tightly coupled an industry is to government, the more likely it is that individual firms will respond to the actions of government. Both government and industry are much less likely to take any important action independent of each other. In societies where this relationship is not transparent this tight coupling can lead to corruption, a lack of checks and balances, and catastrophic consequences if harm comes to one of them. A collapse of such a government will cause the collapse of the industry that is tightly coupled to it. Where this relationship is transparent, both the industry and the government can argue to consumers (who are also voters) that the right balance is being struck. If the balance becomes economically unfavorable for consumers it will become politically unpopular and it will be realigned through the enforcement of antitrust laws.

If both industry and government are taking into account the interests of consumers/voters (and the interests of each other) it might mean that fewer rules are

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[31] See, Longstaff, *Information Theory as a Basis for Rationalizing Regulation of the Communications Industry,* PIRP (1994), and *The Communications Toolkit: How to Build and Regulate Any Communications*

necessary to maintain the appropriate balance of power – and this would lead to looser coupling! This seems to be borne out in the real world where the power of the coupling between an industry and government does, in fact, fluctuate over time, finding new balances in changing times.

IX. Regulation and Management of Unpredictability

Accepting uncertainty is not easy. It is much easier to believe that if you just had the right information and used the right formula (economic, political, etc.) you could build the right answer to your problem. But as soon as one gives up this belief, it is possible to end the search for the perfect data and the perfect formula and begin to build a system that gives more of what you want, more of the time. Both regulators and business managers can reorder their systems by:

- Realigning everyone's expectations about certainty. This may be the most important and the most difficult.
- Recognizing where your organization or system is loosely or tightly coupled.
- Establishing acceptable parameters for the system that are known to all.
- Creating feedback (both data and context) loops that tell you when the system has gotten out of the acceptable parameters.
- Nudge the system back toward those acceptable parameters as soon as you can – don't wait for it to become too big to fix without extraordinary effort.
- Use that feedback to watch for practical drift and the dangerous situations it can cause.

What everyone wants is a simple set of instructions that can be applied to predictable problems and will result in predictable outcomes. Alas, this paper has no "Simple Rules For Predictable Regulation of Competition." But the ideas developed here can make the regulation of competition more reliable, even if what we seek to regulate remains unpredictable. Specifically, policy makers can:

1. Treat the communications sector as a complex system that will often be unpredictable.

Business, MIT Press: Cambridge, Mass. (2002), Chapter Two.

2. Make it clear that u*npredictability* does NOT mean *ungovernable.* Regulators and the firms they regulate are not *unaccountable* – they are just accountable for different things.
3. Assume that the Blame Game is an inefficient and wasteful correction mechanism.
4. Revise the regulatory methods to recognize that the interaction of competition and cooperation in the communication sector are part of a PROCESS that will continue to evolve after you intervene to regulate/manage it – this interaction must be managed as an ongoing process.
5. Analysis of actual or potential competition or cooperation should include knowing whether the firms (or the firm and its customers) are tightly or loosely coupled and whether tighter regulation will make them more or less unstable.
6. Acceptable parameters for competition and cooperation in the communications sector must be more carefully defined and a feedback mechanism set up to determine when the system has moved outside those parameters.
7. The parameters for competition and cooperation should take into account the fact that old technological boundaries between industries in the communications sector may no longer be appropriate for counting the number of firms who are competing for the same scarce resources. Regrouping them by their function in the communication process will help to reduce this problem.

How far can the analog to other complex systems take us? While the similarities in systems that exhibit complexity are often striking, it is not always the case that the strategies used to regulate (i.e., control) one system can be used to regulate others. Any successful strategies to regulate these systems will take into account both the similarities and the difference in the systems being compared because, to some extent, each system is unique. The analogies made here should not be interpreted as *rules* but as *clues* that can be used to develop strategies in systems that are essentially unpredictable.

These ideas can be used in regulating many systems and organizations. But the communications sector may need them sooner than most. Our communications industries are important for the general welfare of all citizens. The many new forces working on this sector are making its operation extremely complex but not ungovernable. The economic and political consequences of failing to getting a better handle on competition policy will be enormous and long lasting.