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```~``` ```•```. Regulated prices need not be regarded as too low until incumbents are no longer able to realize monopoly rents from their organization structure and are thereby motivated to isolate network-related transaction costs to better identify the impact of regulation.
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Objective and Summary^

Economies of scale and scope are at the heart of today's telecommunications policy debate. Markets based on technologies having scale and scope characteristics imply that a concentrated market structure (typically, of one firm) is more efficient than multi-firm competition. Consequently, the nature or existence of scale and scope economies in telecommunications local access can influence whether policy makers heed the call of the Telecommunications Act of 1996 to remove glaring obstacles to entry, or instead choose to take a laissez-faire attitude in spite of the lack of natural mechanisms to foster efficiency in the sector. Recent debate focus has turned to proposals to limit competitors' access to incumbents' local networks and services.^

The Telecommunications Act of 1996 is based on an Internet-like vision of a "network of networks" that includes multiple access providers, multiple backbones, multiple service providers, multiple suppliers of intermediate service production components, and so forth. The alternative vision usually assumes that the Act's competition policy conflicts with realizing scale and scope economies and thus calls for preserving these economies by limiting wireline competition. Advocates of change would restrict or eliminate wholesale access to the local network and services of incumbents. These conflicting visions offer stark contrasts as to the desirable scope of "competition": open competition within (and between) technologies versus more limited competition envisioned as consisting of a very few vertically integrated service providers using distinct technologies, i.e., telephony, cable and wireless.

At the heart of this debate lies an intriguing question: "How can comparatively more innovative and efficient entrants fail to survive against legacy incumbents?" Those supporting the current policy course view competition as the means of achieving a more efficient communications sector. They support regulation to offset the economic power of an incumbent able to obstruct more efficient entry by virtue of its having integrated all necessary service production components. Those advocating policy change are generally basing their analysis on a pseudo-Schumpeterian concept^ that assumes the efficiency of the incumbent's vertical integration and consequent capture of scale and scope economies. This group concludes that if the entrants could not survive, they were not efficient in the first place.

There are no grounds for assuming a correlation between the telephone companies' structure and efficiency. The incumbent access companies (e.g. "ILECs"^) have incorporated into their organizations most of the service production processes, from managing rights of way to creating the back office systems to manage a ubiquitous network and services business. Unfortunately, the literature has failed to scrutinize these component processes carefully to see if integrating them into the firm were decisions undertaken for the purpose of capturing scale and scope economies. In actuality, ILEC structural decisions took place outside the dynamics of competitive market forces, and therefore there is no basis for attaching to them any efficiency assumptions.

To the contrary, experience strongly implies that many activities that are vertically integrated within today's incumbents could be less costly had they evolved in a competitive market. For example, based upon even the limited competitive experience to date, we see that OSS development can be much more efficient than the legacy systems in place. Therefore, a more logical explanation of why vertical integration of production component activities took place is that incumbent organizational decisions took advantage of the franchised monopoly arrangement guaranteeing a rate of return on their

investment. Such integration provides the administrative convenience of avoiding market transactions, but does not assure lower cost or efficiency.

Most importantly, a complementary effect of vertically integrating production functions is to preclude the development of intermediate markets that could supply competitors and incumbents alike at a market cost basis. Without the benefit of intermediate markets, entrants face extremely high (and inefficient) entry barriers. Entrants are forced to find ways to duplicate the various production processes for themselves and consequently cannot avoid experiencing comparatively higher transaction costs than incumbents. It is very expensive to create supply markets or substitute for markets that don't exist. Thus we have the anomaly of a less than fully efficient incumbent able to foreclose entry of a more efficient entrant. Vertical integration, albeit inefficient in the context of local services, efficiently protects the monopoly.

The production components of local access services are assembled through transactions having associated costs. In telecommunications, the comparative transaction costs experienced by incumbents and entrants do not appear to reflect any superiority of the incumbents' vertical integration over procurement through theoretical supply markets. Rather they seem to reflect several other factors:

The non recurring costs of establishing a transition from vertical monopolies to competition;

The amount of time needed to recreate efficient open markets for the competitive provision of service production piece parts;

The incentives incumbents have to preserve and even foster less efficient production and transaction solutions so as to raise entry costs; and

The regulators' understandable lack of appreciation of the needed environment that can produce efficient trading of local services production components.

In short, entrants, no matter how efficient they may be, face costs that incumbents do not face.^ Among these are the costs of establishing intermediate markets that do not exist, policy information/reliance costs and the costs of discrimination practiced by the incumbents. Those differing costs reflect the inherent value of incumbency and have not been adequately considered in the policy debate. This paper analyzes those cost issues as well.

Correspondingly, ILEC accounting costs based on their sunk cost structures and organizations are shown to provide virtually no information useful in a competitive market structure. For example, the Court of Appeals for the District of Columbia recently contended that "UNEs will be available to CLECs in many markets where there is no reasonable basis for thinking that competition is suffering from any impairment of a sort that might have been the object of Congress's concern."^ The basis for that assertion is a set of assumptions concerning the relevance of "ILECs' historic costs" and presumed ILEC "economies of scale and scope." Those assumptions are completely unfounded. Consequently, their use in pricing decisions is likely to perpetuate supracompetitive rents, misinform the investment community, and discourage entry and investment in advanced infrastructure.

This paper is divided into five additional sections. Section Two, which immediately follows, analyzes the role of economies of scale and scope and their

importance in the context of today's policy debate. The literature on economies of scale and scope in telecommunications is reviewed in the Third section, and describes the limitations of these studies. The Fourth section analyzes the flaws of studies that have attempted to apply the technology theory of the firm to telecommunications scale and scope issues and suggests proper use of the theory and their policy implications. The Fifth section uses transactions cost analysis to complement our suggested approach to scale and scope study . Finally, the Sixth section examines the data problem and other analytical problems confronting policy makers and those arguing for recognition of scale and scope economies. This section notes the lack of market data and the irrelevance of ILEC cost data as a substitute for market data. It also suggests solutions to the market data problem, including describing a "business case" approach to enforcing and achieving the terms of the 1996 Telecommunications Act that provides practical implementation guidelines for regulators.

Economies of scale and scope in today's policy debate

Introduction

The endorsement of competition in the 1996 Telecommunications Act is based on two key premises. First, if any economies of scale and scope characterize incumbents' production process, they are not of a nature to prevent the emergence of local access competition. Second, the transition from a monopoly sector to a competitive sector requires the active intervention of regulators to stimulate and, as necessary, create substitutes for nonexistent intermediate markets through such steps as unbundling and resale. Sustained regulatory action must prime the initial conditions that attract investments in new entrants until entry is sustainable.

As a result of the crisis that started in late 2000 and saw the bankruptcy of a large number of new entrants,^ especially among those who had invested heavily in new infrastructures, some began to question the approach of the Act, rather than the adequacy of implementation steps. Presumed economies of scale and scope play a significant role in those challenges, including assertions of "irrational exuberance" on the part of investors. In this section we look more closely at the role of economies of scale and scope in that debate.

In his survey of telecommunications studies of scale and scope economies, Panzar explored "the technological conditions that may make it necessary to abandon the competitive model; there may simply not be 'enough room' in the market for a sufficiently large number of firms to give credence to the assumption of price-taking behavior."^ Panzar's focus on competition models provides a perfect backdrop for understanding the importance of scale and scope analysis to today's policy debates.

FCC Chairman Michael Powell recently discussed his view of broadband policy, which he declared to be his primary policy focus,^ and its relationship to competition in terms that reflected unease with applying the traditional competitive model as the primary policy objective to achieving efficiency:

A final area, admittedly of great contoversy, is where government draws the line in its competition policy:… Economic scale does matter and it does take a great deal of resources to deploy these networks... I am equally convinced, however, that competition can exist in the race to deploy broadband platforms and that policy should not foreclose competition…. Competition policy must take account of our broadband deployment goals and that we have to calibrate our judgments and, most importantly, our expectations.^

While this would seem inconsistent with the country's historical competition-focused policy, Powell appears to be relying on the views of some economists who regard competition as only one of many policy tools to be managed by policymakers and generally limited. Baumol and Sidak argued in 1994 that "economies of scale and scope apparently pervade at least portions of some telecommunications services, and so perfect competition is an inappropriate standard for regulation in this arena…."^ Their views cast competition as a problem to, rather than cause of efficiency: "[T]he small scale of firms, in equilibrium, can be achieved only at the expense of consumers, who must forgo the savings from the scale economies that would be passed along through lower prices…"^

In contrast, Eli Noam succinctly articulates current policy: "The 1996 Telecom Act was built on the fundamental assumption that competitive markets will emerge."^ This is a vision where economies of scale and scope do not conflict with open and vibrant competition. The network-of-networks structure of the Internet provides a clear picture of how this vision makes sense. The Internet can be viewed as a myriad-firm communications bazaar built upon powerful economies made possible by interconnection and functional disaggregation. These economies transcend the economies of any single firm. Were traditional scale and scope economies claimed to be inherent in Internet technology, the result would be an absurd proposition that the entire Internet should be collapsed within a single firm!

Economies of scale and scope and the 1996 Telecommunications Act

Today's dominant challenge to the idea that local telecommunication access services are characterized by significant long-run economies of scale and scope, and therefore is possibly a natural monopoly, is the 1996 Telecommunications Act. The Act is based on a conventional economic model in which competition is believed to be viable essentially at every level of the telecommunications sector. It also recognizes that local telecommunication access service has been organized as a monopoly for most of its history, that access consists of a complex set of activities, and competition in those activities is not expected to develop at the same pace.^ Consequently, the Act outlines reasoned principles for a transition from monopoly to competition.^

The net cost of making a policy change, a very important dimension to policy implementation at any time, becomes a critical issue where the policy change constitutes a shift from monopoly to competition. It is a dimension that is mostly overlooked in the current debate, however.

On a superficial level, it is perhaps easy to believe that the cost of a policy shift to competition falls on incumbents. Incumbents, after all, are already in business and will have to accommodate new ways of conducting business. However, if the monopoly is not an efficient organization to begin with (an assumption helping to drive the policy shift after all) incumbent shareholders may stand to gain in the long run through more efficient use of their assets.

The reality is that the net cost of a policy transition to competition can fall more heavily upon entrants. It is wrong to assume that entrants enjoy advantages of an "evergreen" world, able to build a business on new policy realities from the beginning and foregoing any needed adjustments. Enactment of legislation does not create a market by itself. Legislation may permit entry, but it cannot create the supply markets that would-be entrants require in order to provide competitive local services. The ILECs have conducted business as a vertically integrated company for many decades during which time they have incorporated most of the production process functions. Consequently, open markets have never developed to supply the production components of local access services – markets the entrants now need. An entrant faces the daunting task of assembling the elements of producing local services for themselves, bearing the substantial cost of stimulating the development of open supply markets or attempting to vertically integrate some or all of them itself. Assembling these elements is a "barrier" to entry. The effectiveness of competition depends upon there being low entry barriers that enable entrants to focus on the activities in which they bring a comparative advantage to the marketplace.

The capital markets have many options in an open economy and that fact creates a basic problem for would-be investors in telecommunications. If entry in one

sector involves entry costs that are not present in other sectors, that sector is put at a competitive disadvantage in the pursuit of investment. Such increased cost creates increased risk. The next question becomes whether the potential for returns are commensurate with such increased risk. When the main competition is a vertically integrated behemoth that begins with virtual 100% of the customer relationships and an ability to shift costs, the prospect for those returns are not bright without substantial regulatory intervention, such as is called for by the '96 Act. Therefore, the costs entrants face as a result of their entry into a previously monopoly industry structure must be addressed by regulatory implementation policy. Unfortunately, all the market adjustment costs borne by entrants have not been systematically identified in regulatory proceedings.^

The implementation of the 1996 Telecommunications Act developed by the FCC has certainly correctly begun the process of regulatory response, and includes the practical specification of unbundling^ as well as TELRIC^ (the FCC's forward-looking unbundling pricing methodology developed for the implementation of the Act). Today's key policy making proponents of this approach are the Supreme Court, through its decision upholding the legality of TELRIC ,^ and a number of state regulators who agree with the policy objectives of the '96 Act. Especially important is the work of the New York Public Service Commission, which has appeared to focus on making competition financially viable in the face of the historic monopoly. Its use of UNE-P pricing has been especially insightful.^

For these state regulators, objectives such as broadband deployment, investment growth, and innovation are all seen as natural outcomes of unbundling and other methods that create efficient entry conditions. Likewise, the emergence of sustainable and efficient infrastructure competition is a natural outcome of the demand stimulated by services-based competition.^

Supporters of the 1996 Telecommunications Act appear to have the kind of vision Teece outlined in 1995 in his economic analysis of the 1992 Ameritech unbundling proposal supporting local competition and unbundling.^ In Teece's model, any economies of scale and scope are insufficient, even in the short-run, to prevent the emergence of healthy competition once an intermediate market for network services was created. Services competition would foster a breakdown of the vertical chain: entrants become more efficient in various dimensions of marketing, identify promising niches, provide specialized billing, and so on. Implicitly, this gradual expansion of entrants in downstream activities would result in new opportunities for entrepreneurs upstream that could better meet specific needs.

Some commentators, including Teece in one of his later papers, have now raised the specter that a policy providing regulated access to network elements may be harmful to investment,^ although not all economists arguing for a change of policy share that view.^ The basis for these claims is negligible in terms of economic theory or empirical evidence. Such claims erroneously equate the sector with the incumbent and ignore the impact lowering entry barriers would have on entrant investment. At the same time that they implicitly assume a monopoly market they ignore the purpose of regulatory pricing. The objective and general effect of regulated pricing is to lower prices to mimic competitive demand conditions. Under regulated pricing, demand is increased beyond the monopolist's profit maximization objective to constrict supply in order to maintain high prices.^ Regulation stimulates greater investment to meet the greater demand induced by the lower regulated price.^ An additional failure of these recent analyses is that they ignore the substantial advantages incumbents

possess by being able to leverage their sunk costs and vertical structure to make their investments less costly compared to new entrants.^

Providing regulated access to the access network still looks to be the most rational and efficient way, if not the only way, to bring about competition and investment at all levels. This vision, Teece observed in 1995,

if implemented, will make the local exchange effectively contestable. A provider wanting to enter any segment could do so at relatively low cost… This flood of new entry will result in heightened competition, both in terms of price and service offerings. The latter is especially critical because service innovations and technological advances confer the greatest benefits upon telecommunications users. The competition to meet consumer needs and create new consumer demands will produce gains that dwarf the savings derived from intensified price competition.^

Economies of scale and scope and a proposed broadband-focused policy direction

In opposition to today's policy are a number of economists and policymakers who are ready to conclude that the 1996 Telecommunications Act is a failure in some key respects. Such policymakers seek to limit or sideline the 1996 Telecommunications Act and foster a new policy vision centered on broadband deployment. In this vision, broadband is costly, it can sustain only a very small number of commercially viable competitors and only large and well-established vertically (and also horizontally) integrated megacorporations with substantial market power have the resources to finance its deployment.^ Some suggest even that large corporations alone would be trusted by investors and financial markets to make returns on such investments.^ In this approach, economies of scale and scope must play a fundamental role throughout telecommunications. Essentially, such analysts believe that these economies are so great that fostering broad entry is inefficient because it does not provide adequate market rents to the strategic players to justify broadband deployment.^ In other words, broadband deployment would only be viable if incumbents are able to use rents from complementary downstream market activities to finance their infrastructure investment.^ Proponents of this approach do not explain the rationale by which the incumbent telephone company and/or cable company would justify to its shareholders such a presumably low-return use of rents.

This unusual approach rejects the viability of a "competitive (large numbers)" downstream segment. ^ Competition is reinterpreted to mean essentially whatever limited competition can be achieved between these megacorporations, using separate network infrastructures such as cable and telephony.

Critics of this viewpoint see this as nothing more than the re-monopolization of the sector^ and doubt the energy likely to be devoted to such investment. Recognizing the retail limitiations of ILEC experience with this new medium, some suggest that nothing short of structural separation, forcing a wholesaling of advanced network capabilities, would cause the network bottleneck to satisfy demand for advanced infrastructure.^ In an ironic observation, Faulhaber recently stated that "it appears that the cable industry is moving toward a wholesale model for broadband at exactly the point that the RBOCs are trying to escape a regulated version of broadband wholesaling."^

Review of the literature

Introduction

In all, there is no disagreement among economists on the high cost of entry, but there is some basic disagreement on the existence of scale and scope economies of the kind that can or should impact competition policy. Overall, empirical studies have not been able to substantiate that scale and scope economies of such a nature exist. Whatever sources of scale and scope economies may exist, they exist within some underlying components of access services, such as trenches, and are not being exploited currently, and across firms, in a network of networks, which depends upon many interconnected players. Such an environment implies the importance of an effectively competitive framework to achieve efficiency in local access services.

Although scale and scope economies are concepts that would be attributed to the production function of a firm, there have been no comprehensive attempts to analyze the production components of local access and no good evaluation of their efficient economic costs.^ Furthermore, there is no study of the transaction costs involved in assembling the components of local access that would indicate existence of scale and scope effects at the level of local access services.

At the same time, although no one questions the high cost of entry into local telecommunication access, no one has yet established that such high entry costs are due to scale and scope effects. The idea that local telecommunications access is characterized by economies of scale and scope is frequently presumed (Laffont and Tirole, 2000, Nolle, 2001, Noam, 2002).^ The forthcoming Handbook of Telecommunications Economics states: "For much of its history, the local telephone industry was thought to be naturally prone to monopoly as a consequence of massive scale and scope economies in provision of services over wireline networks."^ The same holds for judges and regulators.^

As a generalization, most studies implying scale and scope effects were aimed at justifying vertical integration and, as we shall see, are tautological. They started from the assumption that the integration of the firm was efficient, and failed to examine that highly unlikely assumption by breaking down the production function of the integrated firm.

Economies of scale and scope in the literature

Bannock, Baxter, and Davis define economies of scale in terms of those "factors which cause the average cost of producing a commodity to fall as output of the commodity rises."^ The New School notes that "returns to scale are technical properties of the production function… If we increase the quantity of all factors employed by the same (proportional) amount, output will increase."^ Economies of scope relate to whether there are cost savings in producing two or more goods together, within a single process, rather than separately through independent processes. The conventional treatment, as outlined in Panzar (1989) for instance, is to focus on changes in the number of final goods. Firms that are able to produce simultaneously a set of outputs more cheaply than could be done by firms producing those outputs separately are said to be characterized by economies of scope.

Thus, scale and scope are characteristics of the production function. In order to demonstrate their existence, it is necessary to analyze a particular production function by disaggregating it into its sub processes and look at the internal transactions that bind them together. Thus, if the production process being studied is local service provided by an ILEC, one would have to look at all the functions performed by the ILEC to deliver local service. If the component sub processes are most efficiently integrated within a single firm, then the technology of the production function could be defined as having scale and scope effects. The literature does not do this. Instead, the literature generally takes local service as a complete service given, and does not disaggregate its production process. This failure has led to much analysis by tautology. By treating local service as a production technology whole, you automatically assume that the technology that properly defines the firm is the integrated ILEC. Comparisons of the monopoly to entrants under this assumption will favor the monopoly that defined the environment and appear as though scale and scope effects are taking place. To make matters worse, where the monopoly has internalized the supply chain so that there are few if any supply markets for the production components, benchmarking the efficiency of the integrated production process becomes very difficult. These problems by and large have not been solved or even identified by the existing literature. What the literature does do is analyzed next.

Firms choose whenever possible to carry out some activities internally while relying upon the market for their other requirements. The choices are mostly based upon the characteristics of the technology employed by the firm and its need to remain efficient vis à vis their competitors. Economies of scale and scope can be key determinants in that process. The existence of such economies argues for internalization. In a competitive market environment, internalization of functions that do not have scale or scope characteristics but are more efficiently procured on a market basis will put the firm at a competitive disadvantage. There is an important exception. Internalization of functions can take place in an environment free from market pressures if the government has acquiesced in a monopoly industry structure and permits pricing to recover costs. That environment tells us nothing about economies of scale and scope, other than to raise doubts about their existence, as well as about the efficiency of the firms taking this route.

At a policy level, economies of scale and scope are important to understanding competition. Viscuzi, Vernon, and Harrington (1995) argue that "perhaps the most important explanation of why industries are more concentrated than others is the magnitude of economies of scale relative to total market demand."^ Panzar states that "the technological limits to competitive markets have long been attributed to the presence of economies of scale" and of "the intuitively familiar economies deriving from the shear size or scale of a firm's operations."^ This explains Woroch's observation that "First, they [regulators] must decide whether structural competition is beneficial or whether, perhaps because of natural monopoly conditions, entry is not viable and potentially wasteful."^

TECHNOLOGY THEORY OF THE FIRM

The technology theory of the firm views economies of scale and scope as characteristics of the technology. In the modern treatment of economies of scale and scope, the technology determines the firm and management is effectively an optimizing program that decides the quantity of inputs to be demanded at the input market prices so as to realize an output quantity at an optimized cost level.^ For example, Panzar's scale and scope economies, when

they are significant, are technological conditions that make it inevitable that competition will be curtailed, independently of the firm's objective function or an intention not to act anticompetitively.

There are several additional preliminary concepts that should be reviewed prior to discussing the studies:

The building block of any framework for investigating economies of scale and scope is the production function, what Panzar calls the technology set. The production function can be conceptualized as a "black box" through which the inputs the firm is procuring on the relevant markets are transformed into outputs to be sold in downstream markets. The underlying concept is that the production function is a summary description of the technology that embodies the engineering knowledge of the time and that is exogenous, i.e., outside the control of the firm. From the economist's perspective, it is a constraint that sets bounds upon the firm's ability to minimize costs. Given the close link of the production function with the conceptualization of the firm as an engineering entity, one can look at the production function as essentially an aggregate engineering description of the firm's production process.

The output quantity is what the process produces for profit maximizing commercial purposes. In other words, the output has to be a good or service that can be commercialized. More realistically, the output variable will be the aggregation of a large number of distinct outputs that the operator commercializes.

Where the firm does not have market power over the input markets, i.e., where it is a price-taker, and where it is minimizing costs, the production function also can be represented rather directly in the form of a dual cost function, i.e., a cost function that reproduces in the price space the properties of the production function in the quantity space.

The common vehicle used today to say something about the entire "black box" process is to consider the cost function as equating the total cost of production with a set of input prices and a set of output quantities. That function supposedly represents the lowest cost to produce a given amount. On the other hand, if a firm is not a "price taker"^ then there is very little that can be said to establish the efficiency of the firm's particular production technology.

SUNK COSTS RELATIONSHIP TO HIGH ENTRY COSTS

A characteristic of the local services incumbent that can and does confuse analysis focused on efficient industrial organization, including scale and scope analysis, is the sunk costs of the incumbent. Once an operational local telephone company is established on a monopoly basis, the incremental cost of an additional call being provided by that firm is considered essentially zero.^ Similarly, once the telephone company has wired a street, the incremental cost of providing access to one more resident is again relatively low. These observations have been erroneously compared to other technologies, such as chip production, where, once one has designed a new microchip and organized its production process, the incremental cost for an individual chip is almost nil.

The sunk costs of ILECs are deployed in such a way as to help build very high entry costs. The ILECs dug the trenches, laid the conduit, wired the entire region and produced entirely the service capability and delivery systems. Had someone similarly built the Internet, others following would have faced

equivalent high entry costs. Because of the very different history of the Internet, we do not hear much about high start up or entry costs. Furthermore, firms that are characterized by large ex ante sunk costs are also very sensitive to the size of the market they can serve. They must be relatively large. Again, that is not true with respect to the Internet.

This basic problem of misapplying economic learning goes undiagnosed in large part because today's econometric scale and scope studies are conducted in the cost domain rather than in the production domain and start from the sunk costs of the ILECs, thus preordaining what can be shown or tested.^ The cost approach is based on the duality theory that was primarily developed by Shephard (1953) and Fuss and McFadden (1978). The duality theory establishes the conditions under which the cost function can be interpreted as the dual or mirror image of the production function. It implies that, under those conditions, cost functions provide identically the same information as the production function. Using this approach, the presence of scale and scope economies would be consistent with high entry costs. A great number of economists now stress high entry costs, an obvious barrier to entry, as indications of economies of scale (Thierer 1999, NRC 2002).^ Unfortunately, there has been no examination of the assumptions inherent in applying the cost approach to local telecommunications, and thus the conclusions of these are fundamentally flawed.

HISTORICAL EMERGENCE OF DEFINITION THROUGH BELL LABS

It was not until the late seventies and early eighties that the concepts of economies of scale and scope were submitted to formal economic analysis.^ That work started with Bell Labs and the Bell Journal of Economics and Management Science. The issues of concern that led AT&T to finance a top-rated academic journal in economics and that motivated the economists involved at the time included: How would competition impact the sector's efficiency? When could a monopoly become vulnerable to competition? How one would be able to estimate such economies empirically?

Pursuing those questions, formal definitions were formulated and the properties of economies of scale and scope began to be analyzed systematically. The very concepts of economies of scope and subadditivity emerged largely from these studies of telecommunications. Econometric research was launched to evaluate whether having more than one provider of a service and/or different providers for different services (say, local and long distance) would increase the cost for the total output. Panzar notes that "a part of AT&T's initial defensive position was that the break-up of the Bell System's 'natural monopoly' would result in a loss of economic efficiency… Thus, empirically determining the extent of economies of scale in the telecommunications industry became more than a mere academic exercise."

A summary of the leading work on the subject has been very ably reviewed by Panzar, one of the contributors to the rebirth of the study of scale and one of the creators of the concept of economies of scope.^ By and large, the structure of the Bell system was not analyzed critically, but rather became the benchmark for comparison and analysis. This approach began to show its inadequacies once the subject turned to natural monopoly.

NATURAL MONOPOLY^

Surprisingly, and seemingly incongruously, while the notion of significant economies of scale and scope is not well challenged in the literature, there are a fair number of explicit challenges to the notion that incumbents might be

natural monopolies: Thierer 1994, Crandall, 1991, Teece, 1995, and Rosston and Teece, 1995.^ Fransman remarks that "in the days of the Old Telecoms Industry the conventional wisdom was that telecoms was an example of 'natural monopoly', that is due to increasing returns to scale."^ Pittman is also part of the group that questions the natural monopoly. He finds a lack of empirical evidence and concludes that "it is increasingly doubtful whether the local wireline exchange is any longer a natural monopoly."^

Natural monopoly thinking nevertheless underlies telecommunications studies that start from the fixed cost of building a network that is capable of serving anyone – equivalent to the one-provider Internet. These studies often focus on the cost of "the network" per household passed or per subscribing households and then look at the problems and challenges when a second similar network is built. They do not allow for the disaggregation of "the network" or of the different functions (layers) involved in getting to the point of providing services, or the interconnections between those functions.^

Empirical studies

Fuss and Waverman recently reviewed the scale and scope literature and concluded that:

"[E]conometric evidence of the type surveyed in this paper should not, and has appeared not to, influence regulators' decisions regarding permissible market structures."^

"[T]he one empirical result consistent across most studies, including early ones, is the existence of economies of scale in the provision of telecommunications services in the aggregate" [emphasis supplied].^

They note that the focus of attention has moved away from assertions of such economies: "What were, in the 1970's and 1980's, questions of natural monopoly, sustainable prices and unsustainable cross-subsidies have become questions of access pricing and entry conditions."^

Econometricians began to focus on economies of scale and scope in the late 1970s in order to evaluate whether technology made competitive provision of long distance services inefficient and costly to society. The objective of those analyses was to determine both whether one could identify sufficient economies of scale to invalidate the benefits of competition and whether there were economies of scope that might invalidate the division of the market, say, between local and long distance.

Those early efforts combined works by Baumol, Panzar, Willig, and others on economies of scale and scope with the work of McFadden on production functions, especially the translog production function. Baumol and others had clarified and formalized the concept of economies of scale and expended it with complementary concepts such as economies of scope and subadditivity. McFadden had developed a very versatile functional form to model cost functions.

Those analyses took the incumbent as the efficiency benchmark to the extent that it was assumed to be using state-of-the-art technology or properly depreciated older technologies. In addition, the technology was assumed to be independent of the firms, who were assumed to be unable to manipulate it to their advantage. As we shall see in the analysis section, infra., neither assumption has been evaluated and were inadequate from the standpoint of interpreting the significance of economies of scale and scope effects in a policy debate. In the

next section we turn to a complementary problem, the data that are used in empirical studies.

Questions raised by incumbent cost data

The lack of meaningful data to empirically analyze economies of scale and scope (or pricing, or any issue relevant to a transition to competition) is receiving more attention in the economic literature (Pittman 2002, Fuss and Waverman 2002, Gasmi et al. 2002). It is also a central issue for policy makers.^

There is growing recognition of a lack of meaningful data to conduct useful analysis of economies of scale and scope using traditional methodologies.^ Fuss and Waverman point to one of the problems inherent to the empirical quantitative studies of multi-product firms when the source of data is restricted to incumbent data: Consider the possibility that another firm may want to challenge the monopoly over only a subset of the monopoly's activities (say, only on long distance), or on the basis of an inherently different mix of outputs, as in the case of a cable company that would want to offer voice telephony and video programming. In these cases, the entrant's cost function can be expected to have initial cost conditions that are essentially different from those of the monopoly since it does not have to invest in facilities that are irrelevant to that firm's objectives. One could think of a carrier's carrier that does not have to incur any of the costs associated with mass-market retail, costs such as brand name recognition and retail customer services. To that extent, empirical studies of economies of scope are effectively biased, overstating the initial costs the competitors should incur and creating the improper appearance that the incumbent is comparatively more efficient than it is in actually.^ Fuss and Waverman aptly ask: How can one infer an entrant's cost conditions when all we have is accounting data from an established vertically integrated incumbent monopoly that organizes its books around regulatory mandates as opposed to market dictates?

Gasmi et al. (2002) recognize the data collection problem and ask the following question: "How are the costs of a single firm in an industry to be measured? Do these costs depend on the nature of regulation in the industry? Similarly, one must ask, what are the costs of the multi-firm alternative to a regulated natural monopoly? These costs will clearly depend on the nature of regulation that may continue to exist in the market as well as on the strategic behavior of the firms which seek to maximize their profits subject to regulatory constraints and the behavior of rival firms." Those observations identify some of the more important quantitative problems of obtaining adequate data for econometric studies, though not exhaustive of the list. They engage in very original work on modeling operators in order to confront the problems they raise with other econometric work^ Their approach builds on a series of earlier works by Gabel and Kennet and Gasmi, Kennet, Laffont, and Sharkey to look at costs independent of the regulator/monopoly relationship. They model a hypothetical local access infrastructure from an engineering perspective, optimized to reflect such dimensions as the expected traffic flow and the idiosyncrasies of the particular urban environment. Their approach enables them to analyze problems such as interconnection and access pricing free from the constraints of the incumbents' data and accounting procedures. It is an initial and innovative step toward identifying and avoiding some of the inherent problems with using a monopoly incumbent as the benchmark to study competition.^

Another major problem with existing econometric studies is that they look at the firm as a whole, i.e., essentially from a top-down perspective and focused primarily on the two-output cost function that separates the local output from

the long distance output. To that extent, and by necessity in light of the hypotheses that are required to estimate a cost function, such studies do not focus on the local telecommunication access components. Therefore, much too much activity has been aggregated to form the local output variable to say anything useful in terms of local access services alone.

Vertical integration and financial market impacts

The idea that economies of scale and scope may motivate telecom firms to integrate vertically is common in the literature.^ Williamson states that, where a firm selects to "build" rather than "buy" in a competitive market, that decision necessarily means that that firm has found a way to integrate those activities more efficiently in terms of its own idiosyncrasies. In telecommunications, however, vertical integration (and quasi-vertical integration) was established in a monopoly environment and not subjected to the test of market forces.

The vertical integration of two activities by a monopoly means also that whatever market might have existed for that sector no longer exists. Thus, the only way to establish an independent value for the output of one activity that becomes the input of the other activity has disappeared.

Integration also creates a forward-looking data issue for shareholders and management on how to best use these assets through time. When the scope of conducted activities by the firm is large^ and especially where a large number of these activities are sector-specific, there is no way for management or shareholders to value the piece parts where there is limited, if any, competition providing benchmark information. We are aware of only one study, by the Adam Smith Institute (2002), that has attempted to quantify the benefits of vertical integration to the telecommunications firm. It was done with respect to BT's local network in the U.K. and concludes that the benefits are derived from hiding data from regulators rather than effecting efficiency. The Report tells us that: "We have assessed that BT currently gains from being vertically integrated to the tune of about £5-8bn of value [61p -97p per share], as a result of its ability to shift costs within its accounts."^ Effectively the study informs us about the margin of error in the aggregate cost data of an incumbent by estimating that BT is capable of shifting between distinct activities an amount between £5 and £8 Billion.^

A silimar valuation cannot be easily conducted in the U.S. because incumbents here have never publicly discussed the option of reorganizing themselves in terms of wholesale and retail. However, the Adam Smith analysis quantifies a phenomenon known on Wall Street as "balance sheet power," a competitive advantage that derives from an ability to combine competitive and protected markets and shift costs as required to meet shorter-term competitive threats.

That same Adam Smith study adds that: "on the other hand, the financial markets generally view that a broken up BT would have a sum-of-the-parts valuation of some £10- 15bn greater than the current market valuation [£1.22 - £1.83 / share]." While, again, the information required to duplicate those numbers in the U.S. is difficult to obtain,^ the insight of the Adam Smith Institute provides an alternative perspective to Crandall and Sidak's incomplete conclusion that: "BT evidently concluded that unsolicited proposals for divestiture would not adequately compensate the company for the value of infrastructure assets and the costs associated with dismantling its integrated business."^ More importantly, according to the Adam Smith Institute: "The key issue for BT shareholders is being able to determine the real 'sum-of-parts'

valuation, and estimate the probably negative impact on the current 'vertical integration gains.'" The same conclusion holds in the U.S., where shareholders are not given the chance to value the parts because of the lack of market information about the value of the parts due to the historic vertical integration of these firms.

The elements of local access

Little work has been done to disaggregate access. Besanko et al. (2000), like most economists, list "the spreading of fixed costs over an even greater volume of output" and/or a greater diversity of outputs as the most common source of economies of scale and scope.^ Fixed costs are the result of indivisibilities in the production process. Teece (1995) and many other economists have considered the divisibility between retail and network. The first divisibility to receive much attention in the economic literature was the divisibility between access to local services and access to long distance services (Evans, 1983), an exercise that has been revisited in a totally different manner by Gasmi et al. (2002). Excluding those segmentations, economists by and large have not scrutinized the indivisibility assumptions they have been making when addressing terms such economies of scale and scope in local access or the high cost of entry.

Just like the quantitative studies, economic analyses of local telecommunications have taken a top down perspective, paying scant attention to the component activities that, together, constitute local telecommunications. Many economists simply ignore the fact that parts of the activities of the vertically integrated incumbents form a bottleneck for would-be competitors.^ Instead, they argue that use of the bottleneck or essential facility component by the entrant demonstrates its lack of providing useful competition! For instance, Haring and Shooshan state: "Suppose two telecom competitors offer comparable bundles of services embodying some inputs or retail services acquired from an ILEC, such as is generally the case with the UNE platform. Substitution of one competitor's offering for the other's will not alter the identity of the embodied inputs or retail services being resold."^ It is trivially true that the element of the final product that is acquired from the incumbent is the same, by the authors' own assumptions. However, those products are different from the final product each operator offers to potential customers to the extent that they select different ways to commercialize their respective products, different ways to make potential customers aware of it, different ways to price it, and so on. Even if the latter activities were small relative to the whole, consumers would still benefit from those improvements. In actual practice, those activities represent a substantial proportion of the total final product. These authors, like all the authors who argue in favor of asymmetrical regulation between facilities and services-based competition, essentially ignore the value added a competitor contributes through steps such as the definition, marketing, sales, and support of commercialized services, all dimensions around which competitors will seek to compete and innovate.

Justice Breyer's dissenting opinion in a recent Supreme Court decision challenging UNE pricing methods is similarly based on an improper specification of the competition problem. Breyer states that "it is in the unshared, not in the shared, portions of the enterprise that meaningful competition would likely emerge. Rules that force firms to share every resource or element of a business would create, not competition, but pervasive regulation, for the regulators, not the marketplace, would set the relevant terms."^ In fact, competitors always compete on the "unshared" portions of the enterprise. In the case of UNE-P, for example, competition is keen in pricing, branding, marketing, customer service, etc. However, those activities constitutes real competition that results in

true economic efficiency and Breyer appears to imply from the remainder of the quote that it is not, or that he doesn't understand what is going on. Without UNE-P, one faces the very practical prospect of little or not local competition for very many. ^

Interpreting Breyer's words in proper economic context, it also follows that, even if we accept the notion that "the competition that the Act seeks is a process, not an end result,"^ the "regulatory system that imposes through administrative mandate a set of prices that tries to mimic those that competition would have set," over the set of bottleneck activities, as in the case of TELRIC, "does…thereby become …less a regulatory process,…more a competitive one." This is because TELRIC minimizes the monopoly rents the vertically integrated monopoly receives over and above what it would get through competition.

Breyer's comments improperly ignores the framework upon which Teece had based his defense of unbundling. Teece reduced the production process to its component parts in order to understand the competitive problems and the opportunities that competition could create. Teece's simple disaggregation is only a very small first step in moving toward the real world realities. An ILEC's internal organization reflects a much finer unbundling of activities. Activities focused on managing rights-of-way are different from those that take care of trenching, conduits and poles, and all of those are different from network management, and so on. Even the organizations and people are different in most of these cases. It is that dimension that the development of UNEs was conceived to address. Entrants do not enter to become a carbon copy of the incumbent. Different entrants are competing on the basis of different strategies, for customer populations that may be only partially overlapping. There is no reason that they all need the same set of UNEs if entry is to bring about the benefits of competition.

Because of the fundamental logic, as well as clear policy merit, of considering local telecommunication access in disaggregated terms, analyses that do not treat activities separately – say, at a minimum, retail and network - cannot be meaningfully used to evaluate the Act and/or the implementation approaches of the FCC to bring about competition.^ There are authors other than Teece who acknowledge that local telecommunications access is a sum of many activities, and include treatment of the following:

"Local loops, feeder plant and interoffice trunk…"^

"Laying an extensive cable network, constructing numerous call switching stations, and creating a variety of support services, before service could actually be initiated…"^

Falch goes into greater depth, arguing that "investments in telecommunications network divide into the following elements:
...
Terminal equipment
Switching
Transmission
Long line
Others (buildings, etc.)..." ^

The latter disaggregated approaches are reminiscent of Fransman's layered model.^

Other dimensions linked to economies of scale and scope

There are references to economies of scale and scope having other dimensions. Telecom New Zealand talks of "economies of scale in purchasing."^ Economies of density are key to the Gasmi et al.^ analysis of local telecommunications access' economies of scale and scope and to the National Research Council's study.^ Laffont and Tirole make reference to economies of shared facilities.^

Analysis of existing studies

Introduction

Panzar (1989) remarks that "there simply may not be 'enough room' in the market for a sufficiently large number of firms to give credence to the assumption of price-taking behavior." The potential conclusion is that economies of scale and scope may be such that it may socially more efficient to deviate from competition, the reference benchmark.

If economies of scale and/or scope were to become so significant as to decouple competition from efficiency, then the competitive outcome, based on a price-taking behavior, may become unsustainable. On the other hand, if the high entry costs economists observe are not the result of economies of scale and scope but some other factor and, in particular, a factor that incumbents can manipulate strategically, then the laissez-faire policy that is being advocated as a substitute for the 1996 Act would have disastrous consequences for the sector and, beyond, for the economy. Interconnection and unbundling are key challenges to the technology theory of the firm as applied to telecommunications local access.

In this section we show that there is no basis for assuming that the structure of ILECs is a result of economies of scale and scope. Economies of scale and scope studies to date have been applied at too broad a level of telecommunications economic activity to come to any meaningful conclusions about their application to local access. Furthermore, we show that to the extent there could be such economies in certain piece parts of the production process of local access services, or at the larger, network-of-networks level, the vertical integration of incumbents actually restricts or destroys altogether the benefits they may be able to derive from them. In short, Panzar's warning that competition may have to give way to concentration under certain circumstances, a warning that is common in the recent debate (e.g., Woroch 2002), does not and cannot apply to today's telephone incumbents. Quite the opposite, available evidence suggests that the technology, far from being exogenous, would seem to be path dependent and endogenous. Consequently, without strong regulatory support in the process of transition to competition in local access, re-monopolization will likely occur, bringing with it inefficiency and welfare loss.

Innovation

The problems encountered by using the existing firm structure as the start point for analysis can be demonstrated by examining a basic aspect of efficiency – innovation. Scale and scope analyses must effectively assume static technology. Thus, analysis accepting the firm structure for purposes of scale and scope study, although demonstrably erroneous, is explainable. Such discussions generally ignore the fact that wireline access can be much more vibrant and varied in its technology choice, and would likely be so in fact if freed from the stranglehold of monopoly. For example, Kotlikoff has put forward a vision of Electronic Loop Provisioning that substantially upgrades the service potential of the basis telephone line.^ Also, NTT has begun to deploy fiber to the premises in Japan, achieving more than 100,000 customers after only several months of operation.

At the same time, the substantial sunk cost of legacy infrastructure discourages its cannibalization or abandonment in the absent of market or other outside

pressures. For example, although there is much speculation about how freeing incumbents from competitive pressures will result in a wave of investment in advanced infrastructure on their part, such assumptions fly in the face of a dominant player's disincentive to invest^ Furthermore, calls from Wall Street analysts have been consistently emphasizing the need to conserve capital and perhaps increase dividends; they have not called for new capital spending programs.

In addition, typical scale and scope analysis also does not measure the value of competitive innovation that may use the same current technology as the incumbents. For instance, an entrepreneur could decide to enter on the basis of different pricing and marketing strategies relative to the incumbents, as we observe with some CLECs (such as Allegiance), or WorldCom MCI or AT&T's use of UNE-P. If such a different approach is valued by customers, welfare is enhanced.

When we consider any of the recent analyses of economies of scale and scope, e.g., the "take-rate tyranny" presented in the NRC Broadband report^ which implies that there are market size limitations to the number of viable broadband providers,, we are essentially in the world of Henry Ford, where customers could buy their model T Ford in any color they wanted as long as it was black. The shortcomings of this kind of analysis are quite serious in economic terms. It typically presumes that the firm/process considered is not separable, i.e., that the observed vertical integration is inherently efficient. It ignores the diversity and complexity possible if such tasks as building a broadband infrastructure, determining the scope of network coverage, acquiring and managing rights of way, providing a wide variety of service capabilities, etc. are disaggregated and open to entry by multiple entrepreneurs at each level. Each such task is costly and time consuming and may have little to do with telecommunications uniquely. More significantly, many such tasks are still being performed internally within the incumbent firms more from legacy reasons than due to the existing market and regulatory structures. This problem illustrates Kahn's observation that "typically an incumbent company not only will control some facilities truly 'essential' to its rivals but also will enjoy economies of scale or scope [sic] not because of superior enterprise on its part but merely because of its inherited franchised monopoly."^

Another aspect to the inadequacy of existing analysis is that it does not recognize economies that are realized by society when a business becomes an efficient component of the overall market structure that is greater than its individual participants, as through interconnection in a network of networks. In addition, Teece has shown how the benefits of economies of scale can be shared among downstream competitors to the benefits of society.

Benchmarking

Part of the challenge to analysis is to establish an adequate benchmark upon which assessments of economies of scale and scope might be based – in a sense, defining the burden of proof. While the analyses of economies of scale and scope reviewed by Panzar is a significant contribution to the literature, it is also limited in its scope because it is "monopoly-centric." Panzar's conclusion about the possible lack of room to support a "price-taking" behavior is based on a large number of additional hypotheses that he has not specified. For instance, Panzar's natural monopoly is a natural monopoly as long as it is impossible to subdivide the technology into distinct technologies. While this can easily be understood when discussing, say, the art production of a

particular artist, it does not seem credible in the case of a firm as complex in its organization as a telephone company incumbent.

Notwithstanding the technology definition issue, even after deriving the relevant technology one needs an efficiency benchmark that provides market prices derived from a competitive model. Williamson's heuristic model proposes that, at the beginning the world was competitive. However, through innovation and entrepreneurial behavior, some firms may have succeeded in transforming some element of the technology so as to benefit from economies of scale and/or scope and, possibly, for that particular element, weakened the need to pursue price-taking. Williamson's presumption falls apart where regulatory intervention permitted vertical integration outside of market forces, such as through a franchised monopoly coupled with rate of return regulation.

Furthermore, if we can find ourselves in a situation in which the competitive outcome may be neither efficient nor sustainable, we then need a complementary benchmark to compare and evaluate scenarios. The benchmark is required to ensure that empirical estimates of economies of scale and scope reflect economically efficient solutions, i.e., do not include inherent endogenous economic inefficiencies such as discrimination. Kahn has proposed such a standard. In the context of access pricing, that benchmark requires "that prices reflect the additional costs that society will actually incur or save if purchasers take somewhat more or somewhat less of the product or service in question."^

Economies greater than the firm, captured through interconnection - and smaller than the firm, existing in components of the firm's technology, realized through unbundling.

The potential for economies of scale and scope in telecommunications appear to be available at layers that are smaller than the currently structured incumbent firm, for example, the ability to dig a ditch to serve multiple purposes including telephony, sewers, electric lines and street construction, and at levels greater than the currently structured firm, through a network of networks. The current incumbent firm structure – a specialized monopoly – is not positioned to capture either type.

Unbundling

Unbundling continues to be the epicenter of the policy debate. Teece (1995) argued that "unbundling will reduce entry costs [and] increase competitive and entrepreneurial opportunities," i.e., play a key role in reinvigorating the innovation process in telecommunications. This can be contrasted to Faulhaber's negative assessment of unbundling: "Five years after the Telecommunications Act, the RBOCs collective share of the local loop market still stands at 91.5%. Of course, market share data is only suggestive of the state of competition in markets, but share data does suggest that the experiment with local loop unbundling as a mechanism to jump-start local competition has not been a great success."

Given this range of opinions among economists, it is not overly surprising to see Powell taking a lukewarm position on the matter: "'Is unbundling a good thing or a bad thing?' Well to some degree of course it's a good thing. The real issues are about how many things and how deeply you do that if you have a preference for facilities-based competition."

The real issue with unbundling is one of vertical integration and of economies of scope. Woroch (2002) talks about "the misalignment of incentives of

incumbent providers and new entrants. In the end, unbundling is an unnatural act for a vertically integrated provider," a theme that is being raised time and again not just by economists but also by policy makers such as Powell. However, if incumbents were not vertically integrated, then unbundling would not be a problem since incumbent retail organizations would not be able to leverage their position within their incumbent companies to gain an artificial comparative advantage. The problem of misalignment of incentives is one of the social costs of vertical integration.

Teece assumed implicitly that whatever economies of scope there may be between the local telecommunication infrastructure's intermediate output and the downstream final retail products, they are likely to be small relative to the benefits that can be derived from competition once government removes "artificial entry barriers."^ These barriers Teece convincingly identifies as stemming from residual sunk cost facilities, thereby calling for sharing through unbundling.

Furthermore, challenges to unbundling that rely on presumed economies of scope all fail to look inside the black box that represents the firm as a production function. That tool is designed to look at the input/output relationship and not at the reorganization of that relationship where one can break the black box and look at sub-black boxes or where the output of some sub-black boxes become the inputs of some other sub-processes. That tool is not designed to consider issues such as "make vs. buy," i.e., vertical integration,^a flaw fatal to producing analysis useful to policy making.

An illustration of the cost/benefit of vertical integration was demonstrated in Pennsylvania when the regulator decided to consider seriously the structural separation of Pennsylvania Bell in retail and network.^ Very little data about the cost of vertical integration was developed. Pennsylvania Bell merely contended that disaggregation into wholesale and retail units would cost in the order of $1 billion. Those who challenged that number did not even consider the very real possibility that structural separation would have resulted in an overall saving.^

The feasibility of unbundling at many layers points out that any analysis of economies of scale and scope needs to consider more carefully the structure of the production process and the various layers of vertically integrated firms. Unbundling is appropriate wherever there is potential for market activity that does not exit in a clearly sustainable form – as explicitly contemplated by the 1996 Act. In addition, it would appear that the focus on currently configured firms also ignores economies that may exist at a higher sector level, yet depend upon the industry structure put in place by public policy in order to be captured.

Interconnection and the network of networks

Interconnection is the creation of a new network achieved by linking two or more networks in such a way that, for a large range of functions, the interconnected networks operate as a single seamless network that can accommodate innovation arising in one part across a larger base. It is also a direct challenge to the conventional technology theory of the firm as has been applied to telecommunications to date. Economies appear on the basis of the technology integrated into the sector, viz., the network of networks, rather than the individual operators. Economies of scale and scope in a network of networks environment transforms the market structure question. A competitive structure

allowing for specialization and differentiation, and lower transaction costs, becomes key to their capture.

Considering a network of networks technology turns Panzer's and similar analysis upside down. His question about the viability of competition is totally dependent upon his starting point of a monopoly encompassing the relevant technology. When one uses monopoly as the benchmark, then the answer is predictably biased against competition. For instance, taking steps to create intermediate markets to prime competition and achieve efficiency as envisioned by the Act becomes inefficient for the incumbent. To the contrary, when one allows that interconnection can achieve economies of scale and scope, then competition becomes the benchmark and the monopoly is much harder to justify.

Policy analysis gets quickly distorted depending upon which lens one utilizes. Incumbents have perceived interconnection as a threat, and so, they have attempted to set interconnection conditions that are costly to smaller operators. It is ironic but instructive to note that such strategies have been typically justified on the basis of economies of scale. The example of BT's justification for erecting barriers to interconnection illustrates this clearly. For many years, BT did not pay Kingston Telephone for completing BT's calls that terminated in Kingston's territory. At the same time, BT was charging Kingston for Kingston's calls that BT was completing in its territory. In less extreme situations, individual firms share in these economies. In the case of BT and Kingston, BT justified the difference in treatment as based on its larger size and correspondingly alleged greater value of the market it served. In other words, it claimed the right to capture what it saw as increased economies. In the modern environment where the interconnected operators may be competing for the same customers, interconnection makes it possible for all operators to share in common economies. Interconnection facilitates entry and, to that extent, it creates a more competitive market. This will normally result in greater innovation and faster growth. However, the dominance of incumbents still enables them to undermine interconnection and they appear typically to prefer to be the sole provider of a market characterized by lower demand than to be one of many providers of a much larger market.

More fundamentally, interconnection highlights the fallacy of policymakers being concerned about "too many" entrants.^ Economies of scale in a network of networks do not tell us anything about the possibility of too many entrants. Their numbers and diversity would appear by all accounts to be encouraged. Economies of scale and scope in a network of networks environment is not a technological parameter of the individual firm.

The impact of interconnection and unbundling on economies of scale and scope are not exceptional to economic learning. Rather, the problem would seem to be that we have generally been too cavalier in concluding that local telecommunication access is characterized by inherent economies of scale and scope. The root of the problem is going from the theoretical analysis such as the one reviewed by Panzar to the empirical analysis. In applying the theoretical model, economists have typically reversed the logical basis of the analysis. Where the normative analysis is based on a technology that constrains the firm, the empirical work has started from the firm, implying that it is the firm that constrains the technology.^ We suggest that the empiricists have it right. Those who challenge the kind of competition the Act would bring about are using the vertical structure of incumbents to frame their policy question. To that extent and as with interconnection, they are creating a bias in their analysis. Such analysis turns back the clock to a time when markets were often considered

private domains of dominant players and one could say, "What's good for General Motors is good for country."^

The conclusion from our analysis is that in telecommunications, the technology is largely endogenous, and path dependent. That path continues to be largely shaped by incumbents and it appears to be suboptimal. In addition that path dependence is a burden on new entrants, hence, the situation continues to protect incumbents from even more efficient new entrants.

Economies of scale and scope as an aspect of a vertically integrated firm

Tirole observed in his 1988 textbook on industrial organization that "it is not clear why economies of scale should be exploited within the firm."^ His question becomes particularly powerful as applied to telecommunications given what happens with the introduction of unbundling and interconnection. If we go back to Panzar (1989), the technology is defined as a production function that is available to the firm: "the most basic concept with which to characterize the productive technology available to the firm is the technology set T, a list of the combinations of inputs and outputs that are available to the firm." We know that the technology is exogenous through Panzar's specification of the cost function. In general, economists specify the exogeneity of the technology by the way they specify their production and/or cost functions.^

While the input/output relationship would seem to be purely "technological," in fact that is rarely, if ever, the case. For instance, even mechanical machines can be run at various speeds depending upon what is an acceptable level of wear. Workers may have more or less training and that training may be more or less successful. Similarly, the quality of the labor input is likely to be affected by the incentives associated with the payment mechanism as well as the ability to monitor and evaluate the work performed, to name but a few determinants. Of course, the organization of the inputs is always a key issue.^ The output itself is often dependent upon the particular business model the firm adopts. An operator from New Zealand will provide flat-rated local service while operators in Europe will charge customers on a per-minute basis. In fact, Williamson makes this point forcefully when he states that "technology is fully determinative of economic organization if (1) there is a single technology that is decisively superior to all others and (2) that technology implies a unique organization form."^

Economists have remained very vague about what is meant by a technology constraint except to say that it was exogenous, i.e., that it could not be manipulated by individual stakeholders with a view to gain a comparative advantage. This hypothesis will only be useful in a sufficiently narrowly-defined setting, however. Let us take the illustration of the trench-digging activity. It would seem reasonable to assume that it is a fairly well defined activity and thus possible to evaluate whether it is an activity that is characterized by economies of scale and scope.

While trench-digging is a vertically integrated activity for most telephone operators, this is not always the case. Interestingly, in France, there is an independent market of "ETLs," independent construction companies that were formed in the 1970's when the French government pushed France Telecom to complete universal service. Rather than increase its own staffing, France Telecom spawned the development of independent companies that could supply the need. Those firms would appear to be quite competitive and there are always a few of them bidding for projects. Economies of scale appear to be apply to this business to the extent that medium size urban areas do not have more than a few

of those firms. On the other hand the economies ETLs achieve have no common measure with existing incumbents. ETLs are able to exploit economies of scale and scope vertically integrated telephone incumbents have refused or simply neglected to take advantage of. For instance, ETLs work for other telecom operators on a contractual basis and with the same kinds of conditions as France Telecom. They also provide services to cable operators, public utilities, railroads, and others.

In sum, trench-digging as a stand-alone activity may be characterized by a fair amount of scale and scope efficiencies but not enough to undermine reasonable competition, i.e., price-taking behavior. Why then might incumbents in many countries tend to internalize much or most of their trench digging capabilities and, in practice, barring legislation that may mandate providing access to competitors, almost always restrict the investment to their own use? The outcome of such a practice is clearly sub-optimal for the incumbent and the incumbent's vertical integration of that function is a likely source of substantial inefficiencies. At the same time, however, such inefficiencies may be beneficial to the telephone companies from the standpoint of entry and competition. Vertical integration of a function by a monopoly forecloses competitive intermediate markets such as the ETL market in France. It means that new entrants have to compensate for the lack of intermediate markets and thus face artificially higher entry costs.^ Through integration of the function, the incumbent will have achieved simultaneously an inefficient vertical integration and the erection of an entry barrier that protects it from competition.

One of the lessons from the recent competitive era is that new entrants and competitors can be quite ingenious and innovative in tackling the challenges they face. One of the most impressive innovations was Williams' use of old pipelines to create a national backbone fiber network in the late eighties. It was the kind of innovation that could not come out of a research lab but it was still revolutionary and transformed the way people viewed backbone networks. It also pointed the way to development of new backbone networks such as Qwest's at a fraction of what backbones had cost until then. More generally, entrants have been very successful in addressing the rights-of-way problem where they were at an enormous disadvantage. Whereas prior to competition the level of facility-sharing was limited (but not zero – for example there was pole sharing with electric utilities through much of last century) and new entrants were at a disadvantage when requesting rights-of-way, entrants became very good at identifying alternative rights-of-way owners. Their demand eventually began to create a market for rights-of-way. Sewage, subways, highways, and others including other CLECs^, played a significant role in the emergence of competition. MFS and Teleport started in the eighties using the rights-of-way of the Chicago Loop in one case and of the Port Authority in the other. Similarly, it was Worldcom, through MFS, which first used competing rights-of-way, namely, Paris sewage, to offer commercial services on its fiber ring.

Despite such entrepreneurial innovations to overcome or accommodate some entry barriers, many barriers remain daunting and impenetrable absent regulatory assistance. Moreover, the entrant effort levels can be expected to decrease upon any regulatory signal that communicates lessened regulatory interest in confronting those barriers.^

FOCUSING THE EFFORT OF ECONOMIC POLICY ANALYSIS

What does this means for evaluating economies of scale and scope in local access? It means that one must first segment the activities carried out by any incumbent into identifiable processes that are sufficiently reasonable and

homogenous to be equated as “technologies,” i.e., something that is more engineering that bureaucratic. Only then can “technology” be equated to a firm.

This required effort helps focus on what “technology” means. When it is written within a mathematical context, technology quickly becomes just a mathematical variable and looses its reality. When that technology is used to encompass the range of activities that are carried out by incumbent operators, then the assumption that that definition is even close to the production frontier is essentially empty of any meaning. Incumbents, like any sufficiently large firms, spend a large amount of resources on reorganizations and new ways to use the various “technologies” that they aggregate in their production or cost functions. The assumption of technology exogeneity does not appear particularly realistic given their wide array of organizational forms. In fact, it appears that a very good case can be made that monopoly and dominant incumbents have largely been defining the technology to benefit their own market position. What appears as scale and scope economies at the firm level may actually be nothing more than sabotage,^ the kind of actions a bottleneck monopoly has well-documented incentive to undertake in order to make it harder to compete against.^ Put another way, there is a substantial possibility that the vertical integration of incumbents is not fostering cost minimization and efficiency. Rather, it may be impacting the entry and transaction costs of would be competitors – raising critical costs and acting as a protection of the incumbent against competition. In this context, unbundling at regulated wholesale prices that exclude monopoly rents becomes essential to any possibility of transitioning to a sustainable competitive marketplace in the foreseeable term.

Analysis of economies of scale and scope and transaction costs

Introduction

Years ago, Williamson stressed that economies of scale and scope could not generally be used to justify vertical integration because integration tends to result in diseconomies of scale and scope unless they are sufficiently small to be exhausted. In fact, Williamson was only highlighting the simple argument that legacy-based vertical integration would generally restrict the sector's ability to achieve the kinds of efficiency that could result from economies of scale and scope at a network-of-networks level, or perhaps at the production element level.^

In the preceding chapter, we have seen how the high cost of entry for new entrants in telecommunications access cannot be attributed to economies of scale and scope. To the contrary, the existing vertical structure of incumbents is characterized by likely inefficiencies. The basic question becomes, then, if not economies of scale, what explains the high entry cost in local access?

We have also considered the exogeneity assumption that economists typically make in the study of economies of scale and scope in the context of telecommunications. We have suggested that the technology is unlikely to be exogenous but rather it would seem that it is path dependent and reflects the incumbent's continued market power.

In this section we look at the counterpart of those arguments, namely the transactions that bind production processes together and their cost characteristics.^ A transaction is the cement that links complementary production processes, i.e., upstream processes that feed into downstream processes. It is also the cement that makes it possible to create new processes, such as through interconnection or unbundling.

Our conclusion is that incumbents can manipulate the costs of transactions in the production domain to undermine competition. In addition, an important set of transactions has been largely overlooked -- the transactions associated with a change in policy. Those transition costs are particularly important because they help explain yet another dimension of how efficient entrants might not be able to compete against less efficient incumbents.

The roll of regulation in facilitating efficient transactions as well as creating and capturing economies of scale and scope.

A vertically integrated firm is by definition a firm that aggregates a number of distinct production activities that are in turn linked to one another through transactions that are internalized and take the form of internal procedures, such as a firm's budget process.^ Any economies of scale and scope within a vertically integrated firm include not only technologically determined production conditions but also transactions.

To the extent that firms have sufficient market power to manipulate those transaction costs in their strategic interests, what might be viewed as economies of scale and scope of the vertically integrated firm would include variables that are decision variables for the dominant firms. There is only one available solution to this significant economic problem: The power and incentives of dominant firms to manipulate requires the intervention of

government directed at facilitating efficient transactions and capturing available economies for society.

The dominant vertically integrated firm is faced with a trade off between accepting a larger market that is created through competition and the smaller market it dominates. Welfare, of course, is generally increased through creation of the larger market. There is a mirror image of that trade-off at the technological level that is easily exemplified: The design of the Internet was a trade-off between the highly hierarchical and centralized process traditional in telephony and the kind of decentralized process and reliability the military was looking for when ARPA began to fund its development.^

Government action has been at the core of creating and enabling social capture of economies, including the ITU, DARPA, the FCC and state regulatory bodies. First, mandated interconnection and unbundling has made it possible to create a larger market for operators. Second, regulators have taken concrete steps to streamline contract procedures. To that extent, regulators have contributed substantially to the facilitation of trade and the realization of greater efficiency, not less. It is government's normative function.

Similarly, government action has somewhat disaggregated the extent of vertical integration. Unbundling creates a market alternative to vertical integration and heretofore exclusively internal transactions by incumbents. Creating network "Lego blocks" enables alternative combinations and innovation.

Costs that have been ignored: market transition costs

The structure of the elementary production processes and the structure of the transactions that bind them together are similar in that both are made up of fixed non-recurring costs as well as recurring operational costs. The government's allocation of resources to regulation is very similar to the firm's investment in production technologies. New policy directions such as the 1996 Telecommunications Act involve high sunk costs in the policy definition, implementation, and improvement processes as well as ongoing costs reflecting the commitment to devote the necessary resources in their ongoing operations. The basic cost structure of policy transition is, frankly, not well understood but critically important.

Some commentators, such as Woroch, tell us that even market-based transactions can be costly. ^ But, compared to what? After all, Coase told us over 65 years ago that using a price mechanism has a cost! So, such an observation does not inform us from a policy perspective. It does not tell us anything about the relative merits of vertical monopolies, which are generally less efficient than market transactions. Nor does it tell us what the structure of those costs might be, i.e., how much of those costs are transitory and how much are ongoing operational costs. Transitory costs can disappear once the market environment is established. Regulators and governments can take steps to minimize those costs or hasten the departure of some of them by defining and managing the legal, regulatory, and informational environment that is required for any market-based transaction between private parties. The failure to minimize these costs impacts competition adversely.

The 1996 Telecommunications Act is now part of the public infrastructure within which transactions function, along with competition laws, contracting laws, customer protection procedures, etc.^The government process that makes trade possible is a dynamic platform and one of the primary responsibilities of governments is to invest in its own processes so as to facilitate trading

efficiency. Government cannot abandon its function without damaging market transactions efficiency. Even the threatened possibility can have devastating impacts.

External vs. internal transaction costs and policy implications

The costs involved in changing public policy involve non-recurring transition, adjustment, and learning costs, as well as ongoing operational costs. The "haggling, contracting and monitoring, and in the worst cases, litigation and enforcement" to which Woroch refers requires more careful analysis.

The primary function of a market is to establish quantities to be produced and supplied and the terms and conditions those products will be available as inputs to downstream processes or final use. To the extent these functions are performed within a firm, the equivalent processes take forms such as the budget planning and internal supply processes. Identifying transaction costs is critical to achieving efficiency. They are transparent in a market setting but largely mysterious and often obscure in a setting of vertical integration.

Where the firm is a telephone incumbent, and therefore defined by many vertically integrated component production processes, the market benchmark that usually plays the determinative role to ensure the efficiency of decisions by individual firms to vertically integrate selected functions does not exist. If it is a monopoly under limited pressure to minimize costs, it might find it convenient to bypass much of the effort and simply forego cost minimizing efficiencies. In fact, very few, if any, American ILECs have gone very far along the line of attempting to identify efficient transaction cost benchmarks, notwithstanding the prevalence of price caps.^ Incumbents typically manage the upstream operation (network) as a cost-based entity supplying the profit-maximizing downstream entity (retail).^

Under these circumstances, the informational content of the incumbent's cost data is quite limited. Generally, however, their costs can be expected to be higher than under competitive environments because of the lack of market discipline. The growing number of negative references (e.g. in the work of Faulhaber, Crandall and Sidak) to the transaction costs mandated by the creation of intermediate markets by regulators (UNE/UNE-P, wholesale), do not inform policymakers usefully. They fail to address the critical question of what policy direction minimizes transaction costs and thus can achieve efficiency. Until competitive markets emerge throughout the many layers of local access and service production component processes, we should expect both high transactions costs leading to sector performance inefficiency and significant anticompetitive discrimination opportunity afforded incumbents possessing market power to manipulate those costs against entrants.

Still, the current policy debate lacks appreciation of the transactions cost analysis including by those supposedly focused on efficiency considerations and advanced technology deployment. The National Research Council itself virtually ignores transaction costs analysis yet leaps logic to conclude that facilities-based competition has supposed advantages over mandated unbundling for a variety of reasons that depend upon but ignore transactions costs analysis:

"… reduces the need for persistent regulatory intervention…

permits the natural (i.e., competition-shaped) character of broadband service and industry structure to be discerned…

avoids costs and organizational complications associated with coordination between incumbents and competitors…

facilitates technical optimization of total bandwidth…" ^

Those statements say nothing more than, transactions give rise to costs. The NRC's statements appearing to favor "facilities-based" competition do not establish the superiority (or inferiority) of transactions taking place under a policy supporting vertical integration nor do they provide any substantive evaluation of the potential importance of the regulatory role. Standing alone as they do, these statements are irrelevant to the central policy issue they purport to address.

Recurring vs. non-recurring transaction costs

The "haggling, contracting and monitoring, and in the worst cases, litigation and enforcement" Woroch refers to represents another cost, the full dimensions of which have not been appreciated. The change of policy from monopoly to competition is a complex and time-consuming process. It is a process that involves fundamental changes in the roles played by the various interested parties. This transition is not trivial. It requires a fundamental reworking of roles and responsibilities for the incumbents and the regulators.

Unintentionally, regulators may have backed away from the necessary tasks, largely as a result of the 271 process. As a precondition to long distance entry, regulators have attempted to develop an OSS infrastructure with sufficient transparency to restrict discrimination to a level that is hoped will not endanger the emergence of competition. That was an obviously well-intentioned effort, but there is no basis for assuming that placing a primary focus on the one issue of OSS is sufficient. The problem is very much larger. As Powell has said, "You know there's a million ways to Sunday to get beaten up by an incumbent that's not particularly interested in helping you compete."^

Market adjustment costs are more obvious with the incumbent. Natural human inertia, the uncertainty of a competitive world, the temptations of its market power and its privileged relationship with regulators may all combine to motivate it to minimize the amount of adjustment by attempting to thwart competition. Because incumbents dominate their markets and essentially serve all consumers and businesses, they naturally see entrants as firms that attempt to duplicate their own business in a zero-sum world, where competition means they must suffer loss.

The entrant, far from being the favored child in this scenario, is more accurately the disadvantaged player. Typically, economists and policy makers have not appreciated the fact that entrants also face market adjustment costs and, in fact, the bulk of those costs fall upon them. For example, Supreme Court Justice Breyer argued that ""Regulatory rules that go too far, expanding the definition of what must be shared beyond that which is essential to that which merely proves advantageous to a single competitor, risk costs that, in terms of the Act's objectives, may make the game not worth the candle." Similar are Chairman Powell's recent remarks to Wall Street:

Government policy was to provide extraordinary advantages to competitive entrants in order to bring competition into being rapidly. And it did. Government policy also explicitly and implicitly signaled that it would protect these new entrants from failure…It is here where the government's pro-competitor

industrial policy cracked. It could not possibly protect against these shortcomings.^

These views are fundamentally and extraordinarily incorrect. While Breyer's comments are correct in identifying regulatory costs, he is led to the wrong conclusion. Regulation is a game stacked in favor of the incumbents. The delays and expenses of these proceedings primarily concern attempts by entrants to obtain access to services and facilities they require in order to compete with a vertically integrated monopolist. The incumbents continue their businesses as they engage in the regulatory battles, while the entrants, in the usual case, are delayed or prevented from conducting business. At the least, their costs are raised in greater proportion.

Breyer criticizes compulsory sharing for the need to "oversee the terms and conditions of that sharing"^ but that is the point. Such regulatory oversight is essential to correct a condition that can be equated with a market failure. In the absence of an entrant's ability to procure a supply of essential service/facilities components from the incumbents, entrants have two choices, nether of which is usually practical. One option is self-build, effectively mimicking the vertical integration strategy of incumbents with all its potential inefficiency, even with a greenfield opportunity. That option is financially infeasible on a gross basis given the sunk costs of the incumbent and its pre-existing customer base. The other option is for entrants collectively to build supply markets through, for example, RFPs for goods and services for which there are no supplying markets as yet. That option is both time-consuming and expensive. Entrants must fund that supply market completely, as the incumbent already possesses a full supply capability internal to its organization.

The creation of intermediate markets did begin to take place with surprising speed after passage of the '96 Act and the consequent funding of entrants. The independent OSS supply market is one good example. This new market proved efficient, innovative and cost effective. However, any fledgling market with a thin market base is highly vulnerable and the OSS market is no exception. The current wave of CLEC bankruptcies has seriously damaged these new suppliers, and unless competition is revived, a highly efficient and innovative market could simply disappear.

In this situation where supply markets are weak as a result of the incumbents' vertical integration, it is gratuitous for commentators to talk of "weak or shoddy fundamentals or poor business models" and of "irresponsible… debt levels or exaggerated the growth expectations."^ All this really reflects is the cost, complexity, and the risk of creating intermediate markets when the regulator does not appreciate its responsibilities to improve the trading environment.

The technology of transactions

Powell correctly acknowledges the potential impact of technology on transaction costs with his recent observation that

technology breakthroughs have dramatically lowered the barriers to acquiring information. This does not sound remarkable... until you think about how intrinsic access to (and barriers to) information is to every facet of human activity. At some level, most interactions among people represent transactions of a sort in which information is integral to facilitating the transaction, or setting the value of the exchange. Buyers and sellers in a capital economy barter to determine the price and terms of goods and services."^

State regulators have best applied those lessons through their work on the development of new and appropriate OSSs and BSSs that would minimize the transaction costs for all parties involved. This is a learning process that is bound to improve through time, making the market unbundling option increasingly attractive. There is still a long way to go, however, and there is some danger of a reverse regulatory course.

The government's trading institutions and transaction costs

Powell recognizes that "it's important…that you start off by recognizing that rules and regulations themselves constitute costs, transaction costs."^ Costs can be either positive costs (burdens), or negative costs (benefits to the parties wishing to trade), as illustrated by unbundling contracts in the U.S. Under regulatory supervision new contracts have borrowed from old contracts. The considerable costs of writing the earlier contract has been substantially reduced for subsequent contracts by setting a standard framework, adopting the pick and choose rule,^ and through other means. The European Commission well understood how regulators facilitate market-based trade when it published its reference interconnection contract.^

Powell considers those costs from a very partial perspective, however. He argues:

So how does the FCC lower costs or try to minimize impediments to infrastructure development…? As we go forward with our broadband initiative…, one of the things we're rigorously examining is all our rules and all our flexibility to see if we can lower costs by lowering regulatory costs or harmonizing them in a way that will give people a better opportunity…^

His statement indicates that he sees regulatory costs as inherently a burden on the sector and that it should be the FCC's objective to minimize them. If this were always a primary concern, then interconnection and unbundling contracts would still be negotiated one-on-one the way they have been negotiated in New Zealand for the past decade. As a consequence, facilities-based competition in that country, undertaken through considerable investments by entrants, is now at a virtual standstill. Without wholesale access to essential facilities and services – especially wholesale local service (equivalent to UNE-P), facilities investment is actually being discouraged. Recently, the government has recognized the burden that non-intervention places on the sector and has passed new telecommunication legislation establishing a regulatory agency.^

The efficiency the incumbents' organizational structure

Faulhaber (2001) and Crandall and Sidak (2002) are some of the economists who have begun to consider (broadly) the efficiency of the incumbents' organizational structures. Those economists largely purport to base their work on Williamson. However, Williamson's work hardly supports their views about the rationality of incumbent structure from the standpoint of economic efficiency:

Discussing an oligopoly environment, a situation even less concentrated that the current situation in local access, Williamson states:

"Entry impediments of two types arise where the leading firms in stage I integrate (backward or forward) into what could be otherwise a competitively organized stage II activity. For one thing, the residual (non-integrated) sector of the market may be so reduced that only a few firms of efficient size can service the stage II market. Firms that otherwise would be prepared to enter

stage I may be discouraged from coming in by the prospect of having to engage in small-numbers bargaining, with all the hazards this entails, with those few nonintegrated stage II firms. Additionally, if prospective Stage I entrants lack experience in stage II related activity, and thus would incur high capital costs were they to enter both stages themselves, integrated entry may be rendered unattractive. The integration of stages I and II by leading firms is then anticompetitive in entry aspects at least, if severing the vertical connections would permit a competitive (large-numbers) stage II activity to develop without loss of scale economies."

Notwithstanding apparent lack of support from Williamson's academic studies, Faulhaber attempts to argue that the internal transactions of incumbents are too complicated to allow for unbundling. His support for this amazing proposition boils down to the following:

"The magnitude of the change sought by the FCC can best be viewed using a transaction cost theory of the firm. In this view, transactions characterized as follows are best done within the firm:

Involve transaction-specific long term assets
Are rich in information requirements
Long term relationships greatly improve the transaction
Involve close and ongoing coordination between transactors

For such transactions, simple markets will fail to reflect the full economic value of the transaction and are likely to fail. Therefore, such transactions are brought within the firm so that this value can be fully internalized.

Conversely, transactions characterized as follows are best done between firms:

Assets are not dedicated to a single transactor
Have relatively simple information requirements, such as a simple price and product description
Long-term relationships are largely irrelevant;
Transactions are individually self-contained and do not require ongoing coordination

These transactions are best mediated through a market, in which competition and external innovation ensure that firms are getting the best deal possible without fear of market failure."^

In economic terminology, Faulhaber's argument is that asset specificity - the need for specialized transactions to supply the firm - is so great that markets can't supply the need adequately.^ In fact, there is no support for that proposition here and empirical evidence to the contrary. Gasmi et al^ establish that incumbents cannot avoid discriminating in their favor as a matter of simple resource allocation.^ A similar result emerges from the work on sabotage.^

Fransman's study of the relationship between operators and vendors over time is particularly revealing, as it solidly meets all of Faulhaber's criteria calling for internal transactions. The study included AT&T, Deutsche Telekom, NTT, France Telecom, and BT, among others. It's results show no particular relationship as inevitable, but wide variety from vertical integration (Western Electric) to a virtual competitive environment (NTT's suppliers). Furthermore, Fransman demonstrates that asset specificity declined substantially starting in the late 1970's and accelerating in the eighties.^ The progressive undoing of the asset specificity described by Fransman closely parallels the emergence of

competition in telecommunications. This suggests that the asset specificity between manufacturers and operators may have been nothing more than the expected response to the operators' monopoly status. This would be fully consistent with neo-institutionalist analysis in general. The 1996 Telecommunication Act might have ended up to be the coup de grace for asset specificity of the kind we had known decades earlier had it not been for the telecommunication recession that began to take shape in the late 2000.^

Fransman notes the carriers of the eighties and early nineties had relied almost exclusively upon the established manufacturers and on an evolution in the technology, while the new entrants of the mid-to-late nineties deviated much more significantly from that path. These new entrants began to create a new manufacturing segment that did not rely on the previous highly centralized technologies that had evolved from the legacy.

Data Problems and an Approach to Solving Them

Introduction

Faulhaber noted recently that "Estimates of the cost of phone service vary; the lack of true competition has kept these costs from being transparent."^ Gasmi et al. ask the question: "What are the costs of the multi-firm alternative to a regulated natural monopoly?"^ How can policy makers hope to get to the bottom of these problems? Without knowledge of costs as they would appear in a competitive environment, the task of deriving wholesale prices to implement the '96 Act are quite daunting. So is any simple benchmarking effort.

Intuitively, cost data from a monopoly environment generally has no regulatory relevance to the transition to a competitive environment. Absent a natural monopoly, the incumbent's data is inadequate to inform even the most basic analytical questions such as the presence of scale and scope economies and whether operators might be economizing transactions costs. Moreover, its use can even undermine the very policies it is being used to implement. Notwithstanding, incumbents' cost data has been the conventional database for most quantitative studies, including estimation of scale and scope economies. This basic problem is not totally unappreciated in current literature. Fuss and Waverman (2002) have pointed out that a major problem with today's econometric analyses in telecommunications is that they are based almost exclusively on data from incumbents.^

The history of telecommunications provides the means to understand the full dimensions of the data problem and its solutions.

A historical perspective

Introduction

There are two regions in the world where telephony emerged in a competitive environment: North America (Canada and the U.S.A.) and Sweden. In many ways competition in those two regions had many common characteristics. These periods challenge the view held by some that "too many" entrepreneurs entered the sector after 1996. The scope of early entry appears to have been at least equally broad, especially amazing considering the lack of mandated interconnection.

To summarize the salient conclusions up front: Telecommunications sector behavior looks like a textbook example of competition versus monopolies, with differences in the periods evident in terms of growth, pricing, product differentiation, and innovation. Growth was relatively moderate and slower in non-competitive periods and rapid during competitive times. Prices fell rapidly during the competitive periods, while being predictably stable during non-competitive periods. The most recent competitive period of the mid to late nineties strongly suggests that the current vertical structure that characterizes established operators is not natural and that competition, if it were allowed to develop, would bring about a very different market structure. This prospective competitive market structure appears more capable of spreading risks, to the benefit of investors, and producing greater investment and innovation.

To begin, it is useful to divide the history of the sector's market structure history into four broad periods:^

1877/1894 - The initial Bell monopoly built on the basis of Bell's original patents until expiration;

1894/1913 - Twenty years of intense growth and competition that ended with the Kingsbury Commitment;

1913/1992 - The regulated monopoly based on Vail's 1910's conception: ""One Policy, One System, Universal Service." ; and

1992/today - The gradual emergence of local telecommunication access competition.

The monopoly periods tell us very little about the relative merits of market forces in telecommunications relative to vertical integration. Those two periods were characterized by slow and managed telephone penetration, slow and managed growth,^ slow and managed innovation, and extreme vertical integration. We will therefore discuss only the competitive periods.

1894-1913

The first competitive period started with the end of Bell's exclusive patents and continued until World War I. The essential characteristics of that period, for our purposes here, are as follows:

Competition took the form of what some today are calling "full facilities-based competition";

Competition was almost exclusively local in nature;

The absence of interconnection, as it was left purely a commercial matter; and

Long distance was leveraged by AT&T to gain a competitive advantage (long distance was perceived as telephone's bottleneck of the time).

This segment of the competitive history might appear to give support to Powell's predilection for what we can call "full facilities-based competition." However, there are major differences between that environment and today.

In this first competitive phase, AT&T still had a low penetration level and the entrants, even if they did compete head-to-head with AT&T in some places,^ did not have to dislodge AT&T's customers to be able to build their customer base. In addition, competitors had vast areas, even within major cities, where telephony was not yet available and where they were expanding very much the way AT&T was expanding its network. In other words, telephony was a brand new product and competition contributed to the acceleration of its deployment.^ Those are not the conditions that are faced by entrants today whose contribution is to a far greater extent in dimensions such as improved marketing and sales, improved services and service differentiation. Incumbents have had most of the twentieth century to deploy their infrastructure and without having to interconnect with potential competitors.

Since the advent of telephony, only two telecommunication infrastructures have emerged -- cable and mobile. In both cases, they did not provide a product that was in direct competition with telephony even though the convergence issue appears to have been the object of discussions as early as the '50s.^ The crucial point, from a policy perspective, is that both of these infrastructures

developed as we know them because of the regulator's pro-active policies that ensured that independence.^

In much of Europe, (e.g., France, Germany, and Sweden), the cable infrastructures were built by incumbent telephone operators. There are two interesting lessons from that European experience. First, those cable networks are still largely not upgraded to support telephony capabilities. Second, the strategies of those operators largely contradict the arguments in support of vertical integration made by many economists. Cable infrastructures built by European telephone companies were built as self-standing independent networks that shared little if anything with those same operators' voice and data infrastructures. This suggests that the alleged benefits of integration stressed by so many authors such as Falch and the NRC have not been established and cannot just be asserted to exist.^

The first competitive period was also characterized by strong growth, some amount of product differentiation, and rapidly falling prices.^ During that period, the advent of long distance capability combined with the lack of interconnection between competing operators helped the AT&T Company slowly gain market power. Local operators that did not build long distance networks needed access to long distance networks to be competitive.^ Long distance looked at that stage as a natural monopoly and it provided its owners a tool to leverage their monopoly power over local telecommunications. In fact, long distance was characterized by the same kinds of pseudo "economies of scale" that are assumed by some to exist today in local access, as the subsequent competitive transformation of long distance demonstrates.

In this early period, local access was never thought of as a natural monopoly. Whatever "natural monopoly" might have existed at the time was much more the result of Vail's slogan ("One System. One policy, universal service.") than any technical constraint. ^ Rather, AT&T's prohibition on interconnection, combined with it's unique long distance business, forced full facilities-based competition and by doing so signaled competition's death knell.^ The situation is worse for competitors today, given that penetration is high, not low, with entrants facing incumbents whose facilities reach close to 100% of all potential customers. At the same time, that early period also helps us appreciate the need for regulation in the face of market power, as when Powell makes a parallel between the transition to competition at the local level and at the long distance level.^

1992 and after

The second competitive era is very different from the first. This is primarily due to mandated interconnection with competitors. The lack of mandated interconnection in the earlier competitive period appears to have contributed to the instability that allowed for Bell consolidation at the expense of competitors.

Interconnection requirements notwithstanding, further policy intervention has been required to stimulate competitive entry. Competition emerged only after court challenges, new legislation, and new regulatory strategies that focused specifically on access. One constant in the growth of competition is the extent to which incumbents everywhere have repeatedly underestimated demand. That was true in 1894 after the end of the Bell patent. It was true with the CPE. It was true with long distance and international traffic. It was true with Internet and will probably be true with broadband deployment.^ Underestimation of demand is a frequent condition associated with a monopolist's attempts to

control markets and foreclose the development competitive activities and technologies that could endanger it's existing market position.

The modern competitive era demonstrated the value of competition and of offering customers a wide range of options. Entrants innovated in almost every dimension of the business, from the use of rights-of-way,^ to becoming early adopters of new technology.^ Entrants innovated at the OSS/BSS level by working closely with new vendors that were developing modular off-the-shelf elements that would support a plug-and-play strategy.^ While incumbents were selling their real estate because of the miniaturization of equipment and complaining that there was not enough space for collocation, entrepreneurs created the telehouse, where myriad service providers could collocate and interconnect efficiently. Fiber became commercialized under a growing diversity of formats -- dark or lit, by strands or lambdas. While ADSL had been developed by Bellcore in the late 1980's, it was the CLECs who were the first to push for its large scale deployment. In all, entrants brought a new standard of innovation and efficiency to the marketplace.

The incumbents' cost data in econometric studies can be misleading

Econometricians working in telecommunications attempt to estimate cost functions by basing their work on the historical experience of one or more incumbents. From this they attempt to model the operators' technological constraints. However, the incumbents' market power creates a cost structure based on a monopoly industry model that fundamentally conflicts with Chairman Powell's laudable goals of arriving at "the market fundamentals that provide proper incentives for long term, sustainable competition" at the level of network activities.^ As we have stated throughout, this cost modeling approach presumes the efficiency of the existing monopoly and doesn't bother to look behind those costs to assess them against market benchmarks.

Despite the inadequacies of the cost model, it is basic to much telecommunications sector analysis and has led to erroneous conclusions when applied to policy issues. Thus, for instance, Armstrong, Cowan, and Vickers set their analysis of regulation in the context of "the trade-off between competition and the exploitation of scale economies."^ These improper assumptions can give rise to comments such as Michael Powell's: "Economic scale does matter... I am equally convinced, however, that competition can exist in the race to deploy broadband platforms and that policy should not foreclose competition and jump on the monopoly trolley as it did in the early 1900s."^ Intuitively, Chairman Powell understands that competition must be accommodated by public policy, yet he is confronted with analyses that can erroneously appear to limit where that competition can effectively play a role.

The endogeneity of communications technology began in the early 1900s when the Bell System was able to regain control it had had on the sector prior to patent expiration. The success of that dominant player meant that the intermediate markets that emerged in the early days of open competition largely disappeared. Another impact was to encourage incumbents to develop unique relationships with chosen vendors that resulted rapidly in asset specificities. Endogenous asset specificity made the technology endogenous and thereby generated a unique technological path. The monopoly was born, and with it the power to sustain itself and protect itself from competitive threats.

The incumbents' cost data is based on a vertically integrated market structure. Market-based examples, such as with OSS, strongly suggest that this structure leads to inefficient operations. Compounded with this, the experience we have

had with competition, albeit short, provides a good view of what an efficient market structure for local telecommunication access might look like. An efficient industry structure is one that relies much more heavily upon decentralization and the use of independent supply markets to ensure efficient resource use and allocation, the very kind of efficiency that competition imposes. In other words, the cost data of incumbents are not representative of what would emerge if Powell's objective of realizing "market fundamentals that provide proper incentives for long term, sustainable competition," were to be implemented.

Going back to the fundamental point that scale and scope economies must arise from a production technology that is beyond the control of the firm, we find that in the case of local telecommunications, the firm, through its ability to choose vertical integration outside of the dynamics of market discipline, has itself defined the production technology. Furthermore, it is highly doubtful that vertical integration could have been accomplished in a market environment.^

Clearly, then, incumbent costs do not provide any information about efficient market costs, the kind of market envisioned by the competitive environment mandated by public policy. The actual costs of an incumbent (ironically referred to by incumbents as "their economic costs") reflect only production and organization under a market structure of centralization and concentration, and historic vertical integration. In fact, even under very restrictive conditions such as those that are implicit in most "forward-looking" access pricing models, such estimates are seriously biased and reflect higher than likely economic costs.

Finding a market-based data benchmark for policy-making: the "Business Case" approach

The market power inherent in the ILEC's legacy structure, combined with the lack of market-based information to inform regulatory decision-making, poses a formidable policy challenge to the introduction of competition. The starting point of addressing this policy challenge must be the basic given -- the historic vertically integrated local services industry structure. Given the legacy industry structure, the regulatory objective of achieving sustainable competition in local access services requires the regulator to disaggregate the integrated production of local access into meaningful component processes and establish sustainable market activity in each, or establish substitute prices consistent with a competitive model. Both disaggregation and proper pricing are critical to regulatory success and that fact has been chronically unappreciated. Furthermore, as explained throughout this paper, ILEC accounting costs are useless and largely counterproductive to the required analysis and action.

There are three potential approaches to this problem. The first and most direct is to divest the ILEC networks from their retail organizations and restrict network commercial activity to the wholesale domain, thereby creating incentives for the network company to provide market-responsive nondiscriminatory access. This obvious solution was not required by the 1996 Act and involves an evolutionary process as market demand signals develop over time and as the network company attempts to serve developing needs. The second approach is the Supreme Court-approved method currently being utilized, whereby regulators identify network elements to be unbundled and set prices that anticipate the forward-looking development of markets. The risks of this approach remain significant. Without any market-based guidance, regulators can easily fail to identify the meaningful production components that need to be disaggregated and made available, or fail to establish efficient prices. Either failure results

in lack of entry. The third approach provides at very least market-based assistance to this current process. Policymakers can harness the market signals of financial markets to help them identify the components of the required trading environment and establish the terms and conditions that will achieve entry and transition to a sustainable competitive industry structure.

Financial markets can provide legitimate market-based information on what regulatory action will achieve investment. Entry will occur when regulators provide conditions that equalize for the risk of competing against a vertically integrated incumbent with ubiquitous customer control. Success in implementing the goals of the 1996 Act results in investment in new entry. Failure does not. Lack of meaningful, sustained entry in the context of a policy shift from monopoly to competition signals clearly that the regulator has not done enough to remove inherent entry barriers. For Wall Street, paying "too much" for a production input increases investment risk, so that, for example, paying monopoly rents discourages entry. Unless one accepts Crandall and Sidak's unsupported conclusion that the costs incurred by discrimination and monopoly rents are insignificant, use of incumbent data will grossly underestimate the discrimination-free cost of network elements, warranting further decreases from current levels.

The most obvious and effective tool available to regulators to equalize risk is the price tool, viz., setting wholesale prices of component access services and facilities -- UNE-P and current and other UNEs -- that are low enough to result in investment in new entry and thereby support transition to a more efficient industry structure. Given the magnitude of likely inefficiencies in the current structure, we believe that policymakers should expect to see massive entry attempting to exploit those inefficiencies. When policy equalizes for the risk, policymakers will likely see investment and entry more akin to the period of the late 1990's, than to today.

The importance of UNE-P is this process warrants particular attention. One of the goals of the regulator must be to foster incentives to invest in advanced services and infrastructure, as contemplated by the 1996 Act.^ Eliminating elements of UNE-P and thereby UNE-P availability, as suggested by some proposals, forces would-be entrants to invest in old analogue technology just so that they can utilize the other legacy network piece parts made available to them to reach existing customers. That result is as contrary to legislative objectives as imaginable. Regulatory failure to limit the entry investment that must be sunk before customers can be served and revenues realized discourages investment and preserves the legacy industry structure that the Act requires be transformed.^

It is also important to observe that all new entry resulting from these approaches can be presumed efficient.^ The obstacle to realizing efficient entry is solely the result of the vertical organization of the incumbent and its ability to exert considerable control over new entrant input costs as well as to game its own cost structure.^

Finally, there are built-in safeguards using the business case approach to any concern that regulated wholesale prices that attract entry may be "too low" in economic efficiency terms. Policymakers can rely upon the expectation that incumbents will seek the isolation (or even divestiture) of their bottleneck activities if they feel that regulated network component prices fail to generate rents at least as high as what they can expect with a stand-alone bottleneck.^ Their continued fight for a vertically integrated structure implies that they

perceive they are able to extract a significant rent notwithstanding the actions of regulation.

Conclusion

Achieving transformation of the local access services sector to one of effective and sustainable competition requires that functioning supply markets be established for all the component production processes that together constitute local access services. Such supply markets are a critical component of other open and competitive sectors of this magnitude, but they are not present in local access services. Under the old franchised monopoly, ILECs integrated virtually all significant component processes into their firms -- from digging trenches, to planning and building the infrastructure for entire regions, to developing OSS and other back office systems. Consequently, would be entrants have few or no such supply markets available to them and are forced either to undertake a similar vertical integration for themselves, or collectively develop supply markets that duplicate the functions performed internally by the ILECs. Either option is expensive and time consuming and forces investments in legacy technologies that delay investment and deployment of broadband services and capabilities.

The decisions made by ILECs as franchised monopolies to vertically integrate rather than rely on supply markets were never subjected to normal market disciplines. Thus, no efficiency presumption can be attached to these decisions or to current ILEC operations. Studies of scale and scope and transactions costs in telecommunications have failed to establish these efficiencies in ILEC organizations and networks. There are serious analytic and anecdotal indicators of substantial inefficiencies, however.

It therefore appears that the ILECs' network and organizational sunk costs simultaneously perpetuate operational inefficiency yet protect them against efficient entry. Entry, and thereby investment in advanced infrastructure and broadband services is discouraged. Regulators thus face a situation where more efficient entrants will fail to establish themselves against less efficient incumbents. This anomalous environment presents a classic case of market failure in the presence of market power that requires government intervention. Regulators must ensure that entrants have access to component processes of the ILECs, the only available resources in very many cases, at price levels reflecting the costs that would obtain in competitive supplying markets.

Assembling the necessary access service components under an industry structure barren of most component markets presents a daunting and possibly unique challenge to would-be entrants. UNE-P and upgraded broadband equivalents quite likely provide the only opportunity for near term efficient end user local services competition. Without the UNE process, or UNE-P and further-developed broadband equivalents, the FCC will risk destroying competition and any near term potential for sustainable competition except perhaps on a niche basis.

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^ See pending FCC '96 Act Triennial Review Docket and other dockets relating to competitor access to incumbent infrastructure (e.g., NPRM to reexamine UNEs, NPRM to reclassify broadband services as unregulated "information services").
^ We use the expression "pseudo-Schumpeterian" to stress the difference between Schumpeterian analysis and the analysis that applies in the present telecommunications context. "Schumpeter observed that in order for firms to have an incentive to bear risks, they must have the prospect of earning supra-competitive profits if the venture turns out to be successful." Haring et al., "The Disincentives for Broadband Deployment Afforded by the FCC's Unbundling Policies," presented before the FCC, In the Matter of Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers; Implementation of the Local Competition Provisions of the Telecommunications Act of 1996; Deployment of Wireline Services Offering Advanced Telecommunications Capability in CC Docket Nos. 01-338; 96-98 and 98-147 as Attachment to Comments of High-Tech Broadband Coalition, April 5, 2002. 3. But in Schumpeter's analysis, the monopoly survives as long as it takes sufficient steps to increase its efficiency and delay or undermine entrepreneurial competition. In the case of telecommunications, the monopoly creates and expands entry barriers through vertical integration by foreclosing intermediate markets that, if they existed, entrants would use in their production processes of final goods and services. There is no basis for asserting that the absence of such markets is efficient. Because of this, Kahn's "tension between Schumpeterian competition and the regulator's mandate to provide for the prompt dissolution of franchised monopoly" is of little relevance. Kahn, Alfred E. Whom the Gods Would Destroy or How Not to Deregulate. Washington, D.C. AEI Press, 2001.
^ "Incumbent local exchange company."
^ Of course, incumbents can also face costs as a result of policy transition. Unfortunately, discussion to date has not analyzed those costs to determine whether they reflect transition from less efficient ways of conducting business. It is likely these costs do reflect inefficiencies as the competitive model of the 1996 Act is widely expected to increase efficiency.
^ USTA v. FCC, No. 00-1012, D.C. Cir., decided May 24, 2002.
^ Noam, Eli M. "How Telecom Became a Cyclical Industry, and What to Do About it". Draft paper. New York, NY: Columbia University, 28 June 2002.
^ Panzar, John C. "Technological Determinants of Firm and Industry Structure". Handbook of Industrial Organization. Vol. I, Schmalensee, Richard and Willig, Robert, eds. New York: Elsevier, 1989. 4.
^ "As we go forward with our broadband initiative...it is the No. 1 key central communications policy objective we're pursuing here at the FCC." Dawson, Fred. "The Powell Doctrine: FCC Chairman Talks Policy with XCHANGE as Action on Broadband Intensifies". Xchange Web Extras, (• HYPERLINK http://www.xchangemag.com/webextra/241webx1.html ´•http://www.xchangemag.com/webextra/241webx1.html•). Virgo Publishing, April 2002.
^ Powell, Michael K. "Remarks". FCC, National Summit on Broadband Deployment. Washington, D.C., 25 October 2001.
^ Baumol, William J. and Sidak, J. Gregory. Toward Competition in Local Telephony. Cambridge, MA: MIT Press, 1994.
^ Id.
^ Noam, Eli, New York Times, July 28, 2002.
^ "Having assembled tightly integrated, end-to-end monopolies, incumbent telephone companies begin with powerful advantages over newcomers – the ability to offer end-to-end one-stop shopping to all comers, immediately. Competitors have to build up, piece by piece, a process that can take years. The only way they can offer comparable service while they build is to resell the services of the incumbents in the interim. In due course, competition will force incumbents to break down their integrated services into smaller pieces, but a certain

amount of well-placed regulatory dynamite can certainly accelerate the process. Or, that, in any event, is what Congress has concluded." Huber, Peter W., Kellogg, Michael K., Thorne, John, The Telecommunications Act of 1996, Little, Brown and Company, Boston, 1996, pp. 8-9.

^ The '96 Act approaches competition on multiple levels, including resale and facilities-based using parts of the existing network. The Act's competition premise is also consistent with Thierer's historical analysis, concluding the absence of natural monopoly conditions. However, Thierer ignores the market failure that requires regulatory intervention to correct for the entry barriers resulting from the legacy structure. Specifically, he has ignored the adjustment costs inherent in transition to an efficient competitive stage and fails to appreciate the need for the development of efficient component markets to achieve services competition. Thierer/1994

^ This observation is the crux of several ensuing sections of this paper.

^ See the series of FCC orders commencing with the FCC First Report and Order in CC Dockets No. 96-98, 95-185, adopted August 1, 1996.

^ "total element long-run incremental cost"

^ Verizon vs. Federal Communications Commission, No. 00511, decided May13, 2002.

^ See, Order Instituting Verizon Incentive Plan, Case Nos. 00-C-1954, 98-C-1357, adopted February 27, 2002: "We recognize, as parties have noted, the recent setbacks to the development of competition, including the upheaval in the capital markets and observable,
adverse effects of the UNE prices set in the First Network Elements Proceeding, which allowed insufficient margin between UNE prices and Verizon's retail prices. The Plan addresses certain of these concerns, along with the recently reduced UNE prices. The stability provided by the Plan (through such features as Verizon's agreement not to challenge the UNE rates and not to claim exogenous costs) and the Plan's other competitive enhancements related to UNE Platform availability, charges, procedures, and other matters, will enable CLECs to continue to compete in New York. The resolution of the competitive issues to be addressed by the task forces and other
competitive enhancements under the Plan also will enhance opportunities for facilities-based competitors." p.31

^ The terminology of "facilities-based competition" is the source of intentional and unintentional ambiguities and many errors in today's debate, including in some major court decisions (e.g., Breyer's dissent in part in the Iowa Decision that has been cited by economists such as Kahn). There are at least four distinct forms of "facilities-based competition" that are implied in today's debate around the merits of the 1996 Telecommunications Act:
non-network facilities-based competition, limited to ancillary systems such as billing systems and OSS;
network element facilities-based competition where firms invest in some network facilities;
full facilities-based competition where a vertically integrated operators provides all or almost all network elements, and
open facilities-based competition with fully developed and competitive intermediate markets as well as all of the above.
Only the latter is representative of an efficient competitive environment. In fact, Williamson's "transaction costs economizing" hypothesis requires such an environment as its initial condition.
Williamson, Oliver. The Economic Institutions of Capitalism. New York: Free Press, 1985.

^ David Teece, Telecommunications in Transition: Unbundling, Reintegration, and Competition, 1 MICH.TELECOMM.TECH.L.REV. 47 (1995)

^ Jorde, Thomas M., Sidak, J. Gregory & Teece, David J. "Innovation, Investment, and Unbundling", Yale Journal on Regulation. 17 (1). 2000. 1-37.

Hausman, Jerry A. "The Effect of Sunk Cost in Telecommunications Regulation". In The New Investment Theory of Real Options and Its Implication for Telecommunications Economics. James Alleman & Eli Noam ,eds. 1999
Haring, John and Rohlfs, Jeffrey. "The Disincentives For Broadband Deployment Afforded by the FCC's Unbundling Policies". Washington, DC: Strategic, Policy, and Research. 4 April 2002. (• HYPERLINK http://www.spri.com/pdf/reports/perspectives/perspectivesfragment2-26-02.pdf ´•http://www.spri.com/pdf/reports/perspectives/perspectivesfragment2-26-02.pdf•)
Haring, John, Rettle, Margaret L., Rohlfs, Jeffrey H., and Shooshan, Harry M. "UNE Prices and Telecommunications Investment". Washington, D.C.: Strategic Policy Research, (• HYPERLINK http://www.spri.com ´•www.spri.com•). 17 July 2002. See also some of Crandall's work cited herein and implications in the NRC Broadband report (cited infra).
^ For example: "It is possible that the FCC's loop unbundling requirement has had some effect on investment incentives to deploy DSL broadband. However, the effect is most likely infinitesimally small compared to the supply, provisioning and service problems the RBOCs have had in the DSL rollout." Faulhaber, Gerald R. "Broadband Deployment: Is Policy in the Way?" (• HYPERLINK http://rider.wharton.upenn.edu/~faulhabe) ´•http://rider.wharton.upenn.edu/~faulhabe)•. 2.
^ Consequently, competitive markets produce the greatest investment.
^ Studies show that where there is greater demand stimulated by the presence of cable modems, incumbent telephone companies have increased their investment notwithstanding regulation. See research undertaken by James Alleman, Colorado University and Paul Rappaport, Temple University and presented at TPRC conference 2002.
^ To the extent that the National Research Council's numbers for rewiring the nation with high-speed broadband connections can be used as an approximation, it is implied that the cable and telephone incumbents' cost to deploy a broadband network would be only in the order of 20% of what new entrants would have to spend. See, Computer Science and Telecommunications Board, National Research Council, Broadband: Bringing Home the Bits, National Academy Press, 2002.
^ Teece's article needlessly references contestability, a reigning theory of the time, in juxtaposition to monopoly. More recent thought recognizes the need for some sort of market-based pricing methodology, or at least a cost-based approach such as TELRIC that is designed to approximate market-based pricing. A cost-based approach such as ECPR ("the efficient component pricing rule" that is related to contestability) is derived from a natural monopoly model rather than being designed for transition to competition.
^ This view can be contrasted to Faulhaber for whom "new infrastructure players may attempt entry into cities and neighborhoods with profitable customers, a strategy currently pursued by RCN, for example." Faulhaber, Gerald R. "Broadband Deployment: Is Policy in the Way?" (• HYPERLINK http://rider.wharton.upenn.edu/~faulhabe) ´•http://rider.wharton.upenn.edu/~faulhabe)•
^ It is interesting to note that those in Wall Street who support this opposition to the 1996 Telecommunications Act are particularly silent about who those competitors might be.
Kovacs, Anna-Maria, Vitale, Gregory S., Burns, Kristin L. "The Status of 271 and UNE-Platform in The Regional Bell's Territories". Industry Report, Telecommunications and Broadband Services, Equity Research, Commerce Capital Markets. Philadelphia, PA, November 2002.
^ "Any further DSL deployment must be justified, in large measure, by the prospect of supracompetitive returns on new broadband applications." Haring, John and Shooshan, Harry M. "Reorienting Regulation: Toward a More Facilities-Friendly Local Competition Policy". Washington, D.C.: Strategic Policy Research, (• HYPERLINK http://www.spri.com ´•www.spri.com•), 3 April 2002.

^ "Economic scale does matter and it does take a great deal of resources to deploy these networks." Powell, Michael K. "Remarks". FCC, National Summit on Broadband Deployment. Washington, D.C., 25 October 2001.
British economist Armstrong discusses the possibility of inefficient entry in such a situation: "If a market is deregulated when there is still substantial market power present, prices will be high, which may in turn induce a high degree of entry. Given that there is a price/cost margin due to market power, this entry may not be the most efficient." On the other hand, it will be entry that is more efficient than the incumbent. If, however, there is restriction on entry, a possibility raised by recent FCC's NPRMs, there will also be restrictions on achieving efficiency. It is important to remember that the incumbent alone is in a position to extract rent from entry restrictions. Armstrong , Mark. "Regulation and Inefficient Entry". Paper prepared for the World Bank meeting on "The institutional foundations of a market economy" Berlin, February 2000.
^ In fact, some of the proponents of this approach have argued that one of the problems with the implementation of the 1996 Telecommunications Act has been excessive entry or what the French call "compétition sauvage." This notion is generally used in Europe to justify a form of restricted club-like competition that is also called "planned and managed competition." According to Crandall and Sidak, managed competition is "sometimes called "asymmetric regulation" or "dominant carrier regulation." It emphasizes cartels of selected industry players. Id. at 338, fn7. Historically, this notion has been quite alien to American economics, and rightly dismissed, because competitive activity stimulates efficient outcomes. Nevertheless, some recent suggestions on how to respond to the current telecommunications sector economic crisis support such a fundamental policy shift. For instance, Deazen recently wrote: "Mr. Powell said the government bore some responsibility for the industry's problems... following the landmark 1996 Telecommunications Act… Mr. Powell said that he thinks the FCC may have erred in the past by implicitly encouraging the formation of hundreds of Bell competitors without realizing how few of them would ultimately be able to survive... 'We correctly believed these markets didn't need to be natural monopolies and they could be competitive, but I think we tended to over-exaggerate how quickly and how dramatically it could become competitive,' Mr. Powell said." Dreazen, Yochi J. "FCC, Faced With Telecom Crisis, Could Let a Bell Buy WorldCom". Wall Street Journal, 15 July 2002. (• HYPERLINK http://online.wsj.com/article/0,,SB1026696580457716480.djm,00.html ´•http://online.wsj.com/article/0,,SB1026696580457716480.djm,00.html•)
^ "The alternative is remonopolization, not free markets." Noam, NYT, supra.
^ Beard, T. Randolph, Ford, George S., and Spiwak, Lawrence J. "Why ADCo? Why Now? An Economic Exploration into the Future of Industry Structure for the "Last Mile" in Local Telecommunications Markets". Phoenix Center Policy Paper Number 12. Washington, DC: Phoenix Center for Advanced Legal and Economic Public Policy Studies, (• HYPERLINK "http://www.phoenix-center.org" ´•www.phoenix-center.org•). November 2001.
^ Faulhaber, Gerald R. "Broadband Deployment: Is Policy in the Way?" (• HYPERLINK http://rider.wharton.upenn.edu/~faulhabe) ´•http://rider.wharton.upenn.edu/~faulhabe)•.
^ In fact, the first serious attempts at understanding efficient costs have been state regulatory proceedings applying TELRIC. Although these efforts have far surpassed the studies of economists to date, the challenges to state regulators given the absence of markets for the building blocks of local access, are daunting.
^ Laffont, Jean-Jacques & Tirole, Jean. Competition in Telecommunications. Cambridge, MA: MIT Press. 2000. p. 16.
Nolle, Tom. "NPN: The RBOCs' Roadmap To Tomorrow's Access Network". Network Magazine, 5 April 2001 (• HYPERLINK

http://www.networkmagazine.com/article/NMG20010319S0011)
´•http://www.networkmagazine.com/article/NMG20010319S0011)•.
Noam, Eli. "Eli Noam: Regulating in order to deregulate. The US Supreme Court has sanctioned a damaging extension of the telecoms regulator's powers". Financial Time.
(http://news.ft.com/servlet/ContentServer?pagename=FT.com/StoryFT/FullStory&cid=1021990923460&p=1020498309075). 22 May 2002.
^ Woroch, Glenn. Handbook
However, Woroch argues also that "beyond the costs of establishing a given number of connections, we might expect production to obey constant returns to scale as the network is replicated to cover a wider territory."
^ Supreme Court Justice Breyer talks of "the often huge fixed costs (of local loops, say, or switches) and overhead needed to provide the dial tone itself," referring to ILECs and their cost recovery requirements. Iowa Utilities Board v. FCC, No. 96-3321, dissenting opinion (July 18, 2000). For Powell, "Economic scale does matter." Powell, Michael K. "Remarks". FCC, National Summit on Broadband Deployment. Washington, D.C., 25 October 2001.
^ Bannock, Graham, Baxter, R.E., and Davis, Evan. The Penguin Dictionary of Economics. (http://www.xrefer.com/entry.jsp?xrefid=445136). 1998.
^ New School. "Returns to Scale". The History of Economic Thought Website, (http://cepa.newschool.edu/het/home.htm).
^ Viscusi, W. Kip, Vernon, John M., & Harrington, Joseph E. Jr., 1995, Economics of Regulation and Antitrust, 2nd Ed., MIT Press. 152.
^ Panzar, John C. "Technological Determinants of Firm and Industry Structure". Handbook of Industrial Organization. Vol. I, Schmalensee, Richard and Willig, Robert, eds. New York: Elsevier, 1989. 15.
^ Woroch, Glenn. "Local Telecommunication Network Competition". Cave, Martin, Majumdar, Sumit K. and Vogelsang, Ingo (eds) Handbook of Telecommunications Economics, Kluwer, forthcoming.
^ The New School's History of Economic Thought notes that "the concept of returns to scale are as old as economics itself, although they remained anecdotal and were not carefully defined until perhaps Alfred Marshall (1890: Bk. IV, Chs. 9-13)… Marshall's [analysis] presented an assortment of rationales for why firms may face changing returns to scale and the rationales he offered up were sometimes technical (and thus applicable in general), and sometimes due to changing prices (thus only applicable to situations of imperfect competition)."
New School. "Returns to Scale". The History of Economic Thought Website. (http://cepa.newschool.edu/het/home.htm).
^ That is, it does not operate in a market world of suppliers or has few if any competitors on its level forcing it to minimize costs.
^ Woroch takes exception to that view to some extent: "Often it is claimed that there are no variable costs to delivery of local services. This is wrong for several reasons. First, even while the overwhelming majority of costs are durable investments, the plant and equipment have very sharp capacity limits, and as those limits are approached, shadow cost of capacity expansion rises. Second, the variable costs of running a local network entail customer acquisition and care. Typically, customer acquisition costs in competitive cellular telephone markets range from $300 to $500 per subscriber. The importance of these costs grow as customer churn increases and the average tenure of a customer falls, as will surely occur as local services become more competitive." Woroch, Glenn. Local Competition. op. cit.
^ The intent of using a cost approach was to avoid data problems, given the lack of market data.
^ The NRC discusses the "take-rate" tyranny to explain the high cost of entry. NRC, op. cit. 152.

For Thierer, "with such high entry costs, new firms can find it difficult to gain a toehold in the industry. Those problems are compounded by the fact that once a single firm overcomes the initial costs, their average cost of doing business drops rapidly relative to newcomers." Thierer, Adam D. "Unnatural Monopoly: Critical Moments in the Development of the Bell System Monopoly". Volume 14, Number 2. Fall 1994.

"[T]he scale economies that derive from large fixed costs of building different parts of the telephone network… ensure the local exchange will have costs that are (globally) cost subadditive." Woroch, Glenn, Handbook, op. cit.

^ William J. Baumol, John C. Panzar, and Robert Willig. Contestable Markets and the Theory of Industrial Structure. New York: Harcourt Brace Jovanovich, 1982.

^ This paper does not review several attending issues analyzed by Panzar, e.g., such as whether economies of scale are necessary or sufficient to establish the existence of a natural monopoly. We will assume, for the sake of simplicity that there indeed exists a direct relationship between economies of scale and natural monopoly. Extending this paper's results to take into account the greater sophistication of Panzar's analysis is a straightforward matter.

^ The term "natural monopoly" is used in economics to designate a condition whereby monopoly is the most efficient industrial organization. It should not be confused with the term "bottleneck" or the "essential facilities doctrine" in antitrust. Those latter concepts designate a condition where monopoly is not an efficient structure but where market power is present and able to maintain high entry barriers. In cases of bottlenecks or essential facilities government action is required to counter the market power that distorts efficient market forces. The seminal first essential facilities antitrust court decision, the St. Louis Railroad Terminal case, arose as a result of a financial construct and not a "natural monopoly."

^ Thierer, Adam D. "Unnatural Monopoly: Critical Moments in the Development of the Bell System Monopoly". Volume 14, Number 2. Fall 1994.

Crandall, R.W. After the Breakup: U.S. Telecommunications in a More Competitive Era. Washington, D.C.: The Brookings Institution. 1991.

Teece, David. 1995. op.cit.

Teece's policy framework is based on two premises: (1) the need to foster innovation and (2) the vision that "enabling customers to choose among competitive service providers constitutes the most efficient form of 'regulation.'"

Rosston, Gregory L. and Teece, David J. "Competition and 'Local' Communication: Innovation, Entry and Integration". Working Paper CRTP-9, UC-Berkeley. June 1995. 4.

^ Fransman, Martin. "Evolution of the Telecommunications Industry Into the Internet Age." In The International Handbook on Telecommunications Economics. Edward Elgar Publishing, Forthcoming.

^ Pittman, Russell. op. cit. p. 21

^ See, e.g., the NCR Broadband Report.

^ Fuss, Melvyn and Waverman, Leonard. "Econometric Cost Functions". Chapter 5 in Cave, Majumdar, Sumit K. and Vogelsang (eds) Handbook of Telecommunications Economics, Kluwer, forthcoming. One of the questions then becomes, what has changed that would justify calls for the abandonment of competition?

^ Fuss, Melvyn and Waverman, Leonard. op. cit. This would seem to imply recognition of the economies associated with the "network of networks".

^ Fuss, Melvyn and Waverman, Leonard. op. cit.

^ Discussed more fully in Section 6, infra.

^ See, e.g., Pittman 2002, Fuss and Waverman 2002, Gasmi et al. 2002.

^ There are additional costs an entrant would face where it does not have access to markets supplying the specific set of producing inputs it requires to compete in its targeted business(es). For example, it may need to build/acquire more than it otherwise needs. Incurring those additional costs is an additional

problem, however, and those costs should not be added in assessing the comparative efficiency of the incumbent and entrant. Of course, these conditions also erect higher entry barriers.

^ Gasmi, Farid, Kennet, David Mark, Laffont, Jean-Jacques, Sharkey, William W. Cost Proxy Models and Telecommunications Policy; A New Empirical Approach to Regulation. Cambridge, MA: MIT Press, 2002.

^ Their approach's major weakness is the inherent problem of engineering models, namely, it is only able to account for the hardware cost dimension. It is as if, in the computer sector, one conducted a study of the overall sector by considering only the computer hardware.

^ Falch, Morten. Cost and Demand for Telecom Networks". International Telecommunications Society European Workshop. Vienna. 1996; Mitchell, Bridger M. and Srinagesh, Padmanabhan. "Chapter 4: Economic Issues" in Universal Access to e-mail; Feasibility and Societal Implications. Anderson, Robert H., Bikson, Tora K., Law, Sally Ann, and Mitchell, Bridger M., eds. RAND MR-650-MF (• HYPERLINK http://www.rang.org/publications/MR/MR650/ ´•www.rang.org/publications/MR/MR650/•); Kahn, Alfred E. Whom the Gods Would Destroy or How Not to Deregulate. Washington, D.C.: AEI Press, 2001; Woroch, Glenn. Handbook. 2002.

^ Both the local telecommunication network and local telecommunication access might individually constitute a larger segment than long distance, for instance.

^ Adam Smith Institute. "Broadband Britain: Finding a Way Forward". London, U.K.: Adam Smith Institute, 2002.

^ It is also important to understand that this quantification of benefits has nothing to do with economies of scale and scope and thus economic efficiency. Rather, it has to do with the benefits to the monopolist in defending itself against competition through cost shifting.

^ However, some Wall Street analysts have assessed the quantitative benefit of a wholesale/retail divestiture on the shareholders of Regional Bell Operating Companies (RBOCs): "Whether voluntary or not, a potential structural separation of the telcos along wholesale and retail lines would represent an attractive wealth creating event for RBOC shareowners – on par with the breakup of the original AT&T monopoly." CIBC Report, Communications Services Industry: Long-Term Outlook, April 2002, p.23.

^ Crandall, Robert W. and Sidak, Gregory. op. cit. 384

^ Besanko, David, Dranove, David, and Shanley, Mark. Economics of Strategy. New York, NY: John Wiley & Sons, 2nd edition, 2000. 75.

^ Haring, John and Rohlfs, Jeffrey. "The Disincentives For Broadband Deployment Afforded by the FCC's Unbundling Policies". Washington, DC: Strategic, Policy, and Research. 4 April 2002.

Haring, John, Rettle, Margaret L., Rohlfs, Jeffrey H., and Shooshan, Harry M. "UNE Prices and Telecommunications Investment". Washington, D.C.: Strategic Policy Research, (• HYPERLINK http://www.spri.com ´•www.spri.com•). 17 July 2002.

Hausman, Jerry A. "The Effect of Sunk Cost in Telecommunications Regulation". In The New Investment Theory of Real Options and Its Implication for Telecommunications Economics. James Alleman & Eli Noam ,eds. 1999

NRC (2002)

Jorde, Thomas M., Sidak, J. Gregory & Teece, David J. "Innovation, Investment, and Unbundling", Yale Journal on Regulation. 17 (1). 2000. 1-37.

^ Haring, John and Shooshan, Harry M. "Reorienting Regulation: Toward a More Facilities-Friendly Local Competition Policy". Washington, D.C.: Strategic Policy Research, (• HYPERLINK http://www.spri.com ´•www.spri.com•), 3 April 2002.

^ As recognized by the majority of the Supreme Court in its decision in Iowa Utilities Board v. FCC, 8th Circuit U.S. Court of Appeals No. 96-3321 (July 18, 2000).

^ "[G]iven the incumbents' near complete dominance of the local access market, there really is no competitive "market" where a firm can purchase local access at just and reasonable rates that will be provisioned on a timely basis. Acquiring needed inputs (i.e., elements) from the incumbents at just and reasonable rates and provisioning intervals is no cakewalk either." Beard, T. Randolph, Ford, George S., and Spiwak, Lawrence J. "Why ADCo? Why Now? An Economic Exploration into the Future of Industry Structure for the "Last Mile" in Local Telecommunications Markets". Phoenix Center Policy Paper Number 12. Washington, DC: Phoenix Center for Advanced Legal and Economic Public Policy Studies, (• HYPERLINK "http://www.phoenix-center.org" ´•www.phoenix-center.org•) .November2001.
^ Justice Breyer/Iowa. The statement is not clear since the Act clearly demonstrates Congress' intention to achieve competition. In addition, how would one ever know whether the "process" that has been set in place is a process in support of competition if is not allowed to be implemented?
^ One should eliminate from important consideration all the recent papers concluding that unbundling creates an investment disincentive, for example: Haring, John and Rohlfs, Jeffrey. "The Disincentives For Broadband Deployment Afforded by the FCC's Unbundling Policies". Washington, DC: Strategic, Policy, and Research. 4 April 2002. (• HYPERLINK http://www.spri.com/pdf/reports/perspectives/perspectivesfragment2-26-02.pdf ´•http://www.spri.com/pdf/reports/perspectives/perspectivesfragment2-26-02.pdf•); Jorde, Thomas M., Sidak, J. Gregory & Teece, David J. "Innovation, Investment, and Unbundling", Yale Journal on Regulation. 17 (1). 2000. 1-37.
^ Woroch, Glenn. Handbook. op. cit.
^ Thierer, 1994
^ Falch, Morten. "Cost and Demand for Telecom Networks". International Telecommunications Society European Workshop. Vienna. 1996. pp. 4-5.
^ Fransman, Martin."
^ "Submission to the Commerce Commission on 'International Benchmarking: Review of Interconnection and Retail — Minus Wholesale Discounts' (Costquest Associates)". Telecom New Zealand. Wellington, New Zealand. 6 May 2002.
Besanko et al. (2000) go further and consider also inventories, advertising, and R&D.
Besanko, David et al. 2000. op. cit. 75-87.
^ Gasmi, Farid, Kennet, Mark, Laffont, Jean-Jacques, and Sharkey, William. op. cit.
^ NRC . p. 152.
^ Laffont - 2000
^ Kotlikoff, Laurence J. "Telecommunications Policy – Promoting Investment and Vigorous Competition".
^ See, for example, the work of Kenneth Arrow and F.M. Scherer.
^ Wildman, Steve CITI presentation
^ Kahn, Alfred E. Deregulate
Note that the NRC builds his analysis upon the assumption that a broadband infrastructure upgrade would be in the order of 20% of the cost of a new infrastructure, thereby confirming further the benefits of legacy.
NRC
^ He goes on to argue that raising prices over TELRIC produces societal gain by reducing the assumed subsidy to the entrant. Due to inefficiencies of its legacy structure, it is likely that there would continue to be rents under TELRIC to the extent that TELRIC uses incumbent costs as ILECs are currently organized. As such, the rent goes only to those capable of extracting a rent, that is, the incumbent. Entrants could not do so because it would be stripped away by other entrants. That rent exists and incumbents are able to continue to extract it in spite of competitive entry as long as incumbents continue to express a preference for vertical integration. While Schumpeter offers one approach to

deal with monopolies – let technology overcome it -- the value of that approach is dependent upon the monopoly not being able to sustain benefit from inefficiencies. In the present situation, it is the opposite that happens, with the monopoly creating a monopoly-dependent technological path that will generally be less efficient than under a competitive regime and benefiting from it because that creates a barrier to entry. Kahn, Alfred E. Deregulate. op. cit. 3.

^ "... The analysis of eminent economists as diverse as Sylos-Labini... and Schumpeter, and recently renovated and extended by the insightful work of Baumol, Panzar and Willig, means that if one lowers artificial entry barriers and new entrants need not incur significant sunk costs then all the benefits of competition are available regardless of the market share of the incumbent." Teece, David. op. cit. 1995. Teece's argument can be contrasted to Woroch's comment on the same subject: "One last form of scope economies worth mentioning takes the form of cost savings when a firm integrates across two successive stage of production. Such 'vertical economies' likely arise in the local service industries for provision of network carrier services(unbundled elements bulk transport) and retail services (basic services, private line), and in turn, basic local service with certain vertical services (customer calling features, voice mail). As with horizontally related services, the presence of shared resources across stages is a prime source of vertical economies." Woroch, Glenn. Handbook. Op. Cit.

^ Besanko et al. is particularly enlightening on this issue when they name their second and third chapters, "The Horizontal Boundaries of the Firm: Economies of Scale and Scope" and "The Vertical Boundaries of the Firm." Besanko et al. op. cit. 2002

^ See, Pennsylvania Public Utilities Commission, Docket No. M-00001353, Re: Structural Separation of Verizon Pennsylvania, Inc., Retail and Wholesale Operations, 2000.

^ Structural separation, like divestiture, would cause two forms of costs, namely, the nonrecurring adjustment cost to transform the organization from a vertical structure to two or more independent decision-making entities. That is a cost going beyond the particular firm; more in the nature of an investment cost to create a market. The other cost would be the ongoing operational costs for the original firm in the new environment, which may be lower or higher.

^ "Mr. Powell said that he thinks the FCC may have erred in the past by implicitly encouraging the formation of hundreds of Bell competitors without realizing how few of them would ultimately be able to survive..." Dreazen, Yochi J. "FCC, Faced With Telecom Crisis, Could Let a Bell Buy WorldCom". Wall Street Journal, 15 July 2002. (• HYPERLINK http://online.wsj.com/article/0,,SB1026696580457716480.djm,00.html ´•http://online.wsj.com/article/0,,SB1026696580457716480.djm,00.html•)

^ In fact, given the market power of monopoly incumbency, the firm can restrain the technology as this paper shows, but that is not the efficient solution.

^ Attributed to "Engine Charlie" Wilson, GM President, in Senate confirmation hearings as Secretary of State, 1953.

^ Tirole, Jean. The Theory of Industrial Organization. Cambridge, MA: MIT Press, 1988. 20.

He is essentially articulating the conventional and straightforward neo-institutionalist challenge of the technology theory of the firm.

^ e.g., Mas-Colell, Andreu, Whinston, Michael D., and Green, Jerry R. Microeconomic Theory. New York, NY: Oxford University Press, 1995. 127-132.

^ Besanko, David, Dranove, David, and Shanley, Mark. Economics of Strategy. New York, NY: John Wiley & Sons, 2nd edition, 2000.

^ Williamson, Oliver E. Economic Institutions. op. cit. 87.

^ It is also interesting that France Telecom has seen no reason to absorb these companies or integrate their function since.

^ "Competitive local exchange companies."
^ The current regulatory debate about the future of UNEs/UNE-P taking place at the FCC provides just that sort of negative regulatory signal to the investment community. See, e.g., presentation by Richard Lukaj, President, Babcock Capital Partners, Inc, to the NARUC Annual Convention, Chicao, November 11, 2002.
^ Mandy, David M. and Sappington, David E.M. "Incentives for Sabotage in Vertically-Related Industries". April 2001.
^ This conclusion is fully consistent with, and we believe implied by, the work of Williamson (1985, chapter 7).
^ Compare his discussion of market dynamics -- "Markets are often able to aggregate diverse demands, thereby to realize economies of scale and scope…" with his discussion of the firm: (1) Would economies of scale be mainly exhausted if the firm were to produce its own requirements? (2) Are economies of scope significant and can they be realized within the firm?" Williamson, Oliver E. Economic Institutions. op. cit. 92 and footnote 14, p. 97.
^ "Transaction costs" is a term generally applied to transactions that take place outside the technology (or "black box") that is embodied as the firm. Coase argues that a firm would expand until the costs of undertaking a transaction internally are just equal to the cost of using the market to handle the transaction. The cost of using the market to conduct that business is called "transaction costs." See discussion in Waldman and Jensen, Industrial Organization, Addison, Welley, Longman, 2001, p.60. Of course, transactions must take place within a firm also, and these too have associated costs. This section will refer to internal transactions as well for the purpose of understanding where the line suggested by Coase applies in the case of local telecommunications access, an industry where firm organizational choices have been made in a very unusual context of government-acquiesced monopoly. Once Coase's demarcation line is understood for telecommunications access, one finally has the ability to begin an analysis attempting to establish the economic logic of ILEC vertical integration and then examine scale and scope. Establishing that economic logic, of course, requires a benchmark that is market-based.
^ An internal budget process involves a great deal of asset specificity, such as when the network responds to demands from retail channels, or when a trench digging capability is maintained exclusively for the firm. The efficiency of such asset specificity warrants close scrutiny.
^ The same incumbent-centric bias is inherent to other such analyses, e.g., Faulhaber's analysis of unbundling. Faulhaber, Gerald R. "Policy-Induced Competition: The Telecommunications Experiments". (• HYPERLINK http://rider.wharton.upenn.edu/~faulhabe)
´•http://rider.wharton.upenn.edu/~faulhabe)•. 26 August 2001.
^ "From all indications these approaches [resale, unbundling, and structural separation] have failed to take full account of the transaction costs incurred when sharing facilities and resources among competing providers. These transactions have triggered much haggling, contracting and monitoring, and in the worst cases, litigation and enforcement." Woroch, Glenn. Handbook. op. cit.
^ To be more precise, in Powell's words: "Congress legislated mechanisms to re-evaluate and calibrate the incentives, rights, obligations and competitive landscape of the marketplace that underlie the regulatory regime. By creating standards for assessing the terms and conditions of entry and access, by forcing the Commission to review its rules periodically, and by granting powers of forbearance and preemption, Congress invested state and federal regulators with the tools and the daunting responsibility to use them to create workable economic foundations for competition." Powell. Michael K. "Remarks". Goldman Sachs Communicopia XI Conference, New York, NY. 2 October 2002. 3.
^ On the other hand, some incumbents overseas have undertaken such efforts with informative results. For example, one incumbent noticed that when it adopted

for internal accounting purposes the regulated prices set for completing calls between wireless or between wireline and wireless networks, it put itself at distinct competitive disadvantage. Competitors were able to charge large customers lower prices than the incumbent could offer. Completing calls within network proved that the regulated prices for completing calls between networks were set far too high above actual prices, notwithstanding the forward-looking nature of the regulatory accounting methodology that had established them.
^ ILECs seldom speak in terms of managing their constituent organizations on a true profit and loss basis. Most usually, costs are assigned and their revenues are measured as "contribution."
^ NRC. Op. cit. 27-28.
^ Dawson, Fred. "The Powell Doctrine: FCC Chairman Talks Policy with XCHANGE as Action on Broadband Intensifies". Xchange Web Extras, (http://www.xchangemag.com/webextra/241webx1.html). Virgo Publishing, April 2002. Moreover, notwithstanding well-intentioned OSS regulatory efforts, those efforts may have had limited effectiveness. Significant time and expense was expended by Regional Bell Operating Companies to retool legacy OSSs, mostly accomplished via hand-coding fixes performed by internal software personnel at a cost of upwards of hundreds of millions of dollars. Yet, the performance results remain questionable. In contrast, the emergence of CLECs gave rise for the first time to the development of a competitive OSS industry that has produced solutions at a fraction of the cost (as little as 1%-2%) and with arguably far more robust performance characteristics.
^ Goldman Sachs, op. cit.
^ Justice Breyer. Iowa. op. cit.
^ Powell, Michael K. Wall Street. op. cit.
^ Powell. Michael K. "Remarks". Broadband Technology Summit, U.S. Chamber of Commerce. Washington, D.C. 30 April 2002.
^ Powell. Michael K. "Remarks". Broadband Technology Summit, U.S. Chamber of Commerce. Washington, D.C. 30 April 2002.
^ There is considerable debate about the pick and choose rule, but very little factual foundation to negative allegations about its application. That rule is criticized for limiting individual negotiations. However, the FCC staff, in conversation with two of the authors, has been adamant that the rule has never once been applied in a manner that could arguably prevent commercially sensible deal-making.
^ "National regulatory authorities shall ensure the publication, in accordance with Article 14(1), of a reference interconnection offer. The reference interconnection offer shall include a description of the interconnection offerings broken down into components according to market needs, and the associated terms and conditions including tariffs." Article 7(3), Directive 97/33/EC.
^ Powell's Broadband remarks, op. cit.
^ New Zealand's Telecommunications Act 2001
^ Faulhaber, Gerald R. "Policy-Induced Competition: The Telecommunications Experiments". (• HYPERLINK http://rider.wharton.upenn.edu/~faulhabe) ´•http://rider.wharton.upenn.edu/~faulhabe)•. 26 August 2001.
^ Asset specificity can be described as follows: "Transactions that are supported by investments in durable, transaction-specific assets experience 'lock in' effects, on which account autonomous trading will commonly be supplanted by unified ownership" (vertical integration). Williamson, Oliver E. Economic Institutions. op. cit. 53.
^ Gasmi et al./2002
^ "Hence, despite perfect accounting separation, complemented by a fair access price to the regulated sector, the incumbent can, by strategically manipulating effort levels, undercut an entrant, even if the latter happens to possess a comparable or even somewhat superior technology." Op. Cit. P. 181.

^ Mandy, David M. and Sappington, David E.M. "Incentives for Sabotage in Vertically-Related Industries". April 2001.
^ Fransman (2002) dates the transition to the mid-eighties. It might be more appropriate to trace the first hint of a change to the first digital switch by Alcatel in 1972. The first significant change is really Nortel (Northern Telecom at the time)'s decision to scrap its switch early and deploy the DMS in 1979.
^ If that analysis is correct, Powell's effort to link the recovery of the dominant manufacturers, Lucent and Nortel, to a policy that favors the incumbents could have the effect of rebuilding the asset specificity of the past at the expense of competition.
^ Wharton Business School. "War of the Wires."
^ Gasmi et al.
^ As to that issue, the authors point out that incumbents can be expected to produce for some time a much wider array of goods and services than most entrants because they serve all customer segments. If entrants do not produce as broad an array, then their fixed costs may differ substantially from incumbents' fixed costs because they do not have to provide for those goods they do not offer. But the only known fixed costs are the incumbents' fixed costs. It follows that it is not possible to evaluate the production/cost function for an entrant that selects the same broad technology as the incumbent given the absence of disaggregated competitive benchmarks.

^ With the exception of the immediate emergence of competition when Bell's patents expired, the other market transitions spread over many years. Thierer suggests that it was really the decision by individual states to regulate telephony that effectively put an end to whatever competition had survived the Kingsbury Commitment and the nationalization during World War I. Similarly, the beginning of the current competitive era could be dated in many different ways. 1992 was the year when Ameritech and Rochester Telephone proposed respectively unbundling and structural separation for local telecommunication access to emerge. In 1992 local access operators such as MFS and Teleport had already been operating for a number of years. Thierer, Adam D. Unnatural Monopoly. op. cit.
^ There are very many historical studies to this effect and really no serious academic analysis to the contrary. Telephony was much slower to develop than some other technologies such as radio or television. We further suggest that the observed rates of growth (consumer acceptance) were not natural, as we believe is illustrated by the experience of many European countries in the seventies. The rates of growth achieved then, pursuant to government-led penetration programs (e.g., France), were akin to rates of growth achieved with other technologies.
^ "These competitors grew by servicing areas not served by the Bell System, but then quickly began invading AT&T's turf, especially areas where Bell service was poor... Prices were driven down as many urban subscribers were able to choose among competing providers. AT&T's profits and prices during this period began to shrink due to increased competition… [T]his competitive period brought gains unimaginable just a few years earlier."
Thierer, Adam D. Unnatural Monopoly. op. cit.
^ "After seventeen years of monopoly, the United States had a limited telephone system of 270,000 phones concentrated in the centers of the cities, with service generally unavailable in the outlying areas. After thirteen years of competition, the United States had an extensive system of six million telephones, almost evenly divided between Bell and the independents, with service available practically anywhere in the country."
Thierer, Adam D. Unnatural Monopoly. op. cit.
^ By the 1960's the Bell System was certain of imminent threat and created a CATV Task Force that discussed its mission in the following terms: "The most

dismal prospect our group could foresee if we waited too long to do something was being relegated in the future of 'total communications' to an outmoded, voice-only equivalent of Western Union." Letter of O.O. Ashworth, Jr. to W.E. Fisher. February 2, 1968. (Submitted as evidence in United States v. AT&T, U.S.D.C.D.C., No.74-1698.)

^ Including prohibiting the Bells from the cable business and ensuring one wireless operator competitive to the local wireline carrier.

^ Falch, Morten. op. cit.

NRC. op.cit.

^ "In 1893 and 1894, with the expiration of two key Bell patents… entry rapidly occurred… In 1894, 80 commercial systems and seven mutual systems were established. By the end of the year, new entrants had 5% of the market, or 15,000 installed phones… By 1902, 3,000 non-Bell commercial systems had been established… 'The price reduction, selling efforts and service improvements of the competitive era created a dramatic surge in telephone demand – the total number of telephone doubled during the last 10 years of monopoly, but were multiplied by a factor of 12 during the first years of competition.'"

Rosston, Gregory L. and Teece, David. 1995. op. cit. 4-5. citing in parts Brock.

^ Although we have not undertaken independent study of this period, existing accounts would appear to support the proposition that building a parallel long distance network in competition with the dominant AT&T was prohibitively speculative as a consequence of AT&T's patents and also refusal to interconnect.

^ Thierer, James D. Unnatural Monopoly. op. cit. 1994.

^ Events unfolded similarly in Sweden. Televerket was allowed to emerge as a monopoly unchallenged by antitrust concerns, finally buying its only remaining competitor. It remained a de facto unregulated monopoly until the introduction of interconnection for mobile in the early 1980s and of regulation in the early 1990s.

^ "Look, we did it in long-distance. We needed dominance and non-dominance as principles for whether you had to tariff or not tariff. Isn't that kind of what we're about? Isn't that kind of, for example, even the incumbents' argument?"

Dawson, Fred. "The Powell Doctrine: FCC Chairman Talks Policy with XCHANGE as Action on Broadband Intensifies". Xchange Web Extras, (• HYPERLINK http://www.xchangemag.com/webextra/241webx1.html ´•http://www.xchangemag.com/webextra/241webx1.html•). Virgo Publishing, April 2002.

^ There is some evidence developing overseas supporting large demand for "true" broadband service. In Japan, NTT has began this year offering B-Flets, a 100 Mbp service to residences and customers. It has already attracted 100,000 customers since January and NTT expects to have 300,000 customers by March 2003.

^ For example, Qwest's new approach to laying conduits along railroad beds, and MFS's use of the Chicago loop and later the Paris sewage system.

^ Such as MFN's use of the Lucent 430 strand fiber optic cable.

^ For instance, MetaSolv, one of the leading providers of OSS/BSS software systems, noted in its 2000 10-K SEC filing that: "We are focused on creating open and flexible software to help communications service providers take orders and fulfill those orders more efficiently… The regulated break-up of the communications network beginning with the divestiture of AT&T and continuing with the Telecommunications Act of 1996 enabled competition for access to long-distance and local phone service. In early 1994 we began to build order processing, management and fulfillment software focused on simplifying and improving the ordering process necessary to connect local telephone networks to those of the long-distance providers. As a result of the Telecommunications Act of 1996, we expanded our product line to address the needs of communications service providers involved in the resale and wholesale of local and long-distance services. Our software, which was developed from the outset as a

standardized package rather than a custom solution, is designed to automate and simplify the fulfillment of a variety of local and long-distance communications services across interconnected networks."

^ Powell. Michael K. "Remarks". Goldman Sachs Communicopia XI Conference, New York, NY. 2 October 2002.
The argument that has been given by some such as Jorde et al. that unbundling decreases the investment incentive is based on the same inappropriate model. Jorde, Thomas M., Sidak, J. Gregory & Teece, David J. "Innovation, Investment, and Unbundling", Yale Journal on Regulation. 17 (1). 2000. 1-37.
^ Armstrong, Mark, Cowan, Simon, and Vickers, John. Regulatory Reforms: Economic Analysis and British Experience. Cambridge, MA: MIT Press, 1994. 10.
^ Powell, Michael K. "Remarks". FCC, National Summit on Broadband Deployment. Washington, D.C., 25 October 2001.
^ It is true, as noted by Fransman, that the operators carry a much smaller share of the R&D burden than they used to do in the heydays of the monopolies (although the pendulum appears to be swinging back somewhat). Nevertheless, that does not justify the assumption that the technology is, nowadays, exogenous. The primary challenge to an exogenous technology comes from the experience with competition, both around 1900 and, in the case of local access, starting largely in the late 1990s.
^ In the words of the Act, to "encourage the rapid deployment of new telecommunications technologies."
^ Using the business case approach of observing Wall Street actions will also provide regulators with information regarding the incumbents. Currently, allegations that deregulation of the incumbent will result in increased investment in broadband are unsubstantiated and run directly counter to available Wall Street analyses. These analyses by and large call upon ILECs to increase dividends and further reduce capital spending.
^ This assumption is supported by a variety of factors, starting with the observation that open entry will weed out inefficient entrants, and further supported by the apparent inefficiencies of the incumbents and the largely efficient decision-making of free and open capital markets.
^ Wall Street sometimes calls this "balance sheet power." The larger and more complicated the balance sheet, the easier it is to find places to transfer costs to meet competitive threats. This process is akin to the antitrust concept of predatory pricing, but is more sophisticated. It in large measure explains why ILECs do not invade each other's territories but are motivated to acquire each other.
^ We assume away here the incumbents' capacity to influence regulation that Williamson has stressed. Making these costs as transparent as possible was one of the goals of the Australian incumbent Telstra's reorganization and its establishment of a separate Infrastructure Sales and Wholesale organization in 2000. The objective was to try to use, whenever possible, market signals rather than internal organizational decision processes to structure its costs and market responses.


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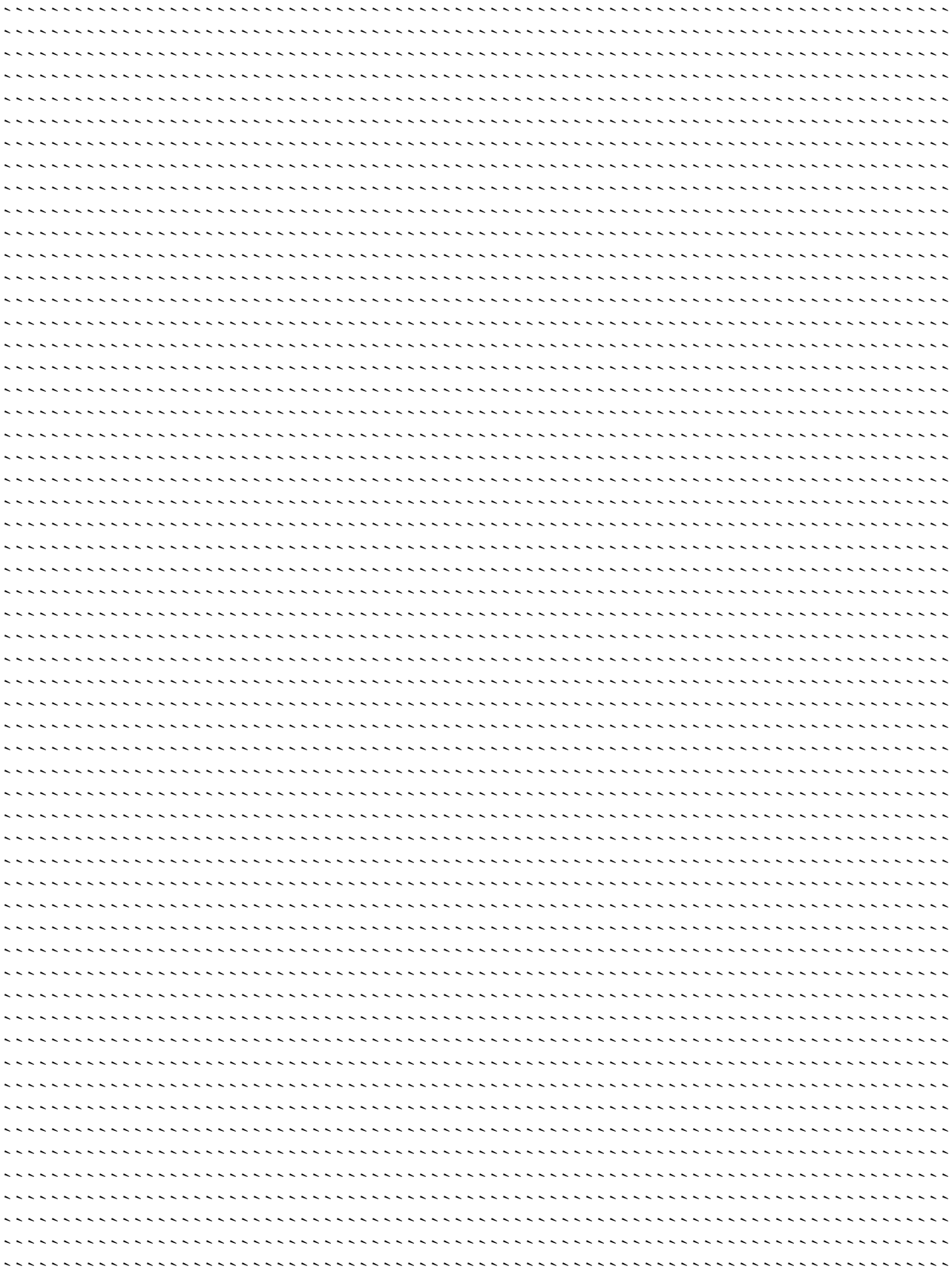

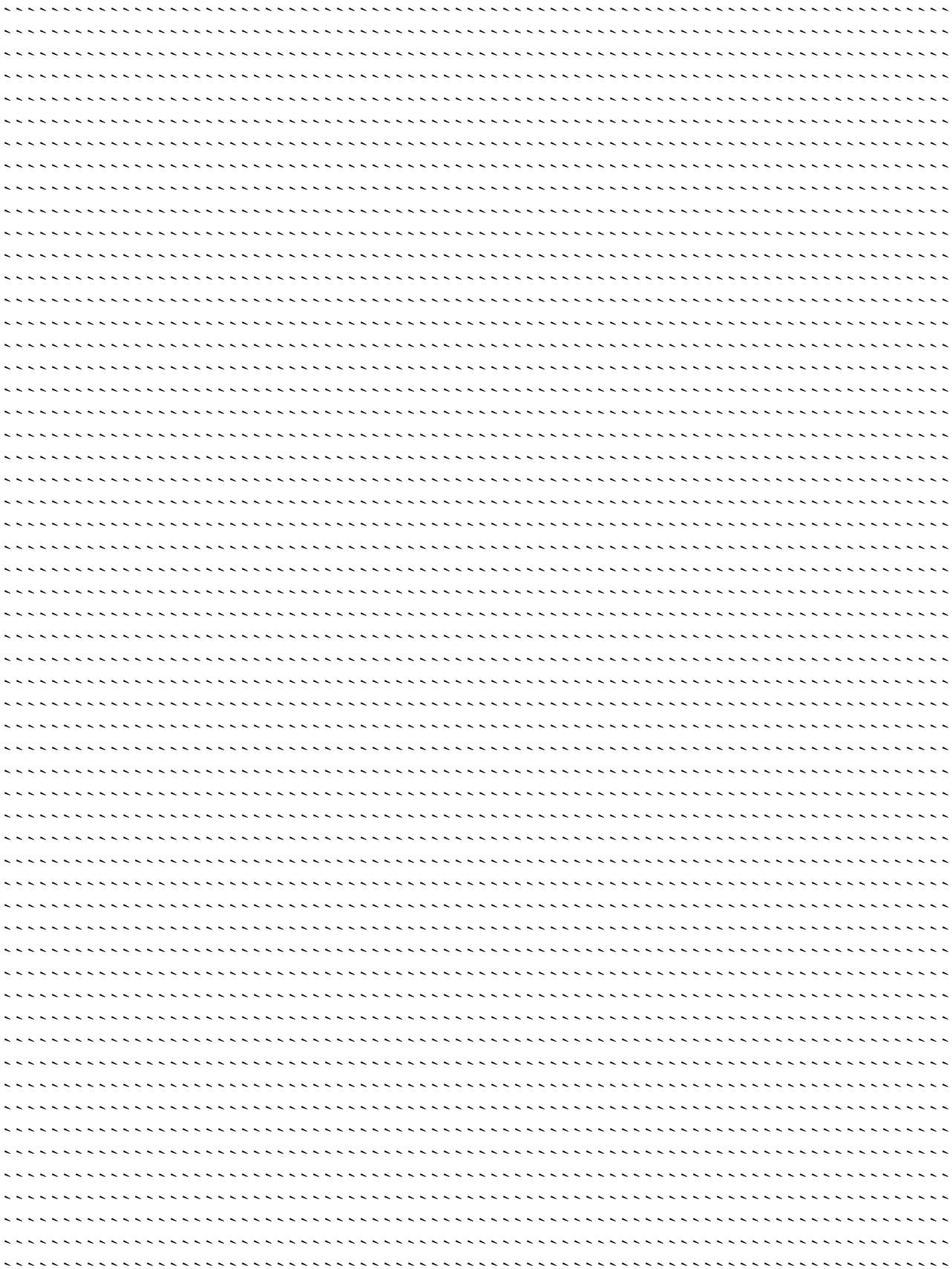

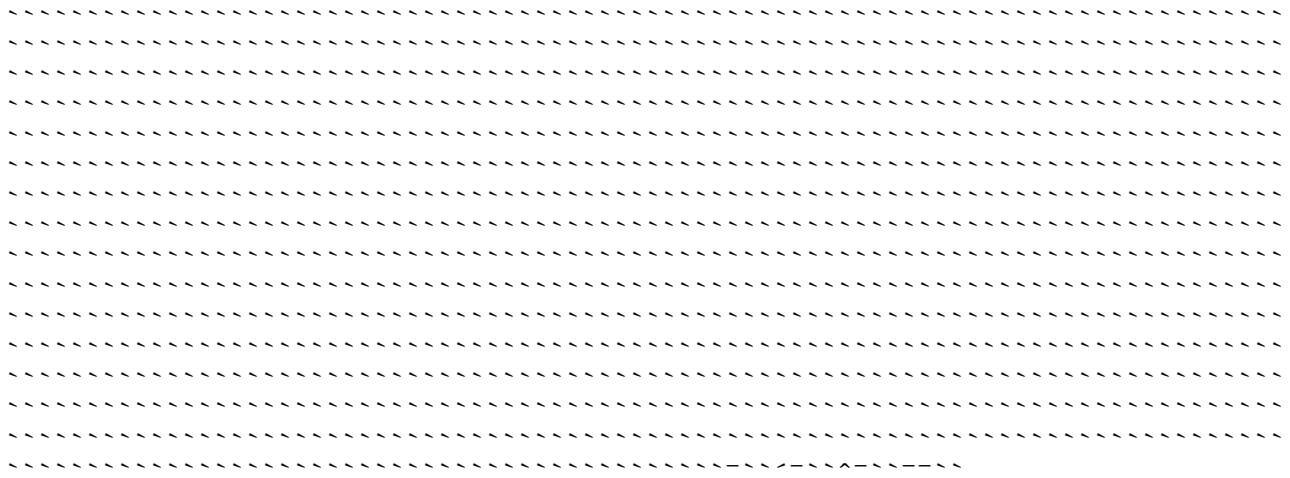

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Ý``Zà``[à``°ä``±ä``®æ``¯æ``åæ``ææ``"ç``•ç``•è``úôïìéæàÛÏÌÉÆÃÀ½°·´±«Ÿœ™–
" Š‡„ ~{xupmjd`"^•`'[æÿÿ¨

`˜'\æÿÿ˜'˝çÿÿ°^•`'
çÿÿ`˜'Açÿÿ˜'Bçÿÿ˜'?éÿÿ˜'@éÿÿ˜'•íÿÿ˜'-
íÿÿ˜'þïÿÿ˜'ÿïÿÿ˜'•ôÿÿ˜'•ôÿÿ˜'‘ûÿÿ˜'’ûÿÿ˜'@ÿÿÿ˜'Aÿÿÿ•'^ÿÿÿ¨´°´` ´˝˜```
B›ÿÿ`˝^°`˜"'C›ÿÿ`˜'ÑŸÿÿ˜'ÒŸÿÿ˜'œ¡ÿÿ˜' ¡ÿÿ˜'L¦ÿÿ˜'M¦ÿÿ˜'p§ÿÿ˜'q§ÿÿ˜'”©ÿÿ˜'•©ÿÿ•'Ç
©ÿÿ¨´°´` ´˝¯```
Ç©ÿÿ`°^•`'È©ÿÿ`˝^•`'¬ÿÿ¨

`˘' ¬ÿÿ˘'u²ÿÿ˘'v²ÿÿ°^•`'
¸ÿÿ`˝^•`'¥¸ÿÿ¨

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À``
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ù``pû``qû``k´´`l´´`üöîæÞÖÓÐÍÁ¾»·´®|£š—
″`Ž‹^…yvspmjgda^```````````˙pèÿÿ˘˙jîÿÿ˘˙kîÿÿ˘˙Dðÿÿ˘˙Eðÿÿ˘˙¹òÿÿ˘˙°òÿÿ˘˙&öÿÿ˘˙'öÿÿ•
˙2öÿÿ¨´°´` ´″´```
4öÿÿ`˘˙3öÿÿ˘˙″ûÿÿ˘˙
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Aÿÿÿ˘˙@ÿÿÿ•˙]ÿÿÿ°´` ´″˜```″^ `˘°˙tãÿÿ`˘˙uãÿÿ¨˙wãÿÿ¨

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`˝^•`˙ØÄÿÿ¨

`˜'ÙÄÿÿ˝^•`'ŠÇÿÿ¨

`˘'‹ÇŸŸ˝^•`'¬ÊŸŸ¨

`˘'-Êÿÿ˘'ÙÊÿÿ˘'ÚÊÿÿ˘'WÍÿÿ˘'XÍÿÿ"'‹Ïÿÿ"

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˘'ÀÚÿÿ˘'ËÚÿÿ˘'ÌÚÿÿ˘'½Üÿÿ˘'¾Üÿÿ•'lÝÿÿ"´°´` ´˝˜```
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`½F´`¿L´`ÀL´`•N´`•N´`BN´`CN´`ÂO´`ÃO´`cV´`eV´`¤V´`¥V´`²V´`³V´`äX´`åX´`gZ´`hZ´`·[´
`¸[´`X]´`Y]´`•_´`•_´`ûøõòïëßÜÙÖÓÐÍÊÇÄÁ¾»¸µ²¯¬©¦£ ˜•Œ‰†ƒ•}zwtqnk˘'ÄŠÿÿ˘',Œÿÿ˘'ƒŒÿ
ÿ˘'#Žÿÿ˘'$Žÿÿ˘'s ÿÿ˘'t ÿÿ˘'ö ÿÿ˘'÷ ÿÿ˘'("ÿÿ˘')"ÿÿ•'6"ÿÿ¨´°´` ´
ÿÿÿ˘'7"ÿÿ•'v"ÿÿ°´`
´″¯`` ˘'x"ÿÿ˘'•šÿÿ˘'•šÿÿ˘'˜›ÿÿ˘'™›ÿÿ˘'É›ÿÿ˘'Ê›ÿÿ˘'• ÿÿ˘'• ÿÿ˘'-£ÿÿ˘'-
£ÿÿ˘'ð§ÿÿ˘'ñ§ÿÿ˘' ¬ÿÿ˘' ¬ÿÿ˘'Ê®ÿÿ˘'Ë®ÿÿ˘'*³ÿÿ˘'+³ÿÿ˘'x¶ÿÿ˘'y¶ÿÿ•'Ã¶ÿÿ¨´°´`
´″¯`` ˘

Å¶ÿÿ`¨'Ä¶ÿÿ¨

˘'1¸ÿÿ˘'2¸ÿÿ˘'å¼ÿÿ˘'æ¼ÿÿ"'•¾ÿÿ"

`*ÃO´`cV´`eV´`¤V´`¥V´`²V´`³V´`äX´`åX´`gZ´`hZ´`·[´`¸[´`X]´`Y]´`•_´`•_´`-_´`–
_´`Ea´`Fa´`oc´`pc´`Íe´`Îe´`Þg´`ßg´`

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r´`″r´`Jr´`Kr´`ys´`zs´`šu´`›u´`Ãx´`Äx´` |´` |´`a~´`b~´`ž~´`Ÿ~´`• ´`• ´`… ´
`† ´`ôñîëèåâßÜÙÖÓÇÄÁ¾»¸µ²©¦£ š—″'Ž‹^•}urjg`````````````˙Vjÿÿ•˙Åjÿÿ˚$`
´″¯````˘˙Æjÿÿ•˙<kÿÿ˚$` ´″~````˘˙=kÿÿ•˙ykÿÿ˚$`
´″^````˘˙zkÿÿ˘˙Kmÿÿ˘˙Lmÿÿ˘˙•qÿÿ˘˙•qÿÿ˘˙@tÿÿ˘˙Atÿÿ˘˙avÿÿ˘˙bvÿÿ˘˙ wÿÿ˘˙'wÿÿ•˙
Ñwÿÿ¨^˚´` ´
döÿÿ˘˙Òwÿÿ˘˙óyÿÿ˘˙ôyÿÿ˘˙Ã}ÿÿ˘˙Ä}ÿÿ˘˙••ÿÿ˘˙–•ÿÿ•˙Ì•ÿÿ¨´˚´` ´″^```
µìÿÿ`˘˙Í•ÿÿ˘˙ü ÿÿ˘˙ý ÿÿ˘˙
„ÿÿ˘˙

„ÿÿ˘˙k†ÿÿ˘˙l†ÿÿ˘˙•ˆÿÿ˘˙–ˆÿÿ˘˙DŠÿÿ˘˙EŠÿÿ•˙ÃŠÿÿ¨˝˚˝`   ˝˝˝```
¬öÿÿ&•i˝`Ei˝`Fi˝`•l˝`•l˝`ço˝`èo˝`
       r˝`˝r˝`Jr˝`Kr˝`ys˝`zs˝`šu˝`›u˝`Ãx˝`Äx˝` |˝` |˝`a~˝`b~˝`ž~˝`Ÿ~˝`• ˝`• ˝`… ˝
`† ˝`Á ˝`ú````````````ø````````````ø````````````ø````````````ø````````````ø`````
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†˝`˜†˝`-Š˝`+‹˝`k‹˝`ñŒ˝`òŒ˝`ó ˝`ô ˝`•–˝`•—˝`•—˝`ú—
˝`•š˝` š˝`(œ˝` œ˝`ûœ˝`üœ˝` ž˝`žž˝`GŸ˝`HŸ˝`KŸ˝` Ÿ˝`˚¡˝`   ¡˝`
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¡´`¤´`a¤´`Â«´`t¬´`{¬´`…¬´`†¬´`³¬´`´¬´`Ø¬´`Ù¬´`•-´`•-´`K-´`M-´`2®´`3®´`t®´`|®´`,
®´`„®´`´®´`µ®´`•¯´`•¯´`E¯´`F¯´`š¯´`œ¯´`U°´`V°´`•±´`•±´`„±´`ýö`ö`ó`ö`ö`óêó`óêó`ó`
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6° PJ``nH ¯°PJ``nH
¯`•˜j´´´´0J•`OJ^`QJ^`U°´°OJ^`QJ^´´´•˜j´´´´0J•`U°´nH•¯¯nH•¯`
˜j´´´´0J•`U°´¯0J•`M† ´`Á ´`Â ´`¥ ´`¦ ´`Ô ´`Õ ´`ç*ƒ*´`è*ƒ*´`™†´`š†´`Ê^´`Ë^´`k‹´`l‹´`ó
Œ´`õŒ´`‹ ´`Œ ´`É"´`Ê"´´´-´´^-´`Ú—´`Û—´`ú—´`û—
´`s˜´`t˜´`„š´`…š´`)œ´`*œ´`fœ´`gœ´`JŸ´`KŸ´`ŸŸ´` Ÿ´`

¡´`÷ôñîâßÜÙÖÓÐÍÊÇÄÁ¾»¸µ²¯¬© š—
″'Ž‹^|yvspmh``````````˚^•``;Jÿÿ`˘˙<Jÿÿ˘˙ Jÿÿ˘˙'Jÿÿ˘˙tMÿÿ˘˙uMÿÿ•˙±Mÿÿ¨^˚´^
´″˜```
DÌÿÿ`˘˙²Mÿÿ˘˙VOÿÿ˘˙WOÿÿ˘˙gQÿÿ˘˙hQÿÿ˘˙àQÿÿ˘˙áQÿÿ•˙`Rÿÿ¨^˚´^ ´″^```
"Ðÿÿ`˘˙´Rÿÿ˘˙ÙSÿÿ˘˙ÚSÿÿ˘˙•Vÿÿ˘˙•Vÿÿ˘˙OZÿÿ˘˙PZÿÿ˘˙æ\ÿÿ˘˙è\ÿÿ˘˙o^ÿÿ˘˙p^ÿÿ˘˙•aÿÿ˘˙•
aÿÿ˘˙Acÿÿ˘˙Bcÿÿ˘˙óeÿÿ˘˙ôeÿÿ˘˙˙hÿÿ˘˙¨hÿÿ•˙5hÿÿ¨^˚´^ ´″´```
Èæÿÿ`˘˙6hÿÿ˘˙•jÿÿ˘˙•jÿÿ•˙Ujÿÿ˚$`
´″˘````'Á ´`Â ´`¥ ´`¦ ´`Ô ´`Õ ´`çƒ´`èƒ´`™†´`š†´`Ê^´`Ë^´`k‹´`l‹´`óŒ´`õŒ´`‹
´`Œ ´`É"´`Ê"´`´–´`^–´`Ú—´`Û—´`ú—
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OJ^`QJ^`nH ¯`
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]^`•]^`?]^`B]^`C]^`±]^`³]^`É]^`Ê]^`•^^`;^^`‘^^`’^^`

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0J•`OJ^`QJ^``

OJ^`QJ^`nH ¯`•6˚ OJ^`QJ^`nH
¯˚OJ^`QJ^``•˜j````0J•`OJ^`QJ^`U˚´¯CJ•`KB]^`É]^`'ˆ^`K_^`na^`âa^`ib^`˜e^`ûe^
`]f^`üg^`àh^` i^`Nk^`-n^`·n^`?o^`[o^`Ap^`æp^`¥q^`Èq^`ïq^`-s^`®s^`Ýs^`
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t^`˝t^`Pt^`Qt^`Gv^`Hv^`-
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¯°OJ^`QJ^``
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OJ^`QJ^`nH ¯`

0J•`OJ^`QJ^`^`•~j`^`^`5° OJ^`QJ^`U°´nH  ¯`-^° ~j

'°´5° OJ^`QJ^`U°´nH ¯`•5° OJ^`QJ^`nH
      ¯`%ê†^``‡^`´‡^`•‡^`•‡^`6^``7^``†‰^`‡‰^`ß‰^`à‰^`á‰^`-
Š^`.Š^`ÂŠ^`ÃŠ^`çŠ^`èŠ^`÷Š^`øŠ^`ƒ‹^`„‹^`™‹^`š‹^`úŒ^`ûŒ^`N ^`O ^`^ ^`_ ^`o ^`p ^`q
 ^`‰ ^`Ô ^`Õ ^`Ö ^`× ^`•Ž^`•Ž^`9Ž^`:Ž^`1 ^`2 ^`Æ"^`Ç"^`•˜^`•˜^`•™^`•™^`•™^`°™^`»
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´^^`$´^^`%´^^`&´^^`«´^^`Û´^^`”.^^`•.^^`–
.^^`¯.^^`°.^^`Ð.^^`Ñ.^^`ý.^^`þ.^^`ÿ.^^`s¸^^`t¸^^`u¸^^`v¸^^`ê¸^^`ë¸^^`ì¸^^`í¸^^`,°^^`ƒ°^^`^¼^^`˜¼^^`)
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´^^$´^^•·^^¯·^^Ð·^^ý·^^t¸^^ë¸^^,°^^^¼^^)¼^^U¼^^$½^^t¾^^^¾^^·¿^^,À^^hÁ^^jÂ^^›Â^^ª
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Ì^^fÌ^^gÌ^^hÌ^^•Î^^BÎ^^CÎ^^DÎ^^.Ð^^/Ð^^·Ð^^¸Ð^^ßÐ^^àÐ^^ŽÓ^^ Ó^^ Ó^^ÂÔ^^ÃÔ^^ÄÔ^^Å
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OJ^`QJ^`nH•¯`¯CJ•``
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i`c`l`e`/`N`M`G`2`0`0`1`0`3`1`9`S`0`0`1`1`)```àÉêyù°Î•Œ,`ª`K©
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r`s`p`e`c`t`i`v`e`s`/`p`e`r`s`p`e`c`t`i`v`e`s`f`r`a`g`m`e`n`t`2`-`2`6`-
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c`t`i`v`e`s`/`p`e`r`s`p`e`c`t`i`v`e`s`f`r`a`g`m`e`n`t`2`-`2`6`-
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†```h`t`t`p`:`/`/`o`n`l`i`n`e`.`w`s`j`.`c`o`m`/`a`r`t`i`c`l`e`/`0`,`,`S`B`1`0`2`
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u`l`h`a`b`e`)```àÉêyù°Î•Œ,`ª`K©
T```h`t`t`p`:`/`/`r`i`d`e`r`.`w`h`a`r`t`o`n`.`u`p`e`n`n`.`e`d`u`/`~`f`a`u`l`h`a`
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´``D``ÐÉêyù°Î•Œ,`ª
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^```•```*```h`t`t`p`:`/`/`r`i`d`e`r`.`w`h`a`r`t`o`n`.`u`p`e`n`n`.`e`d`u`/`~`f`a`
u`l`h`a`b`e`)```àÉêyù°Î•Œ,`ª`K©
T```h`t`t`p`:`/`/`r`i`d`e`r`.`w`h`a`r`t`o`n`.`u`p`e`n`n`.`e`d`u`/`~`f`a`u`l`h`a`
b`e`)`````9´``D```Ð
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^```•```1```h`t`t`p`:`/`/`w`w`w`.`x`c`h`a`n`g`e`m`a`g`.`c`o`m`/`w`e`b`e`x`t`r`a`
/`2`4`1`w`e`b`x`1`.`h`t`m`l```àÉêyù°Î•Œ,`ª`K©
b```h`t`t`p`:`/`/`w`w`w`.`x`c`h`a`n`g`e`m`a`g`.`c`o`m`/`w`e`b`e`x`t`r`a`/`2`4`1`
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~``d~``ÿÿÿe~``f~``g~``°```i
~``j~``k~``l~``m~``n~``o~``p~``q~``r~`` ~``ÿÿ
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`^´ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ````````````````````````````````````4```¬´```````˘`D`o`c`u`m`e`n`t
`S`u`m`m`a`r`y`I`n`f`o`r`m`a`t`i`o`n``````````8`^´–```ÿÿÿÿÿÿÿÿ````````````````
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```````´`C`o`m`p`O`b`j``•`^´"```ÿÿ
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``^´´```^```ÿÿÿÿ````````````````````````````````````Ù´``•î``````•`-
`˝`´`[`•`^``~``~``4``@ñÿ^`4```'`N`o`r`m`a`l````^```•`B*´CJ•`OJ^`QJ^``mH
¯`@`´@´``^`@```   `H`e`a`d`i`n`g`
`1```˚``´``$´@&`•`6˚ CJ•`OJ¯`PJ``QJ¯``B`^@´``^`B```   `H`e`a`d`i`n`g`
`2```•`^``$´•¤ð`•¤<`@&´

`5° 6° OJ˘`QJ˘`D`˜@´`^`D``` `H`e`a`d`i`n`g` `3```
`˜`˜˜$´'$´@&^`•`B*`CJ•`OJ¯`PJ``QJ¯```F`¯@´`^`F``` `H`e`a`d`i`n`g` `4```
`¯`˜˜$´'$´@&˜`•`5° B*`CJ•`OJ¯`PJ``QJ¯`<`˘@´`^`<``` `H`e`a`d`i`n`g` `5```
`˘`˜˜$´'$´@&¯`
`B*`CJ `PJ```F`'@´`^`F``` `H`e`a`d`i`n`g`
`6```•`'`˜$´'$´•„h´@&˘`•`5° B*`OJ˜`PJ``QJ˜`B`"@´`^`B``` `H`e`a`d`i`n`g`
`7```

`"`'$´•„8¯@&'•`6° B*`OJ~`PJ``QJ~`B`°@´`^`B``` `H`e`a`d`i`n`g` `8```

`°`'$´•„¼"@&"•`6° B*`OJ˜`PJ``QJ˜`F` @´`^`F``` `H`e`a`d`i`n`g` `9```•`
`˜$´'$´•„8¯@&°`•`5° B*`OJ˜`PJ``QJ˜`<`A@òÿ¡`<```•`D`e`f`a`u`l`t`
`P`a`r`a`g`r`a`p`h` `F`o`n`t`` `Â`B@´`ò`Â``` `B`o`d`y`
`T`e`x`t```^`•`C$´EÆ•```h\j¦`
`•`6° B*`CJ•
`OJ¯`PJ``QJ¯`@`@´`^´@```'`H`e`a`d`e`r```
`•`
Æ°`^à•À!´^`•`B*`CJ•`OJ˜`PJ``QJ˜`H`C@´`•´H```•`B`o`d`y` `T`e`x`t`
`I`n`d`e`n`t```'`•`•„Ð^•`CJ•`OJ¯`PJ``QJ¯`8`&@¢`!´8```•`F`o`o`t`n`o`t`e`
`R`e`f`e`r`e`n`c`e```˜`H*´`&`)@¢`1´&```
`P`a`g`e` `N`u`m`b`e`r`:`P@´`B´:`´`
`B`o`d`y` `T`e`x`t` `2``` `•`˝&

F```"`B*`PJ```J`•@´`R´J```
`F`o`o`t`n`o`t`e` `T`e`x`t```″`•`
Æ`´´Ð^`•`B*`CJ•`OJ˜`PJ``QJ˜``P`S@´`b´P```•`B`o`d`y` `T`e`x`t` `I`n`d`e`n`t`
`3```'`•`•„Ð^•`B*`OJ˜`PJ``QJ˜`nH•¯`.`U@¢`q´.``` `H`y`p`e`r`l`i`n`k```

`>*´B*^ph``ÿ`@` @´`,´@```'`F`o`o`t`e`r```
`•`
Æ°``^à•À!´^`•`B*`CJ•`OJ~`PJ``QJ~``6`'@¢`'´6```•`C`o`m`m`e`n`t`
`R`e`f`e`r`e`n`c`e```¯`CJ•`0`-@´`¢´0```

`C`o`m`m`e`n`t` `T`e`x`t`^`^`•`¯`CJ•`<`R@´`²´<`^`•`B`o`d`y` `T`e`x`t`
`I`n`d`e`n`t` `2`^`'`•`•„Ð^`^`0`+@´`Â´0`^`

`E`n`d`n`o`t`e`
`T`e`x`t```^`•`¯`CJ•`8`V@¢`Ñ´8```•`F`o`l`l`o`w`e`d`H`y`p`e`r`l`i`n`k```'`>*´B*

6`þoñÿâ´6```"`D`e`f`a`u`l`t```^`-`•`OJ``PJ``QJ``mH ¯nH ¯-
``••``á•```•``î#``2'``Õ0``Ô3``ñ4``¥7``”9``«:``Q;`` @```A``'M``îM```N``ðN``9P``©Q
``,R`` U``ÎU``5X`` X``–
Y``"\``V_``â_``)a``äa``•c``2d``ƒe``zf``”j``Çl``Øm``˜n``Jp``•q``'~``  ``h•``•,``•
‹``A `` ’``&•``³–
``Pœ``H `` ž``MŸ``3 `` ¢``¦£``z¤`` ¥``)-``Â-``W²``Í¶``®¹``¸¼``FÀ``^Ã``3Ä``XÇ``³È
``¸Ë``ÒÏ``ÝÑ``ã×``íÙ``¥Ú``

â``ßâ`` ã``aä``¶ä`` å``³å``,æ``sæ``Žò``Ëô``ý÷``eý``h°´``h•´``

•´`•´`}•´`·'´`Æ+´`£-´`ñ/´`©2´`•5´`  7´`ôA´`[G´`
J´`ÆO´`KP´`ÝT´`RX´`Ÿ\´`Æa´`rh´`¤l´`+t´`½t´`°{´`",´`í^´`ï‹´`•"´`|-
´`÷˜´`™š´`C›´`¯ ´`\ ´`Q¬´`•-´`•-´`ñ-´`'®´` °´`ë²´`tµ´`èµ´`Z°´`çÀ´`|Ã´`µÇ´`9É´`ÌË
´`‹Ì´`-Ï´`;Ð´`fÑ´`èÓ´`§Ô´`MÖ´`þÙ´`¹Û´`èÛ´`-
Ü´`]á´`}ã´`Ää´`,í´`)´^`d˜^`¸¯^`'^`•ä^`´`^`˜`¯`˜`'`"`°` `″`
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`•`•`•`•`•`•`•`•`•`•`•`•`•`•`•`•`-`` `!`"`#`$`%`&`'`(`)`*`+`,`-
`.`/`0`1`2`3`4`5`6`7`8`9`:`;`<`=`>`?`@`A`B`C`D`E`F`G`H`I`J`K`L`M`N`O`P`Q`R`S`T`U
`V`W`X`Y`Z`[`\`]`^`_```a`b`c`d`e`f`g`h`i`j`k`l`m`n`o`p`q`r`s`t`u`v`w`x`y`z`{`|`}
`~` `•` `,`ƒ`„`…`†`‡`^`‰`Š`‹`Œ` `Ž` ` `‘`’`“`”`•`–`—
`˜`™`š`›`œ` `ž`Ÿ` `¡`¢`£`¤`¥`¦`§`¨`©`ª`«`¬`®`¯`°
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``à•``Q•``Ä•``Ê•``ö•``.•``P•``™•`` •``L•`` •``ª•``G!``Ê!``~&``Ù'``-(``b)``7+``E-
``°.``y0``ð1``$6``″=``b=``^?``¬?``ð@``HB``gC``$E``²E``'F``®F``vG``0H``ÇJ``NK``}N
``àN``ÅQ``dR``¡S``•V``ÉX``^Y``«Y``ÒY``´[``'[``À[``ì[``•`-
`″`´[`•`^`~`~`~`4``@ñÿ^`4```'`N`o`r`m`a`l```^```•`B*´CJ•`OJ^`QJ^`mH
¯`@`´@´`^`@```  `H`e`a`d`i`n`g`
`1```°`´`'$´@&`•`6° CJ•`OJ¯`PJ``QJ¯```B`^@´`^`B```  `H`e`a`d`i`n`g`
`2```•`^`'$´•¤ð`•¤<`@&´

`5° 6° OJ˘`QJ˘`D`˜@´`^`D```  `H`e`a`d`i`n`g` `3```
`˜`˜˜$´'$´@&^`•`B*`CJ•`OJ¯`PJ``QJ¯```F`¯@´`^`F```  `H`e`a`d`i`n`g` `4```
`¯`˜˜$´'$´@&˜`•`5° B*`CJ•`OJ¯`PJ``QJ¯`<`˘@´`^`<```  `H`e`a`d`i`n`g` `5```
`˘`˜˜$´'$´@&¯`
`B*`CJ `PJ```F`'@´`^`F```  `H`e`a`d`i`n`g`
`6```•`'`˜$´'$´•„h´@&˘`•`5° B*`OJ˜`PJ``QJ˜`B`"@´`^`B```  `H`e`a`d`i`n`g`
`7```

`"`'$´•„8¯@&'•`6° B*`OJ~`PJ``QJ~`B`°@´`^`B```  `H`e`a`d`i`n`g` `8```

`°`'$´•„¼"@&"•`6° B*`OJ˜`PJ``QJ˜`F` @´`^`F```  `H`e`a`d`i`n`g` `9```•`
`˜$´'$´•„8¯@&°`•`5° B*`OJ˜`PJ``QJ˜`<`A@òÿ¡`<```•`D`e`f`a`u`l`t`
`P`a`r`a`g`r`a`p`h` `F`o`n`t`` `Â`B@´`ò`Â``` `B`o`d`y`
`T`e`x`t```^`•`C$´EÆ•```h\j¦`
`•`6° B*`CJ•
`OJ¯`PJ``QJ¯`@`@´`^´@```'`H`e`a`d`e`r```
`•`
Æ°`^à•À!´^`•`B*`CJ•`OJ˜`PJ``QJ˜`H`C@´`•´H```•`B`o`d`y` `T`e`x`t`
`I`n`d`e`n`t```'`•`•„Ð^•`CJ•`OJ¯`PJ``QJ¯`8`&@¢`!´8```•`F`o`o`t`n`o`t`e`
`R`e`f`e`r`e`n`c`e```˜`H*´`&`)@¢`1´&```
`P`a`g`e` `N`u`m`b`e`r`:`P@´`B´:`´`
`B`o`d`y` `T`e`x`t` `2```  `•`˝&

F```"`B*`PJ```J`•@´`R´J```
`F`o`o`t`n`o`t`e` `T`e`x`t```″`•`
Æ`´´Ð^`•`B*`CJ•`OJ˜`PJ``QJ˜``P`S@´`b´P```•`B`o`d`y` `T`e`x`t` `I`n`d`e`n`t`
`3```'`•`•„Ð^•`B*`OJ˜`PJ``QJ˜`nH•¯`.`U@¢`q´.``` `H`y`p`e`r`l`i`n`k```

`>*´B*^ph``ÿ`@` @´`,´@```'`F`o`o`t`e`r```
`•`
Æ°``^à•À!´^`•`B*`CJ•`OJ~`PJ``QJ~``6`'@¢`'´6```•`C`o`m`m`e`n`t`
`R`e`f`e`r`e`n`c`e```¯`CJ•`0`-@´`¢´0```

`C`o`m`m`e`n`t` `T`e`x`t`^`^`•`¯`CJ•`<`R@´`²´<`^`•`B`o`d`y` `T`e`x`t`
`I`n`d`e`n`t` `2`^`'`•`•„Ð^`^`0`+@´`Â´0`^`

`E`n`d`n`o`t`e`
`T`e`x`t```^`•`¯`CJ•`8`V@¢`Ñ´8```•`F`o`l`l`o`w`e`d`H`y`p`e`r`l`i`n`k```'`>*´B*

6`þoñÿâ´6```"`D`e`f`a`u`l`t```^`-`•`OJ``PJ``QJ``mH  ¯nH  ¯-
``••``á•```•``î#``2'``Õ0``Ô3``ñ4``¥7``”9``«:``Q;`` @```A``'M``îM```N``ðN``9P``©Q
``,R`` U``ÎU``5X`` X``–
Y``"\``V_``â_``)a``äa``•c``2d``ƒe``zf``”j``Çl``Øm``˜n``Jp``•q``'~``  ``h•``•,``•
‹``A `` ’``&•``³–
``Pœ``H `` ž``MŸ``3 `` ¢``¦£``z¤`` ¥``)-``Â-``W²``Í¶``®¹``¸¼``FÀ``^Ã``3Ä``XÇ``³È
``¸Ë``ÒÏ``ÝÑ``ã×``íÙ``¥Ú``

â``ßâ`` ã``aä``¶ä`` å``³å``,æ``sæ``Žò``Ëô``ý÷``eý``h°´``h•´``

•´`•´`}•´`·'´`Æ+´`£-´`ñ/´`©2´`•5´`  7´`ôA´`[G´`
J´`ÆO´`KP´`ÝT´`RX´`Ÿ\´`Æa´`rh´`¤l´`+t´`½t´`°{´`",´`í^´`ï‹´`•"´`|–
´`÷˜´`™š´`C›´`¯ ´`\ ´`Q¬´`•-´`•-´`ñ-´`'®´` °´`ë²´`tµ´`èµ´`Z°´`çÀ´`|Ã´`µÇ´`9É´`ÌË
´`‹Ì´`-Ï´`;Ð´`fÑ´`èÓ´`§Ô´`MÖ´`þÙ´`¹Û´`èÛ´`–
Ü´`]á´`}ã´`Ää´`,í´`)´^`d˜^`¸¯^`'´^`ªä^`´`^`˜`¯`˘`'`"`°`  `˝`
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´`˜ ´`•¢´`•¢´`¡¢´`¢¢´`±|´`²|´`½§´`¾§´` "´`,"´`°"´`Õ"´`¯
©´`H©´`I©´`/ª´`0ª´` ª´`•ª´`±ª´`•«´`B«´`—
«´`˜«´`S¬´`T¬´`*®´`+®´`î²´`ï²´`¡´´`Ï´´`Ð´´`Ý´´`Þ´´`ö¶´`÷¶´`Y¹´`]°´`^°´`Ü°´`Ý°´`ö
°´`÷°´`¯»´`˘»´`Ú¼´`Û¼´`xÀ´`yÀ´`êÀ´`ëÀ´`QÁ´`RÁ´`·Á´`¸Á´`2Â´`3Â´`†Â´`‡Â´`öÃ´`÷Ã´`´
Ä´`^Ä´`ÈÄ´`ÉÄ´`'Å´`(Å´`\Å´`]Å´`¬Å´`-Å´`6Æ´`7Æ´`•Ç´`•Ç´`œÊ´` Ê´` Ì´` Ì´`±Ï´`²Ï´`ä
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´`˜ ´`•¢´`•¢´`¡¢´`¢¢´`±¦´`²¦´`½§´`¾§´` "´`,"´`°"´`Õ"´`¯
©´`H©´`I©´`/ª´`0ª´` ª´`•ª´`±ª´`•«´`B«´`—
«´`˜«´`S¬´`T¬´`*®´`+®´`î²´`ï²´`Ÿ´`¡´`Ï´`Ð´`Ý´`Þ´`ö¶´`÷¶´`Y¹´`]°´`ˆ°´`Ü°´`Ý
°´`ö°´`÷°´`¯»´`˘»´`Ú¼´`Û¼´`xÀ´`yÀ´`êÀ´`ëÀ´`QÁ´`RÁ´`·Á´`¸Á´`2Â´`3Â´`†Â´`‡Â´`öÃ´`÷
Ã´`Ä´`Ä´`ÈÄ´`ÉÄ´`'Å´`(Å´`\Å´`]Å´`¬Å´`-Å´`6Æ´`7Æ´`•Ç´`•Ç´`œÊ´` Ê´` Ì´` Ì´`±Ï´`²
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´` –´`%˜´`&˜´`b˜´`c˜´`F›´`G›´`››´`œ›´`° ´` ´`^ ´` ´`—
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«´`˜«´`S¬´`T¬´`*®´`+®´`î²´`ï²´`¡´`Ï´`Ð´`Ý´`Þ´`ö¶´`÷¶´`Y¹´`]°´`^°´`Ü°´`Ý°´`ö
°´`÷°´`¯»´`˘»´`Ú¼´`Û¼´`xÀ´`yÀ´`êÀ´`ëÀ´`QÁ´`RÁ´`·Á´`¸Á´`2Â´`3Â´`†Â´`‡Â´`öÃ´`÷Ã´`´
Ä´`^Ä´`ÈÄ´`ÉÄ´`'Å´`(Å´`\Å´`]Å´`¬Å´`-Å´`6Æ´`7Æ´`•Ç´`•Ç´`œÊ´` Ê´` Ì´` Ì´`±Ï´`²Ï´`ä
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y^`•z^`Â{^`™|^`¤|^`-˜^`Ô ^`„…^`©…^`¹…^`E†^`[†^`9‡^` ‡^`¼‡^`•^`^` ^`^`1^`^`—
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´´´B´´´C´´´D´´´E´´´F´´´G´´´H´´´I´´´J´´´K´´´L´´´M´´´N´´´O´´´P´´´Q´´´R´´´S´´´T´´´U
´´´V´´´W´´´X´´´Y´´´Z´´´[´´´\´´´]´´´^´´´_´´´´´´´a´´´b´´´c´´´d´´´e´´´f´´´g´´´h´´´i
´´´j´´´k´´´l´´´m´´´n´´´o´´´p´´´q´´´r´´´s´´´t´´´u´´´v´´´w´´´x´´´y´´´z´´´{´´´|´´´}
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§´`<©´`G©´`¥ª´`¯ª´`m¬´`x¬´`u-´`z-´`+®´`5®´`®®´`¹®´`
¯´`•¯´`þ¯´`'º´`¿º´`Çº´`Ý±´`í±´`ï²´`÷²´`Þ´`ç´`vµ´`{µ´`ª¹´`²¹´`¡Á´`ªÁ´` Æ´
`‡Æ´`\Ï´`aÏ´`ÝÕ´`ãÕ´`PÝ´`YÝ´`°Þ´`•Þ´`3Þ´`;Þ´`[Þ´`Þ´`<ß´`Kß´`³à´`»à´`ëâ´`ðâ´`Åã´
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"^`Á"^`Ç"^`2#^`8#^`I#^`N#^`«#^`¯#^`©&^`¯&^`È'^`Ñ'^`((^`/(^`™)^`)^`*^`¯*^`-
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G^`ÈI^`ÓI^`ÔI^`ÛI^`,J^`ŠJ^` J^`”J^`ƒL^`‰L^`ŸL^`¥L^`*M^`0M^`ÎN^`ÔN^`ÜN^`ãN^`åN^`ê
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T^`)U^`/U^`vU^`|U^`^V^`dV^`nW^`´^`^`þÿÿÿ˜^`^`¯^`^`˘^`^`˙^`^`¨^`^`˚^`^` ^`^`˝^`^`
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`ú[^`r]^`y]^`/^^`5^^`0a^`6a^`%b^`,b^`8c^`?c^`,d^`^d^`±d^`·d^`Ád^`Çd^`Ôd^`Úd^`…e^
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k^`ªk^`²k^`Hl^`Ml^`il^`pl^`-
m^`#m^`_m^`gm^`£m^`«m^`-m^`²m^`°m^`Ãm^`Åm^`Èm^`ôm^`úm^`Žn^`–
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„ˆ`@„ˆ`Ž…ˆ`“…ˆ` …ˆ`¥…ˆ`´…ˆ`¹…ˆ`!†ˆ`'†ˆ`F†ˆ`M†ˆ`V†ˆ`[†ˆ`]†ˆ`c†ˆ`â†ˆ`ê†ˆ`,‡ˆ`‹‡ˆ`Ô
‡ˆ`Û‡ˆ`*ˆ`1ˆ`Yˆ`ˆ`ˆ`ˆ`ˆ`ˆ`eˆ`gˆ`mˆ`uˆ`|ˆ` ˆ`—
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©^^U©^^]©^^•«^^†«^^¦«^^««^^¬«^^¸«^^ò¬^^ú¬^^•¯^^†¯^^"¯^^™¯^^ð¯^^÷¯^^,±^^0±^^•²^^•
²^^ù²^^þ²^^•³^^•³^^,³^^2³^^H³^^M³^^[³^^a³^^Ò³^^Ø³^^`·^^h·^^³·^^¼·^^Ò¹^^×¹^^)»^^3
»^^Š»^^'»^^$¼^^+¼^^\¼^^b¼^^ã¼^^ë¼^^2½^^8½^^È½^^Ï½^^ù½^^þ½^^2Á^^9Á^^ÓÁ^^ÜÁ^^GÃ^^O
Ã^^ƒÃ^^ŠÃ^^•Ç^^œÇ^^qÉ^^xÉ^^
Ë^^•Ë^^^Ì^^°Ì^^•Ì^^•Ì^^•Ì^^"Ì^^3Ì^^9Ì^^™Î^^ Î^^±Î^^¶Î^^ãÎ^^èÎ^^"Ð^^)Ð^^•Ð^^ŠÐ^^^
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´`U ´`e ´`â…´`'‡´`Á ´`Ë ´`p”´`z”´`Å•´`Í•´`)œ´`+œ´`ý¦´`
§´`,-´`‹-´`ƒµ´`†µ´`ô¶´`õ¶´`P¸´`\¸´`\»´`d»´`à¾´`ç¾´`#Ì´`,Ì´`ÞÐ´`âÐ´`ÉÓ´`ÍÓ´
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#^`/#^`2#^`[#^`\#^`,#^`«#^`Ô#^`ß$^`à$^`•'^`•`-
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`1```°`´`'$´@&`•`6° CJ•`OJ¯`PJ``QJ¯```B`^@´`^`B``` `H`e`a`d`i`n`g`
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`˘`˜˜$´'$´@&¯`
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`˜$´'$´•„8¯@&°`•`5° B*`OJ˜`PJ``QJ˜`<`A@òÿ¡`<```•`D`e`f`a`u`l`t`
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`3```'`•`•„Ð^•`B*`OJ˜`PJ``QJ˜`nH•¯`.`U@¢`q´.``` `H`y`p`e`r`l`i`n`k```

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Æ°``^à•À!´^`•`B*`CJ•`OJ~`PJ``QJ~``6`'@¢`'´6```•`C`o`m`m`e`n`t`
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6`þoñÿâ´6```"`D`e`f`a`u`l`t```^`-`•`OJ``PJ``QJ``mH ¯nH ¯-
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´`÷˜´`™š´`C›´`¯ ´`\ ´`Q¬´`•-´`•-´`ñ-´`'®´` °´`ë²´`tµ´`èµ´`Z°´`çÀ´`|Ã´`µÇ´`9É´`ÌË
´`‹Ì´`-Ï´`;Ð´`fÑ´`èÓ´`§Ô´`MÖ´`þÙ´`¹Û´`èÛ´`–
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[´`"[´`A]´`B]´`k_´`l_´`Éa´`Êa´`Úc´`Ûc´`″e´`
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´` –´`%˜´`&˜´`b˜´`c˜´`F›´`G›´`››´`œ›´`°´` ´`^ ´` ´`—
´`˜ ´`•¢´`•¢´`¡¢´`¢¢´`±|´`²|´`½§´`¾§´` "´`,"´`°"´`Õ"´`¯
©´`H©´`I©´`/ª´`0ª´` ª´`•ª´`±ª´`•«´`B«´`—
«´`˜«´`S¬´`T¬´`*®´`+®´`î²´`ï²´`¡´´`Ï´´`Ð´´`Ý´´`Þ´´`ö¶´`÷¶´`Y¹´`]°´`^°´`Ü°´`Ý°´`ö
°´`÷°´`¯»´`˘»´`Ú¼´`Û¼´`xÀ´`yÀ´`êÀ´`ëÀ´`QÁ´`RÁ´`·Á´`¸Á´`2Â´`3Â´`†Â´`‡Â´`öÃ´`÷Ã´`´
Ä´`^Ä´`ÈÄ´`ÉÄ´`'Å´`(Å´`\Å´`]Å´`¬Å´`-Å´`6Æ´`7Æ´`•Ç´`•Ç´`œÊ´` Ê´` Ì´` Ì´`±Ï´`²Ï´`ä
Ò´`åÒ´`OÖ´`PÖ´`_Ö´`Ö´`ž×´`Ÿ×´`çÚ´`èÚ´`öÞ´`÷Þ´`;ß´`<ß´`#â´`$â´`£å´`¤å´`Kè´`Lè´`¬
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´` –´`%˜´`&˜´`b˜´`c˜´`F›´`G›´`››´`œ›´`˚ ´`  ´`ˆ ´`_ ´`—
´`˜ ´`•¢´`•¢´`¡¢´`¢¢´`±¦´`²¦´`½§´`¾§´` ¨´`,¨´`°¨´`Õ¨´`¯
©´`H©´`I©´`/ª´`0ª´` ª´`•ª´`±ª´`•«´`B«´`—
«´`˜«´`S¬´`T¬´`*®´`+®´`î²´`ï²´`Ÿ´`¡´`Ï´`Ð´`Ý´`Þ´`ö¶´`÷¶´`Y¹´`]°´`ˆ°´`Ü°´`Ý
°´`ö°´`÷°´`¯»´`˘»´`Ú¼´`Û¼´`xÀ´`yÀ´`êÀ´`ëÀ´`QÁ´`RÁ´`·Á´`¸Á´`2Â´`3Â´`†Â´`‡Â´`öÃ´`÷
Ã´`´Ä´`ˆÄ´`ÈÄ´`ÉÄ´`'Å´`(Å´`\Å´`]Å´`¬Å´`-Å´`6Æ´`7Æ´`•Ç´`•Ç´`œÊ´` Ê´` Ì´` Ì´`±Ï´`²
Ï´`äÒ´`åÒ´`OÖ´`PÖ´`_Ö´`˜Ö´`ž×´`Ÿ×´`çÚ´`èÚ´`öÞ´`÷Þ´`;ß´`<ß´`#â´`$â´`£å´`¤å´`Kè´`L
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¯´`•¯´`þ¯´`'º´`¿º´`Çº´`Ý±´`í±´`ï²´`÷²´`Þ´`ç´`vµ´`{µ´`ª¹´`²¹´`¡Á´`ªÁ´` Æ´
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`Íã´`Üä´`âä´`¨å´`³å´`_ç´`lç´`•ë´`-ë´`wð´`}ð´`¡ü´`©ü´`®ü´`µü´`}þ´` þ´`ß•^`-
•^`&•^`þ•^`¨•^`
•^`••^`0•^`7•^`K•^`Q•^`••^`‰•^`Š•^` •^`Ž•^`™•^`ì•^`ó•^`F•^`N•^` •^`
•^`}•^`Š•^`-•^`°•^`

•^`••^`|•^`¯•^`ß•^`ë•^`ó•^`^`•^`£^`|^`Á^`Å^`R ^`X ^`Ì ^`× ^`å ^`ë ^`¯!^`

!^`©!^`¯!^`¼!^`Â!^`•"^`
"^`Á"^`Ç"^`2#^`8#^`I#^`N#^`«#^`¯#^`©&^`¯&^`È'^`Ñ'^`((^`/(^`™)^`)^`*^`¯*^`-
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-^`•-^`¼-^`Å-
^`™.^`ž.^`J0^`R0^`.4^`34^`«4^`°4^`½4^`Â4^`Ñ4^`Ö4^`:5^`A5^`ð5^`÷5^`þ5^`^6^`,7^`^7
^`—7^` 7^`¯7^`·7^`r8^`|8^`é9^`î9^`
:^`•:^`×;^`Þ;^`ý;^`'<^`•>^`-
>^`>>^`L>^`¯?^`½?^`E@^`N@^`ò@^`û@^`MB^`SB^`aB^`gB^`®C^`¾C^`øC^`^D^`4E^`:E^`¥G^`ª
G^`ÈI^`ÓI^`ÔI^`ÛI^`,J^`ŠJ^` J^`”J^`ƒL^`‰L^`ŸL^`¥L^`*M^`0M^`ÎN^`ÔN^`ÜN^`ãN^`åN^`ê
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T^`)U^`/U^`vU^`|U^`^V^`dV^`nW^`tW^`”W^`šW^`˜X^`

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`ú[^`r]^`y]^`/^^`5^^`0a^`6a^`%b^`,b^`8c^`?c^`,d^`^d^`±d^`·d^`Ád^`Çd^`Ôd^`Úd^`…e^
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k^`ªk^`²k^`Hl^`Ml^`il^`pl^`-
m^`#m^`_m^`gm^`£m^`«m^`-m^`²m^`°m^`Ãm^`Åm^`Èm^`ôm^`úm^`Žn^`–
n^`-o^`&o^`so^`zo^`Šo^`’o^`™o^`žo^`hp^`jp^`¦q^`«q^`-q^`²q^`´q^`°q^`Èq^`Ïq^`ßq^`æ
q^`,s^`‡s^`‰s^` s^`

t^`•t^`•t^`$t^`&t^`1t^`«t^`±t^`³t^`·t^`Útˆ`átˆ`Äuˆ`Êuˆ`-xˆ`²xˆ`úxˆ`y^`Öyˆ`ßyˆ`ý
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„ˆ`@„ˆ`Ž…ˆ`“…ˆ` …ˆ`¥…ˆ`´…ˆ`¹…ˆ`!†ˆ`'†ˆ`F†ˆ`M†ˆ`V†ˆ`[†ˆ`]†ˆ`c†ˆ`â†ˆ`ê†ˆ`,‡ˆ`‹‡ˆ`Ô
‡ˆ`Û‡ˆ`*ˆ`1ˆ`Yˆ`ˆ`ˆ`ˆ`ˆ`ˆ`eˆ`gˆ`mˆ`uˆ`|ˆ` ˆ`—
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^^• ^^œ ^^Ô ^^Ú ^^˘ž^^•ž^^/¡^^4¡^^?¢^^F¢^^u¢^^{¢^^}¢^^„¢^^j£^^o£^^(¤^^/¤^^É¦^^Ô
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©^^U©^^]©^^•«^^†«^^¦«^^««^^¬«^^¸«^^ò¬^^ú¬^^•¯^^†¯^^"¯^^™¯^^ð¯^^÷¯^^,±^^0±^^•²^^•
²^^ù²^^þ²^^•³^^•³^^,³^^2³^^H³^^M³^^[³^^a³^^Ò³^^Ø³^^`·^^h·^^³·^^¼·^^Ò¹^^×¹^^)»^^3
»^^Š»^^'»^^$¼^^+¼^^\¼^^b¼^^ã¼^^ë¼^^2½^^8½^^È½^^Ï½^^ù½^^þ½^^2Á^^9Á^^ÓÁ^^ÜÁ^^GÃ^^O
Ã^^ƒÃ^^ŠÃ^^•Ç^^œÇ^^qÉ^^xÉ^^
Ë^^•Ë^^^Ì^^°Ì^^•Ì^^•Ì^^•Ì^^"Ì^^3Ì^^9Ì^^™Î^^ Î^^±Î^^¶Î^^ãÎ^^èÎ^^"Ð^^)Ð^^•Ð^^ŠÐ^^^
Ò^^ŽÒ^^›Ò^^¡Ò^^øÒ^^ÿÒ^^/Ô^^4Ô^^<Ô^^?Ô^^éÔ^^ðÔ^^*Õ^^/Õ^^uÕ^^zÕ^^»Õ^^ÃÕ^^YÚ^^_Ú^^
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`C<^`,=^`Ü=^`ç=^`®B^`±B^`7C^`WC^`RE^` E^`•E^`¢E^`QG^`RG^`ªG^`«G^`UH^`¯H^`3P^`8P^
`‹P^`"P^`ÒQ^`àQ^`ÑS^`öS^`÷S^`•T^`:T^`;T^`AT^`LT^`fT^`hT^`)U^`7U^`dU^`lU^`FW^`PW^
`²W^`ßW^`àW^`^X^`˘X^`4X^`5X^`YX^`zX^` X^`"X^`žX^` Y^`ÛY^`ÜY^``Z^`´Z^`˘Z^`2Z^`5Z^
`WZ^`eZ^`ËZ^`ÎZ^`2]^`=]^`R]^`z]^`{]^`¤]^`ä]^`æ]^`0a^`>a^`?a^`Qa^`

b^` b^` c^`´c^`Äc^`Çc^`,d^`£d^`|d^`Ûd^`Üd^`•e^`ri^`xi^`^i^` i^`´j^`

j^`•j^`•j^`šk^`¤k^`ªk^`»k^`êk^`îk^`^l^`@l^`il^`zl^`Nm^`Sm^`Åm^`Èm^`}n^`,n^`¡n^`¤
n^`
o^`•o^`1o^`4o^`_p^`hp^`¦q^`Kr^`»r^`¼r^`,s^` s^`ôs^`ûs^`^t^`´t^`mt^`nt^`æt^`ét^`Y
u^`Zu^`Âu^`Ãu^`Ou^`Üu^`¨x^`¤y^`Óy^`Úy^`ýy^`$z^`4z^`fz^`gz^`}z^`¸z^`Ùz^`íz^`ðz^`c
{^`p{^`q{^`î{^`O|^`\|^`]|^`n|^`-|^`•}^`$}^`.}^`b ^`g ^`• ^`" ^`^,^`n,^`q,^`…,^`q
ƒ^`'ƒ^`Öƒ^`Ÿƒ^`^„^`a„^`Ô„^`á„^`Œ…^` …^`!†^`/†^`0†^`9†^`V†^`d†^`É†^`Ð†^`×†^`ß†^`š
‡^`®‡^`¯‡^`Ç‡^`È‡^`Ó‡^`ê‡^`ì‡^`*^`^E^`^F^`^I^`^Y^`^¡^`^¢^`^¥^`^-^`^²^`^Î^`^1‰^`}
‰^`^‰^`ž‰^`±‰^`øŽ^`• ^`• ^`• ^`' ^`Ÿ ^` ^`- ^`® ^`± ^`˘,^`

’^^N“^^\“^^]“^^f“^^g“^^o“^^´”^^Á”^^$-^^%-
^^Ý™^^ê™^^ë™^^•š^^Âš^^Æš^^T›^^†›^^‡›^^ ›^^Ô›^^`œ^^´œ^^¯œ^^ñ ^^Wž^^Xž^^cž^^D ^^p
^^q ^^t ^^ª§^^¹§^^•©^^(©^^)©^^2©^^3©^^6©^^•ª^^ «^^•«^^‡«^^ž«^^Õ«^^Ö«^^å«^^i¯^^m¯
^^n¯^^}¯^^•¯^^ ¯^^ð¯^^7°^^8°^^U°^^…±^^Š±^^ñ²^^°³^^
³^^•³^^•³^^
³^^!³^^$³^^,³^^>³^^@³^^N³^^[³^^b³^^y³^^¯³^^º³^^Ï³^^Ò³^^Ù³^^ð³^^&´^^'´^^F´^^Ñµ^^Ü
µ^^s·^^{·^^p¸^^ ¸^^-
¹^^Â¹^^Ã¹^^Æ¹^^^»^^•»^^•»^^{»^^|»^^‡»^^ù½^^˘¾^^ƒÃ^^§Ã^^¨Ã^^«Ã^^ Å^^ŸÅ^^›Æ^^ŸÆ^^G
Ç^^KÇ^^•Ç^^¹Ç^^°Ç^^½Ç^^qÉ^^•É^^-
É^^™É^^¡É^^üÊ^^+Ë^^<Ë^^•Ì^^#Ì^^.Ì^^2Ì^^3Ì^^9Ì^^8Í^^kÍ^^™Î^^¾Î^^ÅÎ^^ÈÎ^^ÓÎ^^ÙÎ^^"
Ð^^GÐ^^HÐ^^KÐ^^^Ò^^•Ò^^øÒ^^ Ó^^•Ó^^ Ó^^•Ô^^•Ô^^§Ô^^²Ô^^ Õ^^—
Õ^^YÚ^^`Ú^^wÚ^^®Ú^^¯Ú^^¾Ú^^ìÛ^^•Ü^^¡Ü^^ÎÜ^^ÏÜ^^ñÜ^^ â^^ â^^•ä^^"ä^^«ä^^"`•^"`•`"
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`d`r`a`f`t`:`S`c`a`l`e`a`n`d`s`c`o`p`e`F`e`b`.`2`0`0`3`.`d`o`c`
`B`r`i`a`n` `S`a`v`i`n`A`M`a`c`I`n`t`o`s`h` `H`D`:`D`e`s`k`t`o`p`
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•``•„h´•„~þ•Æ˘`´h´'^„h´`„~þOJ"`QJ"`o(`´`vð´```•```
•``•„Ð^•„~þ•Æ˘`´Ð^'^„Ð^`„~þOJ"`QJ"`o(`´`Øð´```•```
•``•„8¯•„~þ•Æ˘`´8¯'^„8¯`„~þOJ"`QJ"`o(`´`§ð´```•```••``•„ ˘•„~þ•Æ
˘`´ ˘'^„ ˘`„~þOJ´`PJ``QJ´`o(`´`·ð´```•```••``•„°"•„~þ•Æ˘`´°"'^„°
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©´`H©´`I©´`/ª´`0ª´` ª´`•ª´`±ª´`•«´`B«´`—
«´`˜«´`S¬´`T¬´`*®´`+®´`î²´`ï²´`Ÿ´`¡´`Ï´`Ð´`Ý´`Þ´`ö¶´`÷¶´`Y¹´`]°´`^°´`Ü°´`Ý
°´`ö°´`÷°´`¯»´`˘»´`Ú¼´`Û¼´`xÀ´`yÀ´`êÀ´`ëÀ´`QÁ´`RÁ´`·Á´`¸Á´`2Â´`3Â´`†Â´`‡Â´`öÃ´`÷
Ã´`´Ä´`^Ä´`ÈÄ´`ÉÄ´`'Å´`(Å´`\Å´`]Å´`¬Å´`-Å´`6Æ´`7Æ´`•Ç´`•Ç´`œÊ´` Ê´` Ì´` Ì´`±Ï´`²
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§´`,-´`‹-´`ƒµ´`†µ´`ô¶´`õ¶´`P¸´`\¸´`\»´`d»´`à¾´`ç¾´`#Ì´`,Ì´`ÞÐ´`âÐ´`ÉÓ´`ÍÓ´
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^^`â^^`í^^`˜‰^`•‰^`]Ž^`xŽ^`yŽ^`|Ž^`ŒŽ^`¯ ^`˘ ^`• ^`• ^`• ^`j'^`s'^`³'^`Á'^`Â'^`Ë
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"^`˜"^`>"^`}©^`ªª^`ªª^`ìª^`˜«^`:«^`;«^`J«^`Î®^`Ò®^`Ó®^`â®^`å®^`ò®^`U¯^`œ¯^` ¯^`°
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Ë^`~Ë^`žË^` Ì^`ÐÌ^`þÍ^`#Î^`*Î^`-
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`^`^`^`•`•„p˚•„Lÿ•Æ˘`´p˚˙^„p˚`„Lÿ^^`. `´^`^`^`•´^`^`^`^`^`^`^`^`^`^`^`^`^`^`^`•`•„@
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`„˜þ^˘˜˘.˘ˆ˘˘˘¯•ˆ˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘•˘˘•„x••„˜þ•Æ˘˘ˆx•˙^„x•`„˜þ^˘¯˘.˘ˆ˘˘˘^,ˆ˘˘˘˘˘
˘˘˘˘˘˘˘˘˘˘˘˘˘•˘˘•„H••„Lÿ•Æ˘˘ˆH•˙^„H•`„Lÿ^˘˘˘.˘ˆ˘˘˘˘•ˆ˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘•˘˘•„•••„
˜þ•Æ˘˘ˆ••˙^„••`„˜þ^˘˙˘.˘ˆ˘˘˘¯•ˆ˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘•˘˘•„è••„˜þ•Æ˘˘ˆè•˙^„è•`„˜þ^˘"˘
.˘ˆ˘˘˘^,ˆ˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘•˘˘•„¸••„Lÿ•Æ˘˘ˆ¸•˙^„¸•`„Lÿ^˘˚˘.˘ˆ˘˘˘•˘˘˘˘˘˘˘˘˘˘˘˘˘˘
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•``•„ ˘•„˜þ•Æ˘`´ ˘¨^„ ˘`„˜þOJ°`QJ°`o(`´`o`´´´´• `´´´´´´´´´´h´´´´´´´
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´`¥X´`-X´`Ì´`Ò´`uh´`yh´`:l´`Fl´`-m´`¹m´`az´`hz´`›z´`¢z´`•{´`•{´`,{´` {´`˜|´` |
´`U ´`e ´`â…´`'‡´`Á ´`Ë ´`p”´`z”´`Å•´`Í•´`)œ´`+œ´`ý¦´`
§´`,-´`‹-´`ƒµ´`†µ´`ô¶´`õ¶´`P¸´`\¸´`\»´`d»´`à¾´`ç¾´`#Ì´`,Ì´`ÞÐ´`âÐ´`ÉÓ´`ÍÓ´
`ÈÚ´`ÌÚ´`•Þ´`;Þ´`ëè´`ðè´`-ë´`

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^`ß•^`!•^`(•^`d•^`e•^`Ë•^`Ó•^`¦^`"^`Á^`• ^`R ^`ž ^`Ÿ ^`Ã ^`Ä ^`È ^`õ ^`ø
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‡^`®‡^`¯‡^`Ç‡^`È‡^`Ó‡^`ê‡^`ì‡^`*^`^E^`^F^`^I^`^Y^`^¡^`^¢^`^¥^`^-^`^²^`^Î^`^1‰^`}
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^^q ^^t ^^ª§^^¹§^^•©^^(©^^)©^^2©^^3©^^6©^^•ª^^ «^^•«^^‡«^^ž«^^Õ«^^Ö«^^å«^^i¯^^m¯
^^n¯^^}¯^^•¯^^ ¯^^ð¯^^7°^^8°^^U°^^…±^^Š±^^ñ²^^˚³^^
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˙ˆ„¸˚˘„èü˝˘˘˘.˘´˘.˘ˆ˘.˘˜˘.˘¯˘.˘´˘˘˘˘˘´˜˘¨
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`„~þ^^–`.`^^^^^,´^^^^^^^^^^^^^^^^^^^•^^•„à••„Lÿ•Æ˘^´à•'^„à•`„Lÿ^^^^.`^^^^^•´^^^^^
^^^^^^^^^^^^•^^•„°••„~þ•Æ˘^´°•'^„°•`„~þ^^'^.`^^^^^–•´^^^^^^^^^^^^^^^^^^^•^^•„•••„
~þ•Æ˘^´••'^„••`„~þ^"^.`^^^^^,´^^^^^^^^^^^^^^^^^^•^^•„P••„Lÿ•Æ˘^´P•'^„P•`„Lÿ^^°^^
.`^^^^•^^^^^^^^^^^^^^^^^^^••^^•„h´•„~þ•Æ˘^´h´'^„h´^„~þOJ´^PJ^^QJ´^o(^´^vð´^^^•^^
^^^^^^^^^^^^^^^^^^••^^•„Ð^•„~þ•Æ˘^´Ð^'^„Ð^^„~þOJ´^PJ^^QJ´^o(^´^Øð´^^^•^^^^^^^^^^
^^^^^^^••^^•„8¯•„~þ•Æ˘^´8¯'^„8¯^„~þOJ´^PJ^^QJ´^o(^´^§ð´^^^•^^^^^^^^^^^^^^^^^^^•
•^^•„ ˘•„~þ•Æ˘^´ ˘'^„ ˘^„~þOJ´^PJ^^QJ´^o(^´^·ð´^^^•^^^^^^^^^^^^^^^^^^^••^^•„°"•„
~þ•Æ˘^´°"'^„°"^„~þOJ´^PJ^^§ð´^^^•^^^^^^^^^^^^^^^^^^^••^^•„ ˘•„~þ•Æ˘^´ ˘'^„ ˘^„~þ
OJ´^PJ^^QJ´^o(^´^·ð´^^^•^^^^^^^^^^^^^^^^^^^••^^•„°"•„~þ•Æ˘^´°"'^„°"^„~þOJ´^PJ^^Q
J´^o(^´^"ð´^^^•^^^^^^^^^^^^^^^^^^^
•^^•„p°•„~þ•Æ˘^´p°'^„p°^„~þOJ"^QJ"^o(^´^Øð´^^^•^^^^^^^^^^^^^^^^^^^
•^^•„Ø •„~þ•Æ˘^´Ø '^„Ø ^„~þOJ"^QJ"^o(^´^§ð´^^^•^^^^^^^^^^^^^^^^^^^••^^•„@
•„~þ•Æ˘^´@
'^„@
^„~þOJ´^PJ^^QJ´^o(^´^·ð´^^^•^^^^^^^^^^^^^^^^^^^••^^•„"

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`„˜þOJ´`PJ``QJ´`o(`´`"ð´`````´`````````````````•``•„h´•„˜þ•Æ˘`´h´˙ˆ„h´`„˜þ^```.
`´``````´˜```````````````````•``•„•˜•„Pþ•Æ˘`´•˜˙ˆ„•˜`„Pþ¯```.`´`.`´``````´˜˘````````
`````````•``•„È¯•„˚þ•Æ˘`´ ˘˙ˆ„È¯`„˚þ˙```.`´`.`ˆ`.`´``````´˜˘"```````````````•``•„À
˙•„xý•Æ˘`´p˚˙ˆ„À˙`„xý˚```.`´`.`ˆ`.`˜`.`´``````´˜˘"
``````````````•``•„¸˚•„èü•Æ˘`´Ø
˙ˆ„¸˚`„èü˝```.`´`.`ˆ`.`˜`.`¯`.`´``````´˜˘"
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•„8û•Æ˘`´à•˙^„

`„8û•```.`˘`.`^`.`˜`.`¯`.`˘`.`'`.`"`.`˘``````˘~˘"

••``````````•``•„à••„`ú•Æ˘`´°•'^„à•`„`ú•```.`˘`.`^`.`˜`.`¯`.`˘`.`'`.`"`.`°`.`˘``
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•``•„h´•„˜þ•Æ˘`´h´'^„h´`„˜þOJ´`QJ´`o(`´`vð´```•``````````````````
•``•„Ð^•„˜þ•Æ˘`´Ð^'^„Ð^`„˜þOJ´`QJ´`o(`´`Øð´```•``````````````````
•``•„8¯•„˜þ•Æ˘`´8¯'^„8¯`„˜þOJ´`QJ´`o(`´`§ð´```•``````````````````
•``•„ ˘•„˜þ•Æ˘`´ ˘'^„ ˘`„˜þOJ´`QJ´`o(`´`·ð´```•``````````````````
•``•„˚"•„˜þ•Æ˘`´˚"'^„˚"`„˜þOJ´`QJ´`o(`´`"ð´```•``````````````````
•``•„p˚•„˜þ•Æ˘`´p˚'^„p˚`„˜þOJ´`QJ´`o(`´`Øð´```•``````````````````
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)`´^`^`^`¯•´^`^`^`^`^`^`^`^`^`^`^`^`^`^`^`^`^`^`^`^`^`•`•„ ˘•„˜þ•Æ˘`´ ˘˙^„ ˘`„˜þ^`´. `´^`^`^,´^`^`^`^`^`^`^`^`^`^`
`^`^`^`•`•„p˚•„Lÿ•Æ˘`´p˚˙^„p˚`„Lÿ^^`. `´^`^`^`•´^`^`^`^`^`^`^`^`^`^`^`^`^`^`^`•`•„@
•„˜þ•Æ˘`´@
˙^„@
`„˜þ^`˜`. `´^`^`¯•´^`^`^`^`^`^`^`^`^`^`^`^`^`^`•`•„•

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`„˜þˆˆ¯ˆ.ˆ´ˆˆˆˆ^,´ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ•ˆˆ•„à••„Lÿ•Æ˘ˆ´à•˙^„à•ˆ„Lÿˆˆ˘ˆ.ˆ´ˆˆˆˆˆ•´ˆˆˆˆˆ
ˆˆˆˆˆˆˆˆˆˆˆˆˆˆ•ˆˆ•„°••„˜þ•Æ˘ˆ´°•˙^„°•ˆ„˜þˆˆ˙ˆ.ˆ´ˆˆˆˆ¯•´ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ•ˆˆ•„•••„
˜þ•Æ˘ˆ´••˙^„••ˆ„˜þˆˆ¨ˆ.ˆ´ˆˆˆˆ^,´ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ•ˆˆ•„P••„Lÿ•Æ˘ˆ´P•˙^„P•ˆ„Lÿˆˆ˚ˆ
.ˆ´ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ••ˆˆ•„h´•„˜þ•Æ˘ˆ´h´˙^„h´ˆ„˜þOJ´ˆPJˆˆQJ´ˆo(ˆ´ˆvð´ˆˆˆ•ˆˆ
ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ••ˆˆ•„Ð^•„˜þ•Æ˘ˆ´Ð^˙^„Ð^ˆ„˜þOJ´ˆPJˆˆQJ´ˆo(ˆ´ˆØð´ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆ
ˆˆˆˆˆˆˆˆˆ••ˆˆ•„8¯•„˜þ•Æ˘ˆ´8¯˙^„8¯ˆ„˜þOJ´ˆPJˆˆQJ´ˆo(ˆ´ˆ§ð´ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ•
•ˆˆ•„ ˘•„˜þ•Æ˘ˆ´ ˘˙^„ ˘ˆ„˜þOJ´ˆPJˆˆQJ´ˆo(ˆ´ˆ·ð´ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ••ˆˆ•„˚¨•„
˜þ•Æ˘ˆ´˚¨˙^„˚¨ˆ„˜þOJ´ˆPJˆˆQJ´ˆo(ˆ´ˆ¨ð´ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ••ˆˆ•„p˚•„˜þ•Æ˘ˆ´p˚
˙^„p˚ˆ„˜þOJ´ˆPJˆˆQJ´ˆo(ˆ´ˆØð´ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ••ˆˆ•„Ø •„˜þ•Æ˘ˆ´Ø ˙^„Ø
ˆ„˜þOJ´ˆPJˆˆQJ´ˆo(ˆ´ˆ§ð´ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ••ˆˆ•„@
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ˆ„˜þOJ´ˆPJˆˆQJ´ˆo(ˆ´ˆ·ð´ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ••ˆˆ•„¨

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`„~þOJ´`PJ``QJ´`o(`´`"ð´```~`´```````````````~•``•„8¯•„~þ•Æ˘`´8¯'^„8¯`„~þo(`^`
``.`´```¯`´```````````````•``•„°"•„~þ•Æ˘`´°"'^„°"`„~þ^`´`.`´```´```````
``````~•``•„Œ″•„~þ•Æ˘`´Œ″'^„Œ″`„~þo(`^`^`.`´```•´```````````````•``•„"
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`„˜þ^ˆ˜ˆ.ˆ˘ˆˆˆ¯•˘ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ•ˆˆ•„x••„˜þ•Æ˘ˆ´x•˙^„x•`„˜þ^ˆ¯ˆ.ˆ˘ˆˆˆ^,˘ˆˆˆˆˆ
ˆˆˆˆˆˆˆˆˆˆˆˆˆ•ˆˆ•„H••„Lÿ•Æ˘ˆ´H•˙^„H•`„Lÿ^ˆ˘ˆ.ˆ˘ˆˆˆˆ•˘ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ•ˆˆ•„•••„
˜þ•Æ˘ˆ´••˙^„••`„˜þ^ˆ˙ˆ.ˆ˘ˆˆˆ¯•˘ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ•ˆˆ•„è••„˜þ•Æ˘ˆ´è•˙^„è•`„˜þ^ˆ"ˆ
.ˆ˘ˆˆˆ^,˘ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ•ˆˆ•„¸••„Lÿ•Æ˘ˆ´¸•˙^„¸•`„Lÿ^ˆ˚ˆ.ˆ˘ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ
ˆˆˆˆ

•ˆˆ•„h´•„˜þ•Æ˘ˆ´h´˙^„h´`„˜þOJ"`QJ"`o(ˆ˘ˆvð˘ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆh´ˆˆˆˆˆˆ
•ˆˆ•„Ð^•„˜þ•Æ˘ˆ´Ð^˙^„Ð^`„˜þOJ˚`QJ˚`o(ˆ˘ˆo`˘ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ
•ˆˆ•„8¯•„˜þ•Æ˘ˆ´8¯˙^„8¯`„˜þOJ"`QJ"`o(ˆ˘ˆ§ð˘ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ••ˆˆ•„ ˘•„˜þ•Æ
˘ˆ´ ˘˙^„ ˘`„˜þOJ´`PJ`ˆQJ´`o(ˆ˘ˆ·ð˘ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ••ˆˆ•„˚"•„˜þ•Æ˘ˆ´˚"˙^„˚
"`„˜þOJ´`PJ`ˆQJ´`o(ˆ˘ˆ"ð˘ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ
•ˆˆ•„p˚•„˜þ•Æ˘ˆ´p˚˙^„p˚`„˜þOJ"`QJ"`o(ˆ˘ˆØð˘ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ
•ˆˆ•„Ø •„˜þ•Æ˘ˆ´Ø ˙^„Ø `„˜þOJ"`QJ"`o(ˆ˘ˆ§ð˘ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ••ˆˆ•„@
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`„˜þOJ´`PJ`ˆQJ´`o(ˆ˘ˆ·ð˘ˆˆˆ•ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ••ˆˆ•„"

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`„~þOJ´`PJ``QJ´`o(`´`"ð´```•••`````````h´```````
•``•„Ð^•„~þ•Æ˘`´Ð^'^„Ð^`„~þOJ°`QJ°`o(`´`o`´```• ```````````h´```````
•``•„ ˘•„~þ•Æ˘`´ ˘'^„ ˘`„~þOJ°`QJ°`o(`´`o`´```• ```````````h´```````
•``•„p°•„~þ•Æ˘`´p°'^„p°`„~þOJ´`QJ´`o(`´`§ð´```• ```````````h´```````
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`„˜þOJ˚`QJ˚`o(`˝`o`˝```• ``````````h˝``````
•``•„à••„˜þ•Æ˘`˝à•˙^„à•`„˜þOJ˝`QJ˝`o(`˝`§ð˝```• ``````````h˝``````
•``•„°••„˜þ•Æ˘`˝°•˙^„°•`„˜þOJ˝`QJ˝`o(`˝`·ð˝```• ``````````h˝``````
•``•„•••„˜þ•Æ˘`˝••˙^„••`„˜þOJ˚`QJ˚`o(`˝`o`˝```• ``````````h˝``````
•``•„P••„˜þ•Æ˘`˝P•˙^„P•`„˜þOJ˝`QJ˝`o(`˝`§ð˝````˝`````````````````•``•„h˝•„˜þ•Æ
˘`˝h˝˙^„h˝`„˜þ^```.`˝`````˝~``````````````````•``•„•˜•„Pþ•Æ˘`˝•˜˙^„•˜`„Pþ¯```.`˝`
.`˝`````˝~˘``````````````````•``•„È¯•„˚þ•Æ˘`˝ ˘˙^„È¯`„˚þ˙```.`˝`.`^`.`˝`````˝~˘"``
`````````````•``•„À˙•„xý•Æ˘`˝p˚˙^„À˙`„xý˚```.`˝`.`^`.`~`.`˝`````˝~˘"
`````````````•``•„¸˚•„èü•Æ˘`˝Ø
˙^„¸˚`„èü˝```.`˝`.`^`.`~`.`¯`.`˝`````˝~˘"
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•„8û•Æ˘`´à•˙^„

`„8û•```.`´`.`^`.`~`.`–`.`˘`.`¦`.`"`.`´```´~˘"

••```````•``•„à••„`ú•Æ˘`´°•¦^„à•`„`ú•```.`´`.`^`.`~`.`–`.`˘`.`¦`.`"`.`°`.`´``
```´```````````•``•„h´•„˜þ•Æ˘`´h´¦^„h´`„˜þ^```.`´```´~```````
•``•„•˜•„Pþ•Æ˘`´•˜¦^„•˜`„Pþ¯```.`´`.`´```´~˘```````•``•„È¯•„˚þ•Æ˘`´ ˘
¦^„È¯`„˚þ¦```.`´`.`^`.`´```´~˘"```````•``•„À¦•„xý•Æ˘`´p˚¦^„À¦`„xý˚```.
`´`.`^`.`~`.`´```´~˘" ```````•``•„¸˚•„èü•Æ˘`´Ø
¦^„¸˚`„èü˝```.`´`.`^`.`~`.`–`.`´```´~˘"
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•„Èû•Æ˘``´x•'^„¨

`„Èû

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•„8û•Æ˘`´à•˙^„

`„8û•```.`´`.`^`.`~`.`–`.`˘`.`¨`.`"`.`´´´´´´´˜˘"

••`´´´´´´´´´´•``•„à••„`ú•Æ˘`´°•¨^„à•`„`ú•```.`´`.`^`.`~`.`–`.`˘`.`¨`.`"`.`°`.`´´´
`••`´´´´´´´´´´h´´´´´´´
•``•„Ð^•„˜þ•Æ˘`´Ð^¨^„Ð^`„˜þOJ°`QJ°`o(`´`o`´´´´• `´´´´´´´´´´h´´´´´´´
•``•„ ˘•„˜þ•Æ˘`´ ˘¨^„ ˘`„˜þOJ°`QJ°`o(`´`o`´´´´• `´´´´´´´´´´h´´´´´´´
•``•„p°•„˜þ•Æ˘`´p°¨^„p°`„˜þOJ´`QJ´`o(`´`§ð´´´´• `´´´´´´´´´´h´´´´´´´
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•„˜þ•Æ˘`´@
¨^„@
`„˜þOJ´`QJ´`o(`´`·ð´´´´• `´´´´´´´´´´h´´´´´´´
•``•„•

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`„~þOJ°`QJ°`o(`´`o`´```• ```````````h´```````
•``•„à••„~þ•Æ˘`´à•'^„à•`„~þOJ´`QJ´`o(`´`§ð´```• ```````````h´```````
•``•„°••„~þ•Æ˘`´°•'^„°•`„~þOJ´`QJ´`o(`´`·ð´```• ```````````h´```````
•``•„•••„~þ•Æ˘`´••'^„••`„~þOJ°`QJ°`o(`´`o`´```• ```````````h´```````
•``•„P••„~þ•Æ˘`´P•'^„P•`„~þOJ´`QJ´`o(`´`§ð´```•```````````````````
•``•„h´•„~þ•Æ˘`´h´'^„h´`„~þOJ´`QJ´`o(`´`vð´```•```````````````````
•``•„Ð^•„~þ•Æ˘`´Ð^'^„Ð^`„~þOJ´`QJ´`o(`´`Øð´```•```````````````````
•``•„8¯•„~þ•Æ˘`´8¯'^„8¯`„~þOJ´`QJ´`o(`´`§ð´```•```````````````````
•``•„ ˘•„~þ•Æ˘`´ ˘'^„ ˘`„~þOJ´`QJ´`o(`´`·ð´```•```````````````````
•``•„°¨•„~þ•Æ˘`´°¨'^„°¨`„~þOJ´`QJ´`o(`´`¨ð´```•```````````````````
•``•„p°•„~þ•Æ˘`´p°'^„p°`„~þOJ´`QJ´`o(`´`Øð´```•```````````````````
•``•„Ø      •„~þ•Æ˘`´Ø  '^„Ø  `„~þOJ´`QJ´`o(`´`§ð´```•```````````````````
•``•„@
•„~þ•Æ˘`´@
'^„@
`„~þOJ´`QJ´`o(`´`·ð´```•```````````````````
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•„˜þ•Æˇˋˊ¨

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`„˜þOJ´`QJ´`o(`´`"ð´```•`
•``•„h´•„˜þ•Æ˘`´h´'^„h´`„˜þOJ"`QJ"`o(`´`vð´```•`
•``•„Ð^•„˜þ•Æ˘`´Ð^'^„Ð^`„˜þOJ"`QJ"`o(`´`Øð´```•`
•``•„8¯•„˜þ•Æ˘`´8¯'^„8¯`„˜þOJ"`QJ"`o(`´`§ð´```•`••``•„ ˘•„˜þ•Æ
˘`´ ˘'^„ ˘`„˜þOJ´`PJ``QJ´`o(`´`·ð´```•`••``•„°"•„˜þ•Æ˘`´°"'^„°
"`„˜þOJ´`PJ``QJ´`o(`´`"ð´```•`
•``•„p°•„˜þ•Æ˘`´p°'^„p°`„˜þOJ"`QJ"`o(`´`Øð´```•`
•``•„Ø •„˜þ•Æ˘`´Ø '^„Ø `„˜þOJ"`QJ"`o(`´`§ð´```•`••``•„@
•„˜þ•Æ˘`´@
'^„@
`„˜þOJ´`PJ``QJ´`o(`´`·ð´```•`••``•„"

•„˜þ•Æˇˋˊ¨

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```
`„˜þOJ´`PJ``QJ´`o(`´`"ð´```•```````````````````
•``•„h´•„˜þ•Æ˘`´h´'^„h´`„˜þOJ´`QJ´`o(`´`vð´```•```````````````````
•``•„Ð^•„˜þ•Æ˘`´Ð^'^„Ð^`„˜þOJ´`QJ´`o(`´`Øð´```•```````````````````
•``•„8¯•„˜þ•Æ˘`´8¯'^„8¯`„˜þOJ´`QJ´`o(`´`§ð´```•```````````````````
•``•„ ˘•„˜þ•Æ˘`´ ˘'^„ ˘`„˜þOJ´`QJ´`o(`´`·ð´```•```````````````````
•``•„˚"•„˜þ•Æ˘`´˚"'^„˚"`„˜þOJ´`QJ´`o(`´`"ð´```•```````````````````
•``•„p˚•„˜þ•Æ˘`´p˚'^„p˚`„˜þOJ´`QJ´`o(`´`Øð´```•```````````````````
•`````.`´`.`^`.`˜`.`¯`.`˘`.`´```````´˜˘"

```````````•``•„"
```
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•„Èû•Æ˘``´x•'^„¨

`„Èû

`` ` ` . ` ˇ ` . ` ^ ` . ` ˜ ` . ` ¯ ` . ` ˘ ` . ` ˙ ` . ` ˚ ` ` ` ` ` ˛ ` ˜ ` "

• ` ` ` ` ` ` ` ` ` ` ` • ` ` • „

•„8û•Æ˘`´à•˙^„

˘„8û•˘˘˘.˘ˆ˘.˘^˘.˘~˘.˘¯˘.˘˘˘.˘'˘.˘"˘.˘ˆ˘˘˘˘˘ˆ~˘"

••˘˘˘˘˘˘˘˘˘˘•˘˘•„à••„˘ú•Æ˘˘´°•'^„à•˘„˘ú•˘˘˘.˘ˆ˘.˘^˘.˘~˘.˘¯˘.˘˘˘.˘'˘.˘"˘.˘°˘.˘ˆ˘˘
˘•˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘
•˘˘•„h´•„˜þ•Æ˘˘´h´'^„h´˘„˜þOJ´˘QJ´˘o(˘´˘vð´˘˘˘•˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘
•˘˘•„Ð^•„˜þ•Æ˘˘´Ð^'^„Ð^˘„˜þOJ´˘QJ´˘o(˘´˘Øð´˘˘˘•˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘
•˘˘•„8¯•„˜þ•Æ˘˘´8¯'^„8¯˘„˜þOJ´˘QJ´˘o(˘´˘§ð´˘˘˘•˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘
•˘˘QJ´˘o(˘´˘"ð´˘˘˘•˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘••˘˘•„p˚•„˜þ•Æ˘˘´p˚'^„p˚˘„˜þOJ´˘PJ˘˘QJ´˘o(
˘´˘Øð´˘˘˘•˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘••˘˘•„Ø •„˜þ•Æ˘˘´Ø '^„Ø
˘„˜þOJ´˘PJ˘˘QJ´˘o(˘´˘§ð´˘˘˘•˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘••˘˘•„@
•„˜þ•Æ˘˘´@
'^„@
˘„˜þOJ´˘PJ˘˘QJ´˘o(˘´˘·ð´˘˘˘•˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘••˘˘•„"

•„˜þ•Æˇˋˊ¨

'^ "

`„~þOJ´`PJ``QJ´`o(`´`"ð´```~`´```````````````~•``•„8¯•„~þ•Æ˘`´8¯'^„8¯`„~þo(`^`
``.`´```¯`´```````````````•``•„°"•„~þ•Æ˘`´°"'^„°"`„~þ^`´`.`´```´```````
``````~•``•„Œ″•„~þ•Æ˘`´Œ″'^„Œ″`„~þo(`^`^`.`´```•´```````````````•``•„"
``````

•„˜þ•Æˇˋˊ¨

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`„˜þˆ˜˜`.`ˆ˜˜˜¯•ˆ˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜•``•„x••„˜þ•Æ˘`´x•˙ˆ„x•`„˜þˆ˜¯`.`ˆ˜˜˜ˆ,ˆ˜˜˜˜˜
˜˜˜˜˜˜˜˜˜˜˜˜˜•``•„H••„Lÿ•Æ˘`´H•˙ˆ„H•`„Lÿˆ˜˘`.`ˆ˜˜˜˜•ˆ˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜•``•„•••„
˜þ•Æ˘`´••˙ˆ„••`„˜þˆ˜˙`.`ˆ˜˜˜¯•ˆ˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜•``•„è••„˜þ•Æ˘`´è•˙ˆ„è•`„˜þˆ˜"`
.`ˆ˜˜˜ˆ,ˆ˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜•``•„¸••„Lÿ•Æ˘`´¸•˙ˆ„¸•`„Lÿˆ˜˚`.`ˆ˜˜˜•˜˜˜˜˜˜˜˜˜˜˜˜˜˜
˜˜˜˜

•``•„h´•„˜þ•Æ˘`´h´˙ˆ„h´`„˜þOJ¨`QJ¨`o(`´`vð´``˜•˜˜˜˜˜˜˜˜˜˜˜h´˜˜˜˜˜˜
•``•„Ðˆ•„˜þ•Æ˘`´Ðˆ˙ˆ„Ðˆ`„˜þOJ˚`QJ˚`o(`´`o`´``˜•˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜
•``•„8¯•„˜þ•Æ˘`´8¯˙ˆ„8¯`„˜þOJ¨`QJ¨`o(`´`§ð´``˜•˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜••``•„ ˘•„˜þ•Æ
˘`´ ˘˙ˆ„ ˘`„˜þOJ´`PJ``QJ´`o(`´`·ð´``˜•˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜••``•„˚¨•„˜þ•Æ˘`´˚¨˙ˆ„˚
¨`„˜þOJ´`PJ``QJ´`o(`´`¨ð´``˜•˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜
•``•„p˚•„˜þ•Æ˘`´p˚˙ˆ„p˚`„˜þOJ¨`QJ¨`o(`´`Øð´``˜•˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜
•``•„Ø •„˜þ•Æ˘`´Ø ˙ˆ„Ø `„˜þOJ¨`QJ¨`o(`´`§ð´``˜•˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜••``•„@
•„˜þ•Æ˘`´@
˙ˆ„@
`„˜þOJ´`PJ``QJ´`o(`´`·ð´``˜•˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜˜••``•„¨

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```
`„~þOJ´`PJ``QJ´`o(`´`"ð´```•••`````````h´```````
•``•„Ð^•„~þ•Æ˘`´Ð^'^„Ð^`„~þOJ°`QJ°`o(`´`o`´```• ```````````h´```````
•``•„ ˘•„~þ•Æ˘`´ ˘'^„ ˘`„~þOJ°`QJ°`o(`´`o`´```• ```````````h´```````
•``•„p°•„~þ•Æ˘`´p°'^„p°`„~þOJ´`QJ´`o(`´`§ð´```• ```````````h´```````
•``•„@
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`„~þOJ´`QJ´`o(`´`·ð´```• ```````````h´```````
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`„˜þOJ˚`QJ˚`o(`´`o`´```• ``````````h´``````
•``•„à••„˜þ•Æ˘`´à•˙^„à•`„˜þOJ´`QJ´`o(`´`§ð´```• ``````````h´``````
•``•„°••„˜þ•Æ˘`´°•˙^„°•`„˜þOJ´`QJ´`o(`´`·ð´```• ``````````h´``````
•``•„•••„˜þ•Æ˘`´••˙^„••`„˜þOJ˚`QJ˚`o(`´`o`´```• ``````````h´``````
•``•„P••„˜þ•Æ˘`´P•˙^„P•`„˜þOJ´`QJ´`o(`´`§ð´````´``````````````````````•``•„h´•„˜þ•Æ
˘`´h´˙^„h´`„˜þ^```.`´`````´~``````````````````•``•„•˜•„Pþ•Æ˘`´•˜˙^„•˜`„Pþ¯```.`´`
.`´`````´~˘``````````````````•``•„È¯•„˚þ•Æ˘`´ ˘˙^„È¯`„˚þ˙```.`´`.`^`.`´``````´~˘"``
`````````````•``•„À˙•„xý•Æ˘`´p˚˙^„À˙`„xý˚```.`´`.`^`.`~`.`´``````´~˘"
``````````````•``•„¸˚•„èü•Æ˘`´Ø
˙^„¸˚`„èü˝```.`´`.`^`.`~`.`¯`.`´``````´~˘"
`````````````•``•„°˝•„Xü•Æ˘`´"
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·^„°″`„Xü

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`` ` ` . ` ´ ` . ` ^ ` . ` ~ ` . ` – ` . ` ˘ ` . ` ´ ` ` ` ` ` ` ´ ~ ˘ "

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•„ÈÛ•Æ˘``´•

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`„Èû

`` ` ` . ` ˇ ` . ` ^ ` . ` ˜ ` . ` ¯ ` . ` ˘ ` . ` ˙ ` . ` ˚ ` ` ` ` ` ˛ ` ˜ ` "

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•„8û•Æ˘`´à•˙^„

`„8û•```.`´`.`^`.`~`.`–`.`˘`.`¦`.`"`.`´```´~˘"

••```````•``•„à••„`ú•Æ˘`´°•¦^„à•`„`ú•```.`´`.`^`.`~`.`–`.`˘`.`¦`.`"`.`°`.`´``
```´```````````•``•„h´•„˜þ•Æ˘`´h´¦^„h´`„˜þ^```.`´```´~```````
•``•„•˜•„Pþ•Æ˘`´•˜¦^„•˜`„Pþ¯```.`´`.`´```´~˘```````•``•„È¯•„˚þ•Æ˘`´ ˘
¦^„È¯`„˚þ¦```.`´`.`^`.`´```´~˘"```````•``•„À¦•„xý•Æ˘`´p˚¦^„À¦`„xý˚```.
`´`.`^`.`~`.`´```´~˘" ```````•``•„¸˚•„èü•Æ˘`´Ø
¦^„¸˚`„èü˝```.`´`.`^`.`~`.`–`.`´```´~˘"
```````•``•„°˝•„Xü•Æ˘`´"

·^„°″`„Xü

```
`` ` ` . ` ´ ` . ` ^ ` . ` ~ ` . ` – ` . ` ˘ ` . ` ´ ` ` ` ` ` ` ´ ~ ˘ "

` ` ` ` ` ` ` ` ` ` ` ` ` ` ` ● ` ` ● „ "
```

•„Èû•Æ˘``´x•'^„¨

`„Èû

`` ` ` . ` ˇ ` . ` ^ ` . ` ˜ ` . ` ¯ ` . ` ˘ ` . ` ˙ ` . ` ˚ ` ` ` ` ` ˛ ` ˜ ` "

• ` ` ` ` ` ` ` ` ` ` ` • ` ` • „

•„8û•Æ˘`´à•˙^„

`„8û•```.`´`.`^`.`~`.`–`.`˘`.`¨`.`"`.`´´´´´´´˜˘"

••`´´´´´´´´´´•``•„à••„`ú•Æ˘`´°•¨^„à•`„`ú•```.`´`.`^`.`~`.`–`.`˘`.`¨`.`"`.`°`.`´´´
`••`´´´´´´´´´´h´´´´´´´
•``•„Ð^•„˜þ•Æ˘`´Ð^¨^„Ð^`„˜þOJ°`QJ°`o(`´`o`´´´´• `´´´´´´´´´´h´´´´´´´
•``•„ ˘•„˜þ•Æ˘`´ ˘¨^„ ˘`„˜þOJ°`QJ°`o(`´`o`´´´´• `´´´´´´´´´´h´´´´´´´
•``•„p°•„˜þ•Æ˘`´p°¨^„p°`„˜þOJ´`QJ´`o(`´`§ð´´´´• `´´´´´´´´´´h´´´´´´´
•``•„@
•„˜þ•Æ˘`´@
¨^„@
`„˜þOJ´`QJ´`o(`´`·ð´´´´• `´´´´´´´´´´h´´´´´´´
•``•„•

•„˜þ•Æˇˋˊ•

'^„•

```
`„~þOJ°`QJ°`o(`´`o`´```• ```````````h´```````
•``•„à••„~þ•Æ˘`´à•'^„à•`„~þOJ´`QJ´`o(`´`§ð´```• ```````````h´```````
•``•„°••„~þ•Æ˘`´°•'^„°•`„~þOJ´`QJ´`o(`´`·ð´```• ```````````h´```````
•``•„•••„~þ•Æ˘`´••'^„••`„~þOJ°`QJ°`o(`´`o`´```• ```````````h´```````
•``•„P••„~þ•Æ˘`´P•'^„P•`„~þOJ´`QJ´`o(`´`§ð´```•```````````````````
•``•„h´•„~þ•Æ˘`´h´'^„h´`„~þOJ´`QJ´`o(`´`vð´```•```````````````````
•``•„Ð^•„~þ•Æ˘`´Ð^'^„Ð^`„~þOJ´`QJ´`o(`´`Øð´```•```````````````````
•``•„8¯•„~þ•Æ˘`´8¯'^„8¯`„~þOJ´`QJ´`o(`´`§ð´```•```````````````````
•``•„ ˘•„~þ•Æ˘`´ ˘'^„ ˘`„~þOJ´`QJ´`o(`´`·ð´```•```````````````````
•``•„°¨•„~þ•Æ˘`´°¨'^„°¨`„~þOJ´`QJ´`o(`´`¨ð´```•```````````````````
•``•„p°•„~þ•Æ˘`´p°'^„p°`„~þOJ´`QJ´`o(`´`Øð´```•```````````````````
•``•„Ø      •„~þ•Æ˘`´Ø  '^„Ø  `„~þOJ´`QJ´`o(`´`§ð´```•```````````````````
•``•„@
•„~þ•Æ˘`´@
'^„@
`„~þOJ´`QJ´`o(`´`·ð´```•```````````````````
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```

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`„˜þOJ´`QJ´`o(`´`"ð´```•`
•``•„h´•„˜þ•Æ˘`´h´'^„h´`„˜þOJ"`QJ"`o(`´`vð´```•`
•``•„Ð^•„˜þ•Æ˘`´Ð^'^„Ð^`„˜þOJ"`QJ"`o(`´`Øð´```•`
•``•„8¯•„˜þ•Æ˘`´8¯'^„8¯`„˜þOJ"`QJ"`o(`´`§ð´```•`••``•„ ˘•„˜þ•Æ
˘`´ ˘'^„ ˘`„˜þOJ´`PJ``QJ´`o(`´`·ð´```•`••``•„°"•„˜þ•Æ˘`´°"'^„°
"`„˜þOJ´`PJ``QJ´`o(`´`"ð´```•`
•``•„p°•„˜þ•Æ˘`´p°'^„p°`„˜þOJ"`QJ"`o(`´`Øð´```•`
•``•„Ø •„˜þ•Æ˘`´Ø '^„Ø `„˜þOJ"`QJ"`o(`´`§ð´```•`••``•„@
•„˜þ•Æ˘`´@
'^„@
`„˜þOJ´`PJ``QJ´`o(`´`·ð´```•`••``•„"

•„˜þ•Æˇˋˊ¨

'^ "

`„˜þOJ´`PJ``QJ´`o(`´`"ð´```•`
•``•„h´•„˜þ•Æ˘`´h´'^„h´`„˜þOJ´`QJ´`o(`´`vð´```•`
•``•„Ð^•„˜þ•Æ˘`´Ð^'^„Ð^`„˜þOJ´`QJ´`o(`´`Øð´```•`
•``•„8¯•„˜þ•Æ˘`´8¯'^„8¯`„˜þOJ´`QJ´`o(`´`§ð´```•`
•``•„ ˘•„˜þ•Æ˘`´ ˘'^„ ˘`„˜þOJ´`QJ´`o(`´`·ð´```•`
•``•„°¨•„˜þ•Æ˘`´°¨'^„°¨`„˜þOJ´`QJ´`o(`´`¨ð´```•`
•``•„p°•„˜þ•Æ˘`´p°'^„p°`„˜þOJ´`QJ´`o(`´`Øð´```•`
•``•„Ø •„˜þ•Æ˘`´Ø  '^„Ø  `„˜þOJ´`QJ´`o(`´`§ð´```•`
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`„˜þOJ´`QJ´`o(`´`·ð´```•`
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`„˜þOJ´`QJ´`o(`´`¨ð´``````´```````````````````•``•„h´•„˜þ•Æ˘`´h´˙ˆ„h´`„˜þˆ```.`´``
```´˜```````````````````•``•„•˜•„Pþ•Æ˘`´•˜˙ˆ„•˜`„Pþ¯```.`´`.`´`````´˜˘```````````````
````•``•„È¯•„˚þ•Æ˘`´ ˘˙ˆ„È¯`„˚þ˙```.`´`.`ˆ`.`´``````´˜˘¨``````````````•``•„À˙•„x
ý•Æ˘`´p˚˙ˆ„À˙`„xý˚```.`´`.`ˆ`.`˜`.`´``````´˜˘¨ ```````````````•``•„¸˚•„èü•Æ˘`´Ø
˙ˆ„¸˚`„èü˝```.`´`.`ˆ`.`˜`.`¯`.`´``````´˜˘¨
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'^„°″`„Xü

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•„Èû•Æ˘``´x•'^„¨

`„Èû

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•„8û•Æ˘`´à•˙^„

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••``````````•``•„à••„`ú•Æ˘`´°•˙^„à•`„`ú•```.`´`.`^`.`~`.`¯`.`˘`.`˙`.`"`.`°`.`´``
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•``•„h´•„˜þ•Æ˘`´h´˙^„h´`„˜þOJ´`QJ´`o(`´`vð´```•``````````````````
•``•„Ð^•„˜þ•Æ˘`´Ð^˙^„Ð^`„˜þOJ´`QJ´`o(`´`Øð´```•``````````````````
•``•„8¯•„˜þ•Æ˘`´8¯˙^„8¯`„˜þOJ´`QJ´`o(`´`§ð´```•``````````````````
•``•„ ˘•„˜þ•Æ˘`´ ˘˙^„ ˘`„˜þOJ´`QJ´`o(`´`·ð´```•``````````````````
•``•„°"•„˜þ•Æ˘`´°"˙^„°"`„˜þOJ´`QJ´`o(`´`"ð´```•``````````````````
•``•„p˚•„˜þ•Æ˘`´p˚˙^„p˚`„˜þOJ´`QJ´`o(`´`Øð´```•``````````````````
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````•``•„È¯•„˚þ•Æ˘`´ ˘˙ˆ„È¯`„˚þ˙```.`´`.`ˆ`.`´``````´˜˘¨``````````````•``•„À˙•„x
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•„8û•Æ˘`´à•˙^„

`„8û•```.`˘`.`^`.`~`.`¯`.`˘`.`'`.`"`.`´``````´~˘"

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•``•„h´•„˜þ•Æ˘`´h´'^„h´`„˜þOJ´`QJ´`o(`´`vð´```•`````````````````
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•``•„p˚•„˜þ•Æ˘`´p˚'^„p˚`„˜þOJ´`QJ´`o(`´`Øð´```•`````````````````
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`„˜þOJ´`QJ´`o(`´`·ð´```•`````````````````
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`„~þOJ´`QJ´`o(`´`"ð´```•`````````````````
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•``•„p°•„~þ•Æ˘`´p°'^„p°`„~þOJ´`QJ´`o(`´`Øð´```•`````````````````
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`„˜þOJ´`QJ´`o(`´`"ð´```•`````````````````
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•```•„˚"•„˜þ•Æ˘`´˚"˙^„˚"`„˜þOJ´`QJ´`o(`´`§ð´```•`````````````````
•```•„p˚•„˜þ•Æ˘`´p˚˙^„p˚`„˜þOJ´`QJ´`o(`´`·ð´```•`````````````````
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`„˜þOJ´`QJ´`o(`´`§ð´```●```````````````````
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•ˋˋ•„˚¨•„˜þ•Æ˘ˋˊ˚¨˙ˆ„˚¨ˋ„˜þOJˊˋQJˊˋo(ˋˊˋ¨ðˊˋˋˋ•ˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋ
•ˋˋ•„p˚•„˜þ•Æ˘ˋˊp˚˙ˆ„p˚ˋ„˜þOJˊˋQJˊˋo(ˋˊˋØðˊˋˋˋ•ˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋ
•ˋˋ•„Ø •„˜þ•Æ˘ˋˊØ ˙ˆ„Ø ˋ„˜þOJˊˋQJˊˋo(ˋˊˋ§ðˊˋˋˋ•ˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋˋ
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`„~þOJ´`QJ´`o(`´`"ð´```•`````````````````
•``•„h´•„~þ•Æ˘`´h´'^„h´`„~þOJ´`QJ´`o(`´`vð´```•`````````````````
•``•„Ð^•„~þ•Æ˘`´Ð^'^„Ð^`„~þOJ´`QJ´`o(`´`Øð´```•`````````````````
•``•„8¯•„~þ•Æ˘`´8¯'^„8¯`„~þOJ´`QJ´`o(`´`§ð´```•`````````````````
•``•„ ˘•„~þ•Æ˘`´ ˘'^„ ˘`„~þOJ´`QJ´`o(`´`·ð´```•`````````````````
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•```•„˚"•„˜þ•Æ˘`´˚"˙^„˚"`„˜þOJ´`QJ´`o(`´`§ð´```•`````````````````
•```•„p˚•„˜þ•Æ˘`´p˚˙^„p˚`„˜þOJ´`QJ´`o(`´`·ð´```•`````````````````
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`„˜þOJ´`QJ´`o(`´`§ð´```•```````````````````
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`„˜þOJ´`QJ´`o(`´`·ð´```•````````````````````
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h´`„˜þˆ```.`´````@´˜```````````x```°´```•``•„•˜•„Pþˆ„•˜`„Pþ¯```.`´`.`´````@´˜˘``````
``x```ø´```•``•„•˘•„˚þˆ„•˘`„˚þ˙```.`´`.`ˆ`.`´````@´˜˘¨```````x```ˆˆ````•``•„˜¨•„xý
ˆ„˜¨`„xý˚```.`´`.`ˆ`.`˜`.`´````@´˜˘¨
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```x```8-```•``•„ ••„Èû^„ •`„Èû

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•``x```È-```•``•„X••„8û^„X•`„8û•```.`´`.`^`.`~`.`-`.`˘`.`¦`.`"`.`´`´`´`@´~˘"

••`x``` ˘```•``•„ø••„`ú^„ø•`„`ú•```.`´`.`^`.`~`.`-`.`˘`.`¦`.`"`.`°`.`´`´`´`•´`´`´`
`´`´`h´`´`´`´`•``•„Ð^•„~þ•Æ˘`´Ð^¦^„Ð^`„~þ^```.`´`´`´- ´`´`´`´`´`h´`´`´`´`´`•``•„ ˘•
„~þ•Æ˘`´ ˘¦^„ ˘`„~þ^`´`.`´`´`´^,´`´`´`´`´`´`h´`´`´`´`´`•``•„p°•„Lÿ•Æ˘`´p°¦^„p°`„Lÿ^`^
`.`´`´`´` ´`´`´`´`´`´`h´`´`´`´`´`•``•„@
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`„˜þ^^–`.`´`´`´`´`,´^^^^^^^^^^h´^^^^^^^^•^^•„à••„Lÿ•Æ˘^´à•'^„à•`„Lÿ^˘˘`.`´`´`´`´`´ ´^^^^^^
^^^^h´^^^^^^^^•^^•„°••„˜þ•Æ˘^´°•'^„°•`„˜þ^''`.`´`´`´`– ´^^^^^^^^^h´^^^^^^^^•^^•„•••„
˜þ•Æ˘^´••'^„••`„˜þ^"`.`´`´`´`´`,´^^^^^^^^^h´^^^^^^^^•^^•„P••„Lÿ•Æ˘^´P•'^„P•`„Lÿ^°^^
.`´`´`´`´`´•´^^^^^^^^^h´^^^^^^^^•^^•„Ð^•„˜þ•Æ˘^´Ð^'^„Ð^^„˜þ^^^^.`´`´`´`– ´^^^^^^^^^h´^^^
^^^^^•^^•„ ˘•„˜þ•Æ˘^´ ˘'^„ ˘^„˜þ^^´.`´`´`´`´`,´^^^^^^^^^h´^^^^^^^^•^^•„p°•„Lÿ•Æ˘^´p
°'^„p°^„Lÿ^^^^.`´`´`´`´`´ ´^^^^^^^^^h´^^^^^^^^•^^•„@
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`„˜þ^ˆ¯`.`˘ˆˆˆ^'˘ˆˆˆˆˆˆˆˆˆˆh˘ˆˆˆˆˆˆˆ•ˆˆ•„à••„Lÿ•Æ˘ˆ˘à•˙^„à•`„Lÿ^ˆ˘ˆ.`˘ˆˆˆˆ ˘ˆˆˆˆˆ
ˆˆˆˆh˘ˆˆˆˆˆˆˆ•ˆˆ•„°••„˜þ•Æ˘ˆ˘°•˙^„°•`„˜þ^ˆ'ˆ.`˘ˆˆˆ¯ ˘ˆˆˆˆˆˆˆˆˆh˘ˆˆˆˆˆˆˆ•ˆˆ•„•••„
˜þ•Æ˘ˆ˘••˙^„••`„˜þ^ˆ"ˆ.`˘ˆˆˆˆ^'˘ˆˆˆˆˆˆˆˆˆˆh˘ˆˆˆˆˆˆˆ•ˆˆ•„P••„Lÿ•Æ˘ˆ˘P•˙^„P•`„Lÿ^ˆ˚ˆ
.`&ˆˆˆ¯ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ"•×Sˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ^ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ•ˆˆˆˆˆˆˆˆ
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ˆˆˆˆˆˆˆˆˆˆˆˆˆˆ˘ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ"ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ˜ˆˆˆˆˆˆˆˆˆˆˆˆˆˆˆ˘:b˚ˆˆˆˆˆˆˆ
ˆˆˆˆˆ m3•ˆˆˆˆˆˆˆˆˆˆˆˆ¯uÄlˆˆˆˆˆˆˆˆˆˆˆˆ•Yu|ˆˆˆˆˆˆˆˆˆˆˆˆöVAˆˆˆˆˆˆˆˆˆˆˆˆI^-
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‰^`•‰^`ï‰^`mŽ^`wŽ^` ²^`²²^`®Þ^`¯Þ^`0ß^`Lß^`"ß^`Èß^`ãß^`´à^`"à^`•à^`?à^`Gà^
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ª˜˜˜˜A`•É˘@``A`<ª˜˜˜˜A`ìÉ˘@``A`¤ª˜˜˜˜A`àª˜˜˜˜A`òª˜˜˜˜A`rÊ˘@``A`

«˜```A`ÀÊ˘@``@`2Ë˘@``@`pÍ˘@``@`ˆÔ˘@``@``Ô˘@``A`-«˜```@`zÔ˘@``@`,Ô˘@``@`„Ô˘@``@`†Ô˘@`` ```G˙ ˆ``T`i`m`e`s` `N`e`w` `R`o`m`a`n```5˙ ˆ``•`S`y`m`b`o`l```3˙ ˆ``A`r`i`a`l```3˙ ˆ``T`i`m`e`s```A˙ ˆ``T`r`e`b`u`c`h`e`t` `M`S```;˙ ˆ``H`e`l`v`e`t`i`c`a```Q• ˆM•``T`i`m`e`s`N`e`w`R`o`m`a`n````T`i`m`e`s```;˙ ˆ``•``•```W`i`n`g`d`i`n`g`s```?˙ ˆ``C`o`u`r`i`e`r` `N`e`w```"`¯`q˚Œ•``Ð```h´````²+rf- <r¦E;r¦/`e˙``³L``2µ´`>`ß```¯`˜•¤˜``>`é˜``¥˙À¨´`•`>0``•`•`d```•`` `è•ˆ``Ô˜ˆ`&``ˆˆÿÿ•``
`A`l`a`i`n` `B`o`u`r`d`e`a`u` `d`e` `F`o`n`t`e`n`a`y` `B`r`i`a`n` `S`a`v`i`n``egulatory intervention would therefore appear to be necessary to help create intermediate markets that can ameliorate current high entry barriers to investment.

The historical monopoly structure of local telecommunications companies was derived through government acquiescence and not as a consequence of competitive market forces. Therefore, there is no evidence upon which to conclude that the vertical structure of the firm results in lower transaction costs than do markets. In

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````````¥˙À"ˆ`ˆ`•`&gt;0``•`•`d```•```è•^````````````````````````````````````````
`Ô˜ˆ`&`ˆ```````````````````ˆˆÿÿ•````````ˆ ````````•`A`l`a`i`n` `B`o`u`r`d`e`a`u`
`d`e` `F`o`n`t`e`n`a`y`
`B`r`i`a`n`
`S`a`v`i`n````````````````````,•^``2•^``H•^``I•^``¢•^``¾•^``ß•^``à•^``š)^``á)^``é)^``
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*^`/*^`1*^`B*^`•4^` 4^`•5^`•5^`45^`:5^`;5^`m5^`Š5^`

6^`•6^`r7^`s7^`u7^`©8^`±8^`²8^`°8^`»8^`Â8^`

P^`9P^`&U^`'U^`*U^`fU^`mU^`se^` e^`ìe^``f^`ki^`oi^`pi^`si^`ti^`û^``´‰^`˜‰^`¯‰^`˝
‰^`•‰^`ð‰^`nŽ^`xŽ^`'²^`³²^`ñä^`òä^`þä^``å^`¯å^`˘å^`˙å^`¨å^`@``˚`@``A`¦–
´`þÿ^``ÿÿÿÿ˙ ^`````À``````F•```Microsoft Word
Document`þÿÿÿNB6W•```Word.Document.8`````HGGHHHIHHHHGFFDCACEGHHGFFFEFFFGFDEEFHIJ
Nþÿ``˜˝´````````````````````^````ÕÍÕœ.••‟–˚`+,ù®D```˘ÕÍÕœ.••‟–˚`+,ù®0´``ì```

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`0`0`3`0`6`5`6`7`4`9`1`2`}`````A``` ″``r````~````^`•`~```6````~`````````~````˘````-
```1```h`t`t`p`:`/`/`w`w`w`.`x`c`h`a`n`g`e`m`a`g`.`c`o`m`/`w`e`b`e`x`t`r`a`/`2`4
`1`w`e`b`x`1`.`h`t`m`l```````````ˊ``````x~```Z`•`~```3````~`````````~````˘````-
```*```h`t`t`p`:`/`/`r`i`d`e`r`.`w`h`a`r`t`o`n`.`u`p`e`n`n`.`e`d`u`/`~`f`a`u`l`h
`a`b`e`)``````ˊ``````x~```Z`•`~```0````~`````````~````˘````-
```*```h`t`t`p`:`/`/`r`i`d`e`r`.`w`h`a`r`t`o`n`.`u`p`e`n`n`.`e`d`u`/`~`f`a`u`l`h
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```C```h`t`t`p`:`/`/`o`n`l`i`n`e`.`w`s`j`.`c`o`m`/`a`r`t`i`c`l`e`/`0`,`,`S`B`1`0
`2`6`6`9`6`5`8`0`4`5`7`7`1`6`4`8`0`.`d`j`m`,`0`0`.`h`t`m`l`````-
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```M```h`t`t`p`:`/`/`w`w`w`.`s`p`r`i`.`c`o`m`/`p`d`f`/`r`e`p`o`r`t`s`/`p`e`r`s`p
`e`c`t`i`v`e`s`/`p`e`r`s`p`e`c`t`i`v`e`s`f`r`a`g`m`e`n`t`2`-`2`6`-
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```h`t`t`p`:`/`/`w`w`w`.`p`h`o`e`n`i`x`-`c`e`n`t`e`r`.`o`r`g`/`````-
```ˊ``````x~```D`G`~```$````~`````````~````˘````-
```•```h`t`t`p`:`/`/`w`w`w`.`s`p`r`i`.`c`o`m`/`````-
```ˊ``````x~```D`G`~```!````~`````````~````˘````-
```•```h`t`t`p`:`/`/`w`w`w`.`s`p`r`i`.`c`o`m`/`````-
```ˊ``````x~```|`u`~```-````~`````````~````˘````-
```+```h`t`t`p`:`/`/`w`w`w`.`r`a`n`g`.`o`r`g`/`p`u`b`l`i`c`a`t`i`o`n`s`/`M`R`/`M
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`-`~`~`~`•`~`~`~`~`~`~`~`~`~`~`~`~`~`~`-
`~`9`~`h`t`t`p`:`/`/`w`w`w`.`n`e`t`w`o`r`k`m`a`g`a`z`i`n`e`.`c`o`m`/`a`r`t`i`c`l
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`„˜þOJ´`QJ´`o(`´`·ð´```•``````````````````
•``•„x••„˜þ•Æ˘`´x•˙^„x•`„˜þOJ´`QJ´`o(`´`¨ð´````@´`````````x```h´```•``•„h´•„˜þ^„
h´`„˜þ^```.`´````@´˜````````x```°´```•``•„•˜•„Pþ^„•˜`„Pþ¯```.`´`.`´````@´˜˘`````
``x```ø´```•``•„•˘•„˚þ^„•˘`„˚þ˙```.`´`.`^`.`´````@´˜˘¨`````x```^```•``•„˜¨•„xý
^„˜¨`„xý°```.`´`.`^`.`˜`.`´````@´˜˘¨
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•``x```È-```•``•„X••„8û^„X•`„8û•```.`´`.`^`.`~`.`-`.`˘`.`¦`.`"`.`´`´`´`@´~˘"

••`x```  ˘```•``•„ø••„`ú^„ø•`„`ú•```.`´`.`^`.`~`.`-`.`˘`.`¦`.`"`.`°`.`´`´`´`•´`´`´`
`´`´`h´`´`´`´`•``•„Ð^•„~þ•Æ˘`´Ð^¦^„Ð^`„~þ^```.`´`´`´- ´`´`´`´`´`h´`´`´`´`´`•``•„ ˘•
„~þ•Æ˘`´ ˘¦^„ ˘`„~þ^`´`.`´`´`´^,´`´`´`´`´`´`h´`´`´`´`´`•``•„p°•„Lÿ•Æ˘`´p°¦^„p°`„Lÿ^`^
`.`´`´`´` ´`´`´`´`´`´`h´`´`´`´`´`•``•„@
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•„˜þ•Æˇˋˊ•

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`„˜þ^^–`.`´`´`´`´`,´^^^^^^^^^^h´^^^^^^^^•^^•„à••„Lÿ•Æ˘^´à•'^„à•`„Lÿ^˘˘`.`´`´`´`´`´ ´^^^^^^
^^^^h´^^^^^^^^•^^•„°••„˜þ•Æ˘^´°•'^„°•`„˜þ^''`.`´`´`´`– ´^^^^^^^^^h´^^^^^^^^•^^•„•••„
˜þ•Æ˘^´••'^„••`„˜þ^"`.`´`´`´`´`,´^^^^^^^^^h´^^^^^^^^•^^•„P••„Lÿ•Æ˘^´P•'^„P•`„Lÿ^°^^
.`´`´`´`´`´•´^^^^^^^^^h´^^^^^^^^•^^•„Ð^•„˜þ•Æ˘^´Ð^'^„Ð^^„˜þ^^^^.`´`´`´`– ´^^^^^^^^^h´^^^
^^^^^•^^•„ ˘•„˜þ•Æ˘^´ ˘'^„ ˘^„˜þ^^´.`´`´`´`´`,´^^^^^^^^^h´^^^^^^^^•^^•„p°•„Lÿ•Æ˘^´p
°'^„p°^„Lÿ^^^^.`´`´`´`´`´ ´^^^^^^^^^h´^^^^^^^^•^^•„@
•„˜þ•Æ˘^´@
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`„˜þ^^˜^.`´`´`´`– ´^^^^^^^^^h´^^^^^^^^•^^•„•

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`„˜þ^ˆ¯`.`ˆ````^'ˆ`````````h´```````•``•„à••„Lÿ•Æ˘`´à•˙^„à•`„Lÿ^`˘`.`ˆ```` ˆ`````
````h´```````•``•„°••„˜þ•Æ˘`´°•˙^„°•`„˜þ^`'`.`ˆ```¯ ˆ````````h´```````•``•„•••„
˜þ•Æ˘`´••˙^„••`„˜þ^`"`.`ˆ```^'ˆ`````````h´```````•``•„P••„Lÿ•Æ˘`´P•˙^„P•`„Lÿ^``˚`
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°7````````````•HiV```````````ìgYd```````````èT0C`````````````'````````````````ˆ
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1```````````Ë\Û&```````````6•P"```````````VKS=```````````` <•+`````````
```ˆ```````````````^``````````````````~``````````````ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
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ˆ`ˆ`jÌ``````jÌ```````^´O`¥˜A^´°`C$`EÆ•``````````````````````````````````````
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``````````bÊ'`ÿÿ``^D˘``````q0``{0``±l``Ål``þ"
``••``

ä``•ä``Ô~^^`Õ~^^`Ô•^^´•^^`°•^^`••^^`'•^^`+•^^`1•^^`G•^^`H•^^`¡•^^`½•^^`Þ•^^`ß•^^`™)^^`à)^^`è)^^`°
*^^`
^^`.*^^`0^^`A*^^` 4^^`Ÿ4^^`•5^^`•5^^`35^^`95^^`:5^^`l5^^`‰5^^`
6^^`

6^`q7^`r7^`t7^`"8^`°8^`±8^`¹8^`°8^`Á8^`
P^`8P^`%U^`&U^`)U^`eU^`lU^`re^`Œe^`ëe^`ÿe^`ji^`ni^`oi^`ri^`si^`il^`{l^`|l^`}l^`›
l^`¦l^`-l^`®l^`Çl^`Ñl^`Òl^`$m^`•‰^`›‰^` ‰^`Ž‰^`¤‰^`³‰^`ŠŠ^`° ^`• ^`+³^`M³^`Iß^`J
ß^`Ëß^`çß^`/à^`cà^`~à^`œà^`¥à^`³à^`Úà^`âà^`•á^`•á^`”ä^`•ä^`¡ä^`£ä^`§ä^`"ä^`©ä^`ª
ä^`@`°`@`A`¦-
~`@`âh`@`A` ~`@`Žá`@`A`¢~`@`82´@`A`¤~`@`&Ð´@`A`ª~`@`´•¯@`A`"
~`A`ò+¯@`A`Z"~`A`•,¯@`A`,"~`A`Š"~`A`-"~`A`Â"~`A` ,¯@`A`Ä"~`A`B-
¯@`@`†Ô˘@`@`†-
¯@`A`èÎ¯@´`A`œ~`A`•œ~`A`Pœ~`@`¶Ï¯@´`@`•[¯@`A`š~`@`:[¯@`A`Zœ~`@`öo
¯@`A`šœ~`A`¦œ~`A`Øœ~`A`äœ~`A`.q¯@`A`æœ~`A`Òq¯@`A`
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x¯@``A`8 ~```A`

x¯@``A`H ~```@`•x¯@``A``ž~```@`è¦¯@``A`(~```@`•³¯@``A`&½¯@´`A`* ~```@`P³¯@``A`8
¢~```A`œÓ¯@``A`l¢~```@`šÕ¯@``A``~~~```A`°~~~```A`″~~~```A`•~~~```@`bÝ¯@``A``¬~```A`$
¬~```A`&¬~```A`(¬~```A`d¬~```A`z¬~```A`^¬~```A`Š¬~```A`¼¬~```A`Ð¬~```A`Ò¬~```@`Ž
ã¯@``A``¦~```@`p•˘@``A`

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¦˜˜˜˜A`•¦˜˜˜˜@`¬•˘@``@``-˘@``A`\'˘@¬ @`p'˘@``A`ü¨˜˜˜˜@`âo˘@``A``ª˜˜˜˜A`ÚÇ˘@``A`¯
ª˜˜˜˜A`•É˘@``A`<ª˜˜˜˜A`ìÉ˘@``A`¤ª˜˜˜˜A`àª˜˜˜˜A`òª˜˜˜˜A`rÊ˘@``A`

«˜```A`ÀÊ˘@``@`2Ë˘@``@`pÍ˘@````´``````x˜```Z`•`˜```•````˜`````````˜````˘```-
```*```h`t`t`p`:`/`/`r`i`d`e`r`.`w`h`a`r`t`o`n`.`u`p`e`n`n`.`e`d`u`/`~`f`a`u`l`h
`a`b`e`)``````´``````x˜```9`r`˜```•```˜``````````˜````˘``````-
```h`t`t`p`:`/`/`w`w`w`.`p`h`o`e`n`i`x`-`c`e`n`t`e`r`.`o`r`g`/`````-
```´``````x˜```p`~`˜```•```˜``````````˜````˘```-
```C```h`t`t`p`:`/`/`o`n`l`i`n`e`.`w`s`j`.`c`o`m`/`a`r`t`i`c`l`e`/`0`,`,`S`B`1`0
`2`6`6`9`6`5`8`0`4`5`7`7`1`6`4`8`0`.`d`j`m`,`0`0`.`h`t`m`l`````-
```´``````x˜```D`G`˜```•```˜``````````˜````˘```-
```•```h`t`t`p`:`/`/`w`w`w`.`s`p`r`i`.`c`o`m`/````````´``````x˜```Z`•`˜```

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```*```h`t`t`p`:`/`/`r`i`d`e`r`.`w`h`a`r`t`o`n`.`u`p`e`n`n`.`e`d`u`/`~`f`a`u`l`h
`a`b`e`)``````´``````x~```Z`•`~```` ```~```~```~```~```~```-
```*```h`t`t`p`:`/`/`r`i`d`e`r`.`w`h`a`r`t`o`n`.`u`p`e`n`n`.`e`d`u`/`~`f`a`u`l`h
`a`b`e`)``````´``````x~```D`G`~```'```~```~```~```~```-
```•```h`t`t`p`:`/`/`w`w`w`.`s`p`r`i`.`c`o`m`/````-
```´``````x~```L`"`~```~```~```~```~```~```-
```M```h`t`t`p`:`/`/`w`w`w`.`s`p`r`i`.`c`o`m`/`p`d`f`/`r`e`p`o`r`t`s`/`p`e`r`s`p
`e`c`t`i`v`e`s`/`p`e`r`s`p`e`c`t`i`v`e`s`f`r`a`g`m`e`n`t`2`-`2`6`-
`0`2`.`p`d`f```´```x~```^•`~```~```~```~```~```-
```1```h`t`t`p`:`/`/`w`w`w`.`x`c`h`a`n`g`e`m`a`g`.`c`o`m`/`w`e`b`e`x`t`r`a`/`2`4
`1`w`e`b`x`1`.`h`t`m`l```-
```´``````x```þÿ```~″´```´```à…ŸòùOh•«'°`+'³Ù0```|´```•```´```` ```
`^```~```~```¤```¯```°```˘```Ô```"```à```°```ð``` ```¯´```•```•´```″```,´```
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Bourdeau de Fonten@`ˆÔ˘@``@``Ô˘@``A`v-˜```@`zÔ˘@``@`,Ô˘@``@`„Ô˘@``@`†Ô˘@``
```G˙ ˘``ˆ˙˜˜−˘ˆ˜−``````````````````˘```````T`i`m`e`s` `N`e`w`
`R`o`m`a`n```5˙ ˘ˆ``ˆ˘``````````•``````````````•````S`y`m`b`o`l```3˙ ˘``ˆ
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`M`S```;˙ ˘``ˆ˘``````````````˜`````````˘```````H`e`l`v`e`t`i`c`a```Q• ´M•```````
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ˆˆ˘ˆ−−``˜```````````````˘```````C`o`u`r`i`e`r`
`N`e`w```"`¯`1˚Œ•``Ð```h˘````²+rf#<r¦E;r¦0`i˙``³L``2µ˘`>`ß```¯`˜•¤˜```````````>`˘
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`Ô˜ˆ`&`˘````````````````ˆ```ˆˆÿÿ•````````˘ ```````•`A`l`a`i`n` `B`o`u`r`d`e`a`u`
`d`e` `F`o`n`t`e`n`a`y`
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Why Inefficient Incumbents Can Prevail in the Marketplace Over More Efficient Entrants:

An Analysis of Economies of Scale and Scope, Transaction Costs and the Misuse of Data

February 2003

Alain Bourdeau de Fontenay
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Abstract

Scale and scope economies arise as a consequence of special technological conditions in the production process of goods or services that are outside the control of any firm. If they exist, competition may be inefficient. Our analysis establishes that there is no significant evidence of scale and scope economies of the kind that would support limiting unbundling or regulated wholesale pricing. Incumbents' vertical integration and cost structure appear to generate inefficiencies yet simultaneously protect
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Scale and scope economies arise as a consequence of special technological conditions in the production process of goods or services that are outside the control of any firm. If they exist, competition may be inefficient. Our analysis establishes that there is no significant evidence of scale and scope economies of the kind that would support limiting unbundling or regulated wholesale pricing. Incumbents' vertical integration and cost structure appear to generate inefficiencies yet simultaneously protect them from efficient entry. Regulatory intervention would therefore appear to be necessary to help create intermediate markets that can ameliorate current high entry barriers to investment.

The historical monopoly structure of local telecommunications companies was derived through government acquiescence and not as a consequence of competitive market forces. Therefore, there is no evidence upon which to conclude that the vertical structure of the firm results in lower transaction costs than do markets. In fact, our brief experiences with competition to date, especially the time since enactment of the Telecommunications Act of 1996, enables us to identify inefficiencies in the production and organization processes of incumbent firms.

At the same time, the integration of production component processes into the incumbent firm denies new entrants the ability to procure required production components at market prices thereby handicapping their cost structures, increasing business risk and inflating their cost of capital. As a result, entrants can utilize more efficient technology and organizations than do incumbents, and more innovative, yet still be unable to compete.

In these circumstances, government intervention is required to establish conditions that allow the transition from monopoly to competition. The objectives of government action must be to open to entrants intermediate markets foreclosed by ILEC vertical integration, such as by providing access to incumbent production resources (e.g., UNEs, UNE-P and broadband equivalents) at prices closest to market. Failure to act can be expected to result in abuse of market power by incumbents, inadequate investment in broadband access and advanced services, and a sector operating inefficiently for the foreseeable future.

Benchmarks are available for determining when intermediate good prices are too high or too low. Regulated wholesale prices remain too high until substantial entry occurs to exploit the inefficiencies inherent in the incumbents' cost structuregÌ^`•Î^`CÎ^`.Ð^`·Ð^`ÒÐ^`ßÐ^`=Ó^`ŽÓ^`ÄÔ^`üÔ^`@Ö^`,×^`BØ^`~Ù^`•Ú^`OÚ^`úÞ^`ûÞ^`cß^`Žà^`%á^`-
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`e`q`u`i`v`a`l`e`n`t`s` `i`n` `n`e`w` `o`r` `e`x`i`s`t`i`n`g` `s`e`r`v`i`c`e`s`
` `P`o`w`e`l`l`,` `M`i`c`h`a`e`l` `K`.` ` `G`o`l`d`m`a`n` `S`a`c`h`s`6`2`

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`u`n`s`u`b`s`t`a`n`t`i`a`t`e`d` `b`y` `I`L`E`C` `c`o`m`m`i`t`m`e`n`t`s`o`
`a`v`a`i`l`a`b`l`e` `W`a`l`l` `S`t`r`e`e`t` `r`e`c`o`m`m`e`n`d`a`t`i`o`n`s`.` `
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