The New Economics of ICT: The Regulatory Implications of Post-neoclassical Economics for the ICT Sector

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BIOGRAPHIES

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ABSTRACT

Neoclassical economics has long been a tool and model, for policymakers in the development of legislative and regulatory rules. It has been applied in the information and communications technology (ICT) sectors with such policies as the long-run incremental costs rules, appeals to economies of scale and scope or, inappropriately, reliance on two or three firms to emulate perfect competition’s results. However, economics has moved well beyond these simple, static concepts. Experimental, behavioral, developmental, institutional, complexity and network economics are now part of the economists’ tool kit. Similar advances have been made in financial theory and practice and the disciplines are becoming linked.

The objective of this paper is to understand the implications of the new economics and financial models for the ICT sectors. What do they mean for policymakers, investors, and industry leaders? It shows the failures of the current models and sets forth some of the necessary steps to make improvements.

Keywords

Experimental, behavioral, developmental, institutional, neuro-, network neoclassical economics

CURRENT ENVIRONMENT

When the book was first proposed from which this article is derived, we had been strongly influenced by the debates about the inadequacies of the 1996 Telecommunications Act and the subsequent bungling of regulatory rule making. The consequent failures of the newly formed competitive local exchange carriers (CLECs), the threats to the strengths of the system overall through poor investment in innovation during the period of financial stringency and unruly competition, the protracted period during which instability was explained as “transition”, the widening of the boundaries that internet services created, etc. all portrayed for us a scene we described in terms of the poverty of theory and the resultant poverty of policy.

We anticipated that these criticisms would be met by those whose position seems to have been that “the fundamentals are strong” given that investment was merely moving in cycles, rule-making was appropriately progressing dialectically, and that market forces would ensure self-correcting actions. Such people continued to focus on the traditional concerns of
information and communications technology (ICT) economics, largely unchanged over the past three decades: price-setting, interconnection rules, the structural balance in the industry, etc.

Our position is more radical. We have been strongly influenced from two directions: on the one side we view the industry and market structure in a much larger context that includes a wide range of players from internet and mobile services providers to content suppliers and the activities of users, niche groups, investors, etc. On the other side we view policy in a much more holistic manner, looking far beyond regulators to the broad environment of numerous factors which influence decision making by firms and affects the behavior of markets.

Up to recent times we might have been regarded to be wandering too far from the core of the matter. Leaving aside some critical insights about the internet/communications bubble that burst in 2000, the investment community could be regarded as a sideshow. The general trend toward leniency in regulatory oversight and an increasingly laissez faire attitude would, many thought, provide the appropriate “pro-business” stance that would take care of market needs as well as more far-reaching public good concerns including resilient infrastructure, stability in industrial structure, innovation, and equitable (or at least cheap) access. This attitude toward business behavior was widespread but perhaps exemplified best in the formerly closely regulated industries such as financial services, energy and telecommunications.

Now even the most hardened economic liberals express surprise at the failure of deregulation, most especially in the financial services industry, but well beyond that, too. Few would still argue that the investment community can be regarded as a self-correcting mechanism or that the mass market (for communications any more than for cars) necessarily serves the best interests of the economy.

Our position is no longer controversial. Nevertheless, there remains a poverty of theory and its consequent poverty of policy that we must begin to rectify.

INTRODUCTION

For the telecommunications industry, the years following the turn of the millennium were marked by dramatic turbulence. While many people view the break up of the Bell System in the United States as the beginning of deregulation and competition in the telecommunications industry. The privatization of British Telecom in the mid 1980s was another market. However, it was actually in the late seventies that the foundation was laid for deregulation of the telecommunications industry with the DOMSAT and Customer Provide Equipment (CPE) decisions and the Carterfone case (Kahn, 1988). The latter events led directly to European Union and World Trade Organization (WTO) projects to introduce competition and regulatory reforms in all the major markets. The rapid rise of mobile services through the 1990s, the emergence of data services and voice over internet protocol (VoIP), innovations such as international call-back and the rapid growth of the World Wide Web all contributed to a general recognition that, along with liberalization, the technical, functional and market boundaries that had previously defined telecommunications services were undergoing major change.

Over a hectic five-year period these challenges were marked by four sets of defining events. The first of these was the US Telecommunications Act of 1996 that spurred a proliferation of competing local, functionally diverse and niche market service providers. This was followed the next year by the coincident WTO and European Union agreements to phase in privatization, regulatory reform and international trade liberalization. In the last years of the 20th century radio spectrum was assigned to competing mobile phone service providers, in many countries this was done through auctions that valued exclusive use of certain frequencies at huge amounts of prospective revenue per subscriber. Then, in the closing year of the century, the UK government outlined a plan to create a new kind of regulator that would take into account re-conceptualized boundaries among ICT services of various kinds, broadcast media and content suppliers in anticipation of converged and competing information, entertainment and communications technologies and the organizations offering them.

Throughout this period investment in telecommunications, internet and related infrastructures and services was booming. While Lucent/Bell Labs no longer was in a peerless position, it and its sister research establishment, Telcordia, formed parts of a rapidly growing telecoms research and development industry that came to include major investors in California and New York, in Britain, Japan, South Korea, France, Germany and elsewhere. While investment in the so-called “dot-com” bubble attracted much attention, it was massively overshadowed by both substantive financing of new telecommunications technologies and infrastructure, and in speculative investments in new service providers, niche market players, and seemingly anybody even remotely associated with information and communication technologies. At the turn of the new century everything seemed to be getting better and better.

Scholarship reflected these directions of growth and diversification as well as the optimistic mood of the industry and its investors. There was a core set of issues that analysts, both within and outside of academic institutions, focused upon, price-setting, interconnection rules, the industries structural balance, etc. These influenced the structure of telecommunications...
economics textbooks and handbooks, of specialist conferences, analysts’ briefings, teaching curriculum and the toolkits of consultants. They also defined the agenda of industry lobbyists and of regulators.

Then, panic. The loss of confidence in the promise of internet businesses, improbable or not, led to the bursting of the dot-com bubble. It began to look as though the economics of bits and bites and virtuality was not acting according to rules unrelated to the economics of capital, labor and materials. That began to reveal something about one of the pillars that supported the telecoms edifice; the promise of rapid exponential growth of the internet as a fuel for ever more telecoms capacity build-out. With that pillar no longer sound, the rest of the structure began to appear unstable. Starting in the first months of 2000, investors began to query whether their faithful support of infrastructure build-out should be subject to scrutiny. They questioned whether the projected average revenue per user of mobile telephony justified the reputed values of mobile phone companies and whether the prices those companies had paid in spectrum auctions were at all close to the true ability to turn a profit on such an overpriced asset. Jitters on the stock markets began to force questions about the strategies of the leading firms, and even about the basic capabilities (and in the case of MCI also the veracity) of top management.

In the meantime, however, regulators had become convinced that a potpourri of policies could be the source of practices, without looking carefully at the fundamental principles that guided governmental actions. This is the background to these misguided assumptions that led to inappropriate regulation.

We argue, inter alia, that competition theory has not been interpreted correctly because of a mis-reading of the meaning of competition and a lack of understanding of cost allocations process in the ICT sector. We suggest alternative, dynamic models to address this issue. As throughout the article, we argue that dynamic efficiency is a much more important consideration than the static efficiency criterion used by the policymakers.

We argue that regulation – because of the use of inappropriate models – has led to a decrease in economic welfare. This is in addition to the regulatory costs incurred due to administrative costs, regulatory capture, enforcement difficulties, etc. Inappropriate models that have negative impacts on investment incentives of firms cause a misallocation of resources, and a lowering of economics welfare.

In the solutions and applications section we suggest solutions to the problems identified earlier. We suggest how the post-neoclassical economics model can apply to policy decisions. To illustrate our thinking, we considers networks, in particular we focus on the interconnection issues with the new economics models. Interconnection is a concern with connecting the “network of networks”—wire and wireless; domestic and international; local, regional and long-distance.

The last section explores the implications of the theory and policy we developed. While incomplete, we set out both the recommendations that business strategists, regulators, market analysts, legislators and enforcers would need to apply our findings. We hope to point the direction for future scholars and other serious analysts of the ICT world, its commerce and its role in the economy generally.

DYNAMIC MARKETS, CONSUMER WELFARE AND REGULATION

Introduction

Static forms of analysis have been used for major decisions that have distorted and otherwise artificially shaped the telecommunications, computing and related markets decisions. They have been used to guide pricing, both as a matter of business practice and as a matter of regulatory control. They have been used to plan for, encourage, or provide post-hoc justifications for industry structure and for competition models. And they have lent credence to all forms of arguments about how ICT systems should be optimized.

Their greatest influence can be seen in the design and application of investment models. These have tended to view the industry as if there were a direct, sometimes linear, relationship between level of investment and consequent profits and/or growth. Such investment models, often designed to exploit analytical complexity, have, ironically, introduced the massive waste and huge opportunity costs that characterized the first decade of the twenty-first century.

Dynamic markets

One of our major criticisms of the policy process is the lack of formally accounting for the dynamic nature of the market, principally because the tools used by the policymakers are based static concepts. While lip-service is paid to the policy impact on the future, it, generally, is only addressed as a series of hypotheticals which lack empirical verification. In

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1 See, for example, Nuechterlein & Weiser (2005) or Baumol & Sidak (1995).
addition, random events or stochastic processes are not accounted for in the policy formulations. However, dynamic analysis has been available for decades (Alleman, et al. 2008); moreover, it has become more sophisticated over time.

Our approach is to view markets as dynamic and in particular as holding a variety of forms that are able to transform along a sort of (often non-linear) continuum. Markets are dynamic as they move from form to form. Unusually among sectors, in ICT we see most all market form in close association. For example, we see unregulated private markets wholly interdependent with state owned operations. We see business models used by huge enterprises that rely on inputs of un-owned property and uncompensated volunteers. Conceptually we might view this in the form of a hierarchy, spanning laissez faire commerce on the one end and loose communal norms operating on unvalued assets on the other.

Dynamic movement between states of being requires both a theory of dynamic markets and a methodology that will guide the discovery, measurement, analysis, categorization, etc. of these relations. We can refer to these forms and their internal and intra-dynamics as “exchange regimes”.

**ANALYTIC FRAMEWORK**

“New” theory and applications

Neoclassical economics has long been a tool and model, albeit distorted on occasions, for policymakers in the development of legislative and regulatory rules. In particular it has been applied in the ICT sectors to guide policies such as the formulation of long-run incremental costs rules and to misapply the concepts of economies of scale and scope or, inappropriately, reliance on two or three firms to emulate perfect competition’s results. The regulatory perspective has long assumed a static environment. However, the reality of the theories of markets has moved well beyond these simple, static concepts (Alleman and Rappoport, 2005). Mainstream economics has now embraced experimental and behavioral models within development and institutional frameworks. Complexity and network economics are now part of the economists’ tool kit. Although not yet well integrated, these new economic models show how current economic analysis has departed from traditional neoclassical analysis.2 Similar advances have been made in financial theory and practice and the disciplines are, finally, becoming linked.

While these “new economic models” (and finance models) have been used to study many sectors, it has not yet had a significant impact on the ICT sectors. Reliance on the old models has been maintained. For example, Ofcom first considered but later failed to adopt the real options methodology, or any other dynamic method in determining access pricing.

The analytical framework for ICT policy making has been predicated on traditional assumptions including perfect information, definition of markets, mobility of factors of production, etc. in the context of static or comparative static analysis. Whereas much of the current economic analysis has moved beyond the naïve neoclassical model, the policy community has not. Dynamic analysis is coming to the forefront – revived Schumpeterian and institutional analysis; behavior economics and finance as well as experimental, development, neuro-, complexity and network – the “new” economics – are now the tools which the analyst uses. Only in rare cases is the neoclassical apparatus evoked, although this is not common in the policy community.

We cannot integrate all of the new economics into a whole in this paper. However, to cite but one example, consider the cost models that have been developed by the telecommunications industry and adapted by the regulatory communities around the world. We argue these models have serious flaws. Among these is ignoring the dynamic aspect of the investment. In this case, the real options methodology shows that investment is below optimal and the resulting regulated access charges and interconnections pricing are too low – compared to the neoclassical approach. When investment in just the telecommunications sector of this industry is approaching $63 billion in the United States, these flaws can have a significant impact on the economy.3 And this does not address its impact on innovation! In this case the dynamics of the investment process are ignored and, thus, not accounted for in the pricing policy.

**Market boundary issues**

In addition to the new economics, the convergence of the industries also must be addressed in the new analytic framework. No longer can the cable, broadcasting, telecommunications and internet sectors be viewed in isolation.4 Cellular mobile telephony is replacing the fixed line telephone in many locations. (In the developing world, consumers are moving directly

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2 See http://www4.gsb.columbia.edu/citi/neweconomics for some of the approaches with reference to the ICT sector.


4 See Alleman et al. (forthcoming) and presented in this Conference.
to mobile phones, bypassing the fixed lines altogether.) Many mobile phones are complements or substitutes for wireline access to internet: e-mail, web surfing, movies, photos are now available on most mobile phones. Not only are mobile phones becoming more sophisticated, they are becoming “open source” as is the internet with the resulting promise of yet unthinkable applications and innovations. Other wireless services such as WiFi and WiMax are threatening the traditional fixed line and cable services. Voice and video services of all types are carried over the internet; telephone companies are encroaching on cable and satellite television markets and *vice versa*. Even the print media is suffering from the internet erosion of its time-honored markets. Advertising of all types is moving to the internet, and to mobile devices. Other news sources are available on the web from traditional news sources, alternative sources such as *The Huffington Post*, and unconventional sources such as blogs and twitters. Moreover gaming and social networks are eroding viewers’/consumers’ time for traditional media – newspaper, magazines, books, and television viewing. Market boundaries are no longer clearly defined; however, dominant market power is used as a guideline for antitrust, regulation, or legislative intervention. Clearly, definitions and tools need to be developed to handle this convergence of the products and services.

The objective is to understand the implications of the new economics and financial models for the ICT sectors. What do they mean for policymakers, investors, and industry leaders?

The goal is a more nuanced view of the application of theory and market definitions to strategic and policy decisions. Not simply, as is the current practice, to regulate or not regulate, but rather what tools to use, how to apply them and with what strength should they be applied.

To illustrate this approach (in part), we use an example from real options. The real options methodology uses the tools of financial options theory to evaluate (physical) investment for their inherent “options” value, that is what are the alternative uses of the investment. If the investment were delayed, expanded, contracted, etc. would it be more valuable? In the traditional valuation methodology, the stream of cash flows would be evaluated on the basis of the sum of the discounted cash flows (DCF). Mathematically, if the \( \sum (CF/(1+r)^t) > 0 \), where \( t = 0...N \) and \( r \) represents the discount rate, then invest in this project. The “\( t \)” represents the time period with 0 being the first and \( N \) the last period.\(^5\) It should be clear to the reader that this formulation, although it has time in the inequality, does not leave room for changes in future cash flows. While much more complex, Biglaiser & Riordan (2000) developed a model – but with similar characteristics to the DCF model – to determine “dynamic prices”, but fundamentally, the outcome is determined by the initial specification as in the above valuation method.\(^6\) On the other hand, Pindyck (2004 & 2005a) and Alleman and Rappoport (2006) have constructed alternative models based on the real options methodology which provides very different results precisely because it considers the dynamics and the stochastic nature of the cash flows.

But even this methodology has its drawbacks, because its foundation is based on the “law of one-price,” that is, if any two identical products under similar conditions have different prices, they will converge to one price. This “law” has been challenged on a variety of fronts by economists for example, see Schleifer (2000).\(^7\) Behavioral economics notes that same and similar commodities can differ in price under similar circumstances, but yet the lack of these differences is one of the foundations of neoclassical economics.\(^8\) These various new theories have been developed from the recognition that the neoclassical paradigm did not fit the empirical data.

Because the ICT industries are networks, their particular characteristics must be considered. For example, the consumer’s optimal strategy may not and usually is not the society’s optimal structure. Thus, the nature of networks must be considered in any analysis of the ICT sector, for example, as noted earlier network externalities must be considered. Network economics become more complex when the boundaries of the various ICT sectors merge or are not well defined.

Finally what is the institutional setting? What are the organizational structures, the political and institutional constraints within the economics environment of the ICT sector? In particular, what is the political economics of the structure of social, financial and business institutions such as corporate governance and the regulatory systems?

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\(^5\) In continuous time the formula is \( \int CFe^{\text{-}rt} \, dt > 0 \), where the integration is from 0 to \( T \), the termination of the project.

\(^6\) The paper has additional problems related to its static assumptions which we do not detail here (See Alleman and Rappoport 2006).

\(^7\) For a more general view of behavior finance, see Schiller (2000) which has relevance for the current financial crisis.

\(^8\) This is not the only critique of the behaviorists; they rely more on psychological research and empirical observations of behavior under uncertainty rather than axiomatic deductive reasoning of the neoclassical economists.
COMPETITION AND MARKET STRUCTURES

Perceptions of competition

The neoclassical economic model of perfect competition produces many desirable results. However, in theory only the most efficient producers survive, and are producing at the lowest minimum unit cost. Consumers cannot be made better off without making others worse off. Prices are optimal. Utopia has been achieved with perfect competition. Is it any wonder that the policymakers point to competition as a panacea with which to solve all economic ills? As we saw in section 1, regulators and policymakers accepted that this “competition” has been achieved. This misperception and its consequences are addressed in this section.

Faux Success

We argue that the case of CPE, the conditions were close enough to the classical model to allow competitive entry. But this model did not apply to the other segments of the industry. The necessary conditions did not apply to the long distance segment or the competitive access providers (CAPs). Here the conditions, which prompted the entry of MCI and others into the markets, were due to an arcane mechanism used to determine telephone industry “costs” or cross-subsides built into the incumbent carriers rate structure. Cross-subsides distorted the price structure and entry conditions in both the long-distance and CAPs segments of the market. It was under these costing/pricing disparities that the new entrants were able to shelter themselves from the rigors of the market place.

The two major CAPs, Teleport and MFS proved such a success that they were sold to AT&T and MCI, respectively for billions of dollars. Thus, from the uninitiated perspective, these “proved” the success of competition. So after fighting the introduction of competition, and losing several court battles in the process, the FCC and the legislature embraced the concept. And it became reflected in the Telecommunication Act of 1996. No one noticed that these were arbitrage plays.

Moreover, the apparent success of MCI, and the huge gains in the sale of Teleport and MFS were an example others wished to emulate. In addition, the public was becoming aware of the internet with all its promise. Thus, the stage was set for a spectacular expansion of the information, communications, and technology (ITC) sector and the related bubble in the stock market which as we are all too aware, collapsed in the spring of 2000.

Others have covered the rise and fall of the sector (Crandall 2005, Noam 2003) and the (ir)rationale of the internet stock market crash (Schiller 2000). What we wish to point out in this section is that, in large part it was the failure of government policy due to a lack of understanding of the underlying economics that led to this market failure. Two firms do not create competition in the economist’s sense, nor is competition sustainable when false price signals are sent to the market because of artificial cost allocations. What the policymakers failed to note was the special requirements of perfect competition and the particular circumstances of the industries to which they were applying it.

Optimal Pricing

The false assumptions allow the policymakers to wash their hands of ratemaking principles, and other regulatory tools. However, analysis suggests that regulators may need to be involved in pricing issues, and not just wholesale prices. Since the 1996 Telecommunication Act, the FCC has formalized its pricing policy by relying on the notions derived from (perfect) competition theory, but these conditions do not obtain. Unfortunately, this model has been spread around the world.

This perfect world does not exist, as we have already noted. As many commentators have pointed out, externalities – call and network – distort the simple model; economies of scale and scope eliminate the possibility of an infinite number of providers; indeed in capital intensive network industries such as telecommunications, only a few providers can survive. Nevertheless, policymakers have assumed that this perfect world exists. They have attempted to require the incumbents to interconnect with entrants at prices that approximate static marginal costs. They have attempted this by producing a variety of engineering cost models to mimic the “marginal cost” methodology. These models have serious flaws because they lack a fundamental understanding of economics and finance. We do not wish to criticize these models – this has been done adequately elsewhere – except to note that none of them has a dynamic component that accounts for uncertainty of costs and revenues (See Alleman 1999 and the citations therein).

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9 This section draws from Alleman and Rappoport (2005).

10 As Bourdeau, et al. (2005) show, the problem may be more insidious. Incumbents may be able to exclude competition by virtue of their choice of technology, patents, and other means to foreclose entry into their markets.
Nevertheless, regulatory communities have accepted the traditional first-best pricing results, and the models on which they are based, to apply to the charges for intermediate services such as interconnection or access to the network. We disagree with this approach on numerous grounds, but our primary concern in this section with the lack of dynamic efficiency of these naive pricing instruments (and cost models), which we discuss below.

**Dynamic efficiency**

The current policy practices do not account for dynamic efficiency, which we feel is more significant than static efficiency. Static efficiency is concerned with the allocation of resources at a moment in time when the technologies are the same, knowledge is the same, and the products/services are identical.

A moment's reflection will determine that this is an extremely narrow view of the economy, particularly in the ICT sector, which has seen dramatic changes. As we noted earlier, alternative, but not exactly similar services are in use: fixed-line voice, cellular mobile service, and voice over internet protocol (VoIP) are certainly not identical as assumed of the traditional models. Or on the video side: cable services, direct satellite services, and streaming video over a broadband connection are similar but have their own unique characteristics. Likewise, this sector which has witnessed a series of product innovations and technological progress such as digital service over cable versus digital subscriber line (DSL) service over the traditional telephone line. Or consider the internet or many of its derivative innovations and services such as voice over internet protocol (VoIP). None of these fit the static model of competition.

However, dynamic models assume all of these conditions to varying degrees: resources are not stagnant; innovations will occur, technical change will continue, substitute services will arise, and consumers' desires and needs will shift. Thus, the policymaker does not have a “formula” to apply in developing policy, but must make a much more reasoned approach to what will happen in the market – with technology, innovation, and market power. Consumers' desires may go well beyond simply the price of a service – but include its attributes, performance, qualities, etc. And, since the ultimate goal of public policy may not be lower (short-term) prices, policymakers must be concerned with a larger view of the benefits derived from various market structures. Innovation, economic growth, and the magnitude and quality of investment over the long run should be their concern (Ellig 2002).

Let us consider one aspect of these dynamic issues – investment and, in particular, sunk investments. 11 While it goes without saying, ICT Investment decisions are crucial to the future infrastructure of an economy, and regulatory policy has significant impact on these decisions. Much of the economic literature ignores this consideration of the dynamic impact and how it affects the timing, magnitude and pattern of investments and how these concerns interact with financial markets. 12 The prospective of the equity and bonds markets can be significant in determining the cost and level of funding of the enterprise. Among the goals that the regulators should consider are how their decisions will impact innovation, the cost of capital, the magnitude of investment, as well as its timing because all of these will ultimately have an impact on the cost and prices in the long run. But the nature of investment in this sector have unique characteristics: They are significant and to a large extent sunk or irreversible. Models must be developed with these parameters to establish a post-neoclassical economics view of costs.

If the policymaker is concerned with social welfare, then this requires knowledge of economic cost and benefits, but not simple in the static sense. What we argue here is that not recognizing the dynamic benefits and costs, means that the social welfare is distorted. In particular, without considering the dynamics of the firm, significant costs will be unrecognized. The interaction of regulation with valuation bears on welfare in several dimensions. First, unrecognized costs on the part of the regulatory community means that the prices set by it will not be correct. Second, if the financial community recognizes that the regulatory is not accounting for all the costs of the enterprise, then it will be more expensive to raise debt and equity capital, which, in turn, will increase the cost in a vicious cycle, raising the cost to consumers.

An example of a major cost that has not been adequately identified or quantified is the obligation to serve. Under the current practice in most countries, whenever a customer demands service, the incumbent carriers are obligated to provide the service. It is part of the common carrier obligation. 13 This would not allow the firms to assess the market, determine the best time to enter and where best to enter. They would be on a specific time and geographic schedule. The firms would lose the option to

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11 Ellig develops taxonomy of dynamic economic analysis and this article of readings provides examples of the various methods.

12 Economists, at least since the time of Averch and Johnson (1962) have noted that regulation can impact investment decisions, but make no assumption about regulations impact on financial markets.

13 The United States Congress has passed legislation that will expand broadband services and, apparently, apply the same mandate under the American Recovery and Reinvestment Act.
delay. Moreover, if the customer proves unprofitable, the carrier still must retain this customer. Thus, the carrier also looses their right or option to abandon the service.

The incumbent carriers are precluded from exercising the option to delay. A related option is the ability to shutdown and restart operations. This, too, is precluded under the regulatory franchise. The lack of options has not been considered in the various cost models that have been utilized by the regulatory community for a variety of policy purposes. The lack of these options imposes a cost to the firm and to society. The loss of these options can be thought of as an opportunity cost to the firm. Alleman and Rappoport (2002) used the deployment of DSL to illustrate the delay option, and the learning option. We indicate how both may be quantified and suggest the parameters which are relevant for these options (see Alleman & Rappoport 2006 for an elaboration of these issues). Many of these options arise because of sunk costs or irreversible investments.

Moreover, irreversible investments play a critical role in the determination of market structure (Pindyck 2005b). Indeed, this implicitly recognized to varying degrees by regulatory commissions by the requirement to interconnect entrants to incumbents’ network. What the policymaker failed to recognize is the irreversibility of these costs and their implications.

One of the greatest potential for the application of dynamic analysis has is when dealing with irreversible investments, since such an investment means that a wrong decision cannot be change, in contrast to an investment which, if the investment proves to be unprofitable, can be sold. But who will buy fiber in the ground, if it has proved unprofitable? It cannot be easily move or put to another use. Thus, intuitively, the “hurtle rate” will have to be higher than an investment which is fungible. Alternatively, if the firm “waits-and-watches”; the market to see if a profitable environment is forthcoming, it can make the correct decision before committing the investment with a positive probability of failure.

So what are sunk costs and how do they impact pricing issues, entry conditions, and market structure? Sunk costs generally are industry and firm specific which implies they are not fungible. In particular, when the economy is in a down cycle, the firm’s plant and equipment cannot be sold to others in the industry, because they have no value (Alleman & Rappoport 2006, Pindyck 2005b). Thus, when considered dynamically, it is clear the incumbent firm has already exercised its option to delay. Whereas in the static context, this fact would not be considered and only the direct cost of the investment would be considered. One can think of this as an opportunity cost. But, note even in this simple example, the difference is profound. Even just considering this opportunity cost distinguishes our approach from other cost models or the incremental cost-pricing models. And, this is but one of the many considerations policymakers, business people and financial analysts would consider in making the investment. Potential competitors, too, have to value not just the direct cost of investing, but consider the value of its delay option. The consideration of sunk costs, as opposed to fungible investment alternatives, raises the entry barriers. Neglect of these dynamic issues can cause serious and distorted policy.

This can not be the only concern in a dynamic world. Demand, technology, factor prices, and many other parameters are subject to uncertainty. One of the principal uncertainties for new services is the demand, which, in turn, impacts cash flow, investment valuations, profits, and economic depreciation among other economic variables. Regulation can also present the market and the firm with uncertainty, since regulation can restrict the flexibility of the firm through the imposition of price constraints and by imposing costs associated with either delay, abandonment, or foreclosing other options available to the firm. If these regulatory impacts are left unaccounted, there are significant costs to the firm and to society (Alleman & Rappoport 2002).

The thrust of this has been to outline dynamic models which can be applied to the industry. We intend that this section will spur more discussion and research into the dynamic nature of the ITC market place and its regulation.

REGULATORY STRATEGIES, FAILURES AND SOLUTIONS

Regulation is presumed to be designed to avoid (potential) market failures, the consequence of which leads to a decrease in economic welfare. This is the rationale for government intervention – usually to prevent the abuse of monopoly/oligopoly power. Without government intervention, so the argument goes, prices will be too high, restricting demand and creating excess profits – all of which creates inefficiencies and leads to high social costs and loss of welfare. In network industries
such as the internet and telecommunication industries, “network” externalities are also suggested as a rationale for intervention.\footnote{Economic externalities occur when market prices do not produce the optimal output – the private value does not equal the social value. For example, negative externalities occur when factories pollute the atmosphere without paying the cost of the pollution. In the case of network externalities, the more people using the network, the more value it is to all, but the market price will not account for this social value.}

**Inappropriate models**

We question whether the appropriate models, and hence the suitable polices, have been applied. Others have argued that the cost of regulation may outweigh any positive effects policymakers have on the firm due to administrative costs, regulatory capture and other effects. Our argument does not dispute these regulatory infirmities, but it goes beyond these concerns. As we indicated above, we believe policymakers have been using the wrong models to guide their decisions. Policy communities throughout the world have used a simplistic approach to policy formulation and in particular to competitive and pricing issues, while ignoring investment and innovation issues. For example, policymakers have incorrectly assumed that the outcome of “competition” will promote optimal and desirable investment. We take issue with this conjecture: “competition” is not the competition of the economist; nor does the presence of “competition” address the appropriateness of the investments. Indeed, this section shows that current regulatory policy promoting “competition” has been deleterious to sound investment policy.

**Consequences**

We argue that the application of these inappropriate models has had a major impact on the investment incentives of firms, a misallocation of resources and a lowering of social welfare. As policymakers misread economic theory, they produce results worse than those they are attempting to correct. Thus, these distorting effects are equally as bad, or worse than, the market failure regulators hoped to ameliorate.

**Solutions**

Initially, we focused on whether the tools have been applied correctly and anticipate that they have not. Secondly, we suggest changing the policy paradigm to the new economic framework that considers the dynamic nature of markets and the firm’s incentives and behavior in this context. Although dynamic models are more difficult to specify and analyze, and generally offer no simple solutions, this shift in focus, if it were to be maintained, would correct many of the distortions created by the inappropriate paradigm and make regulation meaningful. Dynamic models will correct many of the problems with the static models identified. By concentrating on dynamic models, rather than on the simple static models on which policymakers have focused, it is possible to improve economics welfare and obtain results that at least are better than the costs associated with current regulatory practices.

In light of the New European Regulatory Directives and the regulatory legislation under consideration by the Obama administration in the United States, it is timely to consider changing the operating paradigm.

**INNOVATION POLICY**

The telecommunications environment exhibits an extraordinarily high degree of innovation and capturing that innovation potential has been from the outset a primary purpose of the change of policy from monopoly to open entry. Innovation certainly poses potential threats to existing markets. At the same time, it offers greater growth and profit potential, and stimulates differing views.

From the monopoly-centric vantage point, innovation appears particularly focused on lowering costs to improve profits. High-speed digital subscriber line (HDSL) is an example. HDSL implementation happened to be largely transparent to customers and it increased profitability. HDSL did not contribute to the expansion of the private line segment, as retail prices were largely maintained. Its primary contribution was to lowering the cost of procuring private lines, hence increasing the incumbents’ profits.

From the competitive-centric vantage point, innovation primarily seeks new market opportunity. Deployment of ADSL and SDSL are cases in point. At the same time, combined with unbundling, those technologies created an immediate threat to incumbents in the form of cannibalization of private lines’ revenue. A legacy monopoly that is not a natural monopoly can be expected to be susceptible to innovation. This can be illustrated by operations and support systems (OSS) development. New entrants did not want to carry the cost of the internal software development organizations incumbents use to build the huge network management systems and OSS and business support systems. Consequently, a market developed to serve
entrants and the result has been dramatically lowered costs. These systems are now modularized and built largely with off-the-shelf elements. Although incumbents have been slow to follow that trend in their core activities, it is not unusual to observe an arm-length subsidiary such as a long distance subsidiary subject to the challenges of competition, adopt those new technologies and reject the legacy systems.

Optimizing planning calls for a fuller understanding of innovation opportunities from all perspectives including cost savings, anticipating competitive challenges, new market opportunity, and managing transition markets. Economists have consistently argued that beyond traditional regulatory oversight, higher social welfare can be achieved in this sector through a credible threat of entry that pressures established players to be efficient. The credibility of that threat is a direct function of the cost of entry (Teece, 1995) as well as the institutional costs of facilitating the innovation process, including improved cost management. In addition, that threat must identify and address the cost imposed by entry barriers. Such an objective is complex and costly to implement but policymakers should accept that challenge because of the common assessment that the welfare cost of continued monopoly in a dynamic environment is much more costly. By the same token, the dynamic environment creates new challenges for existing players and existing markets, but it also creates new opportunities for growth and profit. The public policy purpose of achieving greater efficiency for the public welfare is mirrored by the opportunity and the need for existing players to become more efficient. In conclusion, models of static monopolies do not apply to dynamic networks of networks.

The traditional economic modelling of competitive ICT markets and performance has been biased by unexpressed and unchallenged assumptions concerning economies of scale and scope. Those assumptions are most likely false and thereby put at risk a good deal of the analysis taking place by industry managers and policymakers alike – the analysis specifically devoted to anticipating markets, assessing competitive challenges and determining pricing. It also has impact on a firm’s organization and efficient use of assets, or, profit maximization. Analysis based upon the old policy and old industry structure model will be accurate only to the extent the old model is preserved and unchallenged by Schumpeter’s “winds of destructive innovation.” What is being missed is a better ability to recognize new market opportunities that are opened by the change of policy and a better way to prepare to prosper within a dynamic environment. There are tools that can be created for planning within this world. But creating such tools cannot be done based on existing economic assessments of the sector; it requires us to seek market benchmarks and helps us identify the levels at which economies of scale and scope actually operate in today’s dynamic environment.

INFRASTRUCTURE REGULATORY AND CORPORATE STRATEGIES

Regulatory actions everywhere have an impact on corporate behavior and strategy; but the influence is in the opposite direction as well. ICT firms have regulatory units whose goal is to influence legislation and regulation to the desired direction of the firm. It is rational and efficient for companies to invest in lobbying activities – the rules of the game clearly indicate that it is advantageous to spend the money on this activity. Some, such as Google, were late with its lobby effort particularly with respect to the net-neutrality issue; however, it quickly realized that it had better participate or lose in the political/regulatory arena. Thus a more subtle and complex argument that there is an environment in which higher goals, in particular innovation, equity of access, resilience of infrastructure, and the “service function” to bolster economic growth are taken into account. We show the relationship between the regulatory institutions and corporate strategy. Institutional tools developed should be utilized to understand the motivations and ambitions of the policymakers. How do these translate into the economic tools the policymakers use and the policies they promote?

16 This is well illustrated with many experiences in telecommunications and not just efforts by the regulator’s often successful efforts to lower wholesale transaction costs by creating wholesale markets throughout the ’80s and ’90s. For instance, the videotext experience of the 80’s leads to the same results. While videotext was introduced in such countries as Canada (Telidon), France (Teletel), Germany (Bildschirmtext), Japan (Captain), Sweden, the U.K., and the U.S., it was only in France that its deployment was successful. One of the key differences between France and all the other countries is that France was the only one to provide information service providers a decentralized (i.e., not vertically integrated) public address on the X-25 network. All the others adopted a vertically integrated, centralized approach. Teletel’s entry cost was so low that a majority of the information service providers created their services and managed them on the Apple II computers. Some of those were exceptionally successful.

17 FCC Chairman Powell (2001) argues that “[s]uch an approach requires heavy regulation to protect against the anticompetitive and anti-consumer tendencies of a monopolist. And, it requires heavy government management of expenses, revenues and rates... Economic scale does matter and it does take a great deal of resources to deploy these networks...”

18 The network providers, particularly the telephone companies, wanted to charge internet companies, such as Google, higher prices for access to the internet under the theory that these companies generated more traffic on the net. However, Google was not prepared to address this issue in the Washington policy arena. It came late to the table. Google, Apple and others fought this differential pricing scheme. They coined the term “net neutrality” meaning everyone would be charged the same price for equivalent services on the network.
IMPLICATIONS OF THE THEORIES

We suggest that new tools are needed to solve applied economics issues in the ICT industries. Coherence is required among the key alternative forms of explanations. Empirical and quantitative analysis, as well as formal modelling tools in conjunction with observations of how differing institutions and economic actors behave in differing contexts need to be considered. Neoclassical economics is no longer the appropriate tool to apply. We show that the solutions and applications presented in a coherent approach has the advantage of guiding future action because it is not a slapped-together fix to a bunch of ephemeral problems. Moreover, there is no need to be narrowly orthodox in adhering to, for example, institutional economics. That said, our particular combination of approaches is not at all the same as unbridled eclecticism, methodological/theoretical opportunism, or a potpourri of fleetingly alluring approaches. The theories can be fit into the institutional context and applied in a variety of circumstances, but more importantly, provide better results than the neoclassical economics would. This framework provides the guideline for the policymakers and decision makers which we develop in the next section.

POLICY/STRATEGIC IMPLICATIONS

Throughout this article we have referred to policies and governmental practices to demonstrate the economic impact of rules and regulations. We have shown by example how the poverty of economic policy applied to ICT has distorted markets, reduced the efficacy of business strategies, and led to numerous disadvantageous positions. The new economics can address pricing policies, costing methodologies, electromagnetic spectrum issues, mergers and acquisition policies and the related antitrust policies and enforcement practices.

The abandonment of much of neoclassical economics can better shape policy. One element of that process is to reconsider which rules and associated practices ought to be confined to the realm of national governments, which might be applied locally (at the state level for the most part in the US, but in some places as the county or municipal levels), and which hold implications for corporate policy.

The approach holds direct implications for innovation policy, labor markets, and national efforts to enhance economic growth. At the heart are social welfare policies, and here the balance that can be struck between corporate incentives and the governance of markets.

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