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Local and Global Competition in Information Technology[1]

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We examine the implications of changing competitive dynamics in global information and communications technology (ICT) markets for government demand-steering policies whose goal is local rents. Both computing and telephony are undergoing changes in global industry structure and changes in the nature of competition. The convergence of computing and telephony and the rapid technological change (and accompanying technological uncertainty) driving this convergence reinforce trends toward vertical competition. The emergence of global ICT markets lowers entry barriers, likely encouraging government-supported local entrants into global ICT markets. There are, however, strongly offsetting disadvantages. The underlying economics of ICT markets under vertical competition will work to reinforce the dominant position of U.S.-based incumbents in many segments. The prospects for exports, command of rent-related standards, and large rents from exports are not very bright. We expect to see far more demand-steering attempts than successes. *J. Japan. Int. Econ.*, December 1999 **13**(4), pp. 336–371. Landau Economics Building, Department of Economics-6072, Stanford, California 94305-6072; and International Computer Services Research, Stanford Computer Industry Project, Landau Economics Building, SIEPR 144, Stanford, California 94305-6016. © 1999 Academic Press

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1. INTRODUCTION

The convergence of computing and telecommunications has generated substantial popular, policy, and scholarly attention. Propelled by ever-cheaper processing and bandwidth, the potential for inter-network competition in global telecommunications markets, and the explosion of the Internet, convergence is widely heralded as a new, worldwide market opportunity. This emergent interactive "information superhighway" has spawned entry by a number of new firms and mobility by existing firms. Both hope to position themselves to take advantage of what are sure to be some of the largest business opportunities of the next decade.

In an international context, there are two consequences of convergence. First, convergence lowers telecommunications entry barriers. There will be a raft of new applications, most of which have no doubt not yet been developed. They will be provided by new firms with new business models. Meanwhile, rapid technological change, technological uncertainty, and the emergence of new applications will lessen the ability of incumbents to control technological growth and marketplace standards. We expect governments outside the United States and local firm(s) to pursue joint strategies of entry into global informations and communications technology (ICT) or market preservation in local ICT. Such private/public partnership (PPP) will draw on the firm(s)'s technological capabilities, on connections to local complementors or customers, and on linkages to international complementors or customers. Connections to local complementors or buyers may be reinforced by governmental demand-steering efforts. We examine the private returns to such a linked strategy, that is, the prospects that the local firm(s) will earn rents either locally or in the world market. We do not examine the broader wisdom of this strategy, which depends on demanders' returns as well as the rents that might accrue to sellers.

The problems for such a PPP entry strategy arise out of the same changes that permit the entry. The second consequence of convergence is lower costs of cross-border delivery of services and thus greater competition between global and local providers. To date, global-local competition has been limited by regulatory barriers or requirement of local presence for delivery of services.[2] Now, however, any cost-effective local entry initiative will make use of globally supplied products and services: It will use Microsoft, Cisco, and Intel products, among others. Whatever subset of ICT a local PPP pursues, from local phone lines to son-of-Minitel to regulated electronic commerce, foreign products and technologies will play a complementary role. No purely local solutions to computing or telephony applications are even imaginable give current ICT. Thus, like any other entrant into ICT, our PPP is compelled to cooperate with technologically powerful and

[2] This is particular true given the legacy of government intervention in both computing and telecommunications. In computing hardware and packaged software are already globally competitive. Although comprehensive data is prohibitively costly to obtain, anecdotal evidence suggests that the majority of *computer services and custom software* are provided by local, as opposed to foreign, suppliers.

strategically active complementors—foreign ones. The PPP will be a participant in *vertically competitive global ICT markets*. Rents to the PPP will be determined, in considerable part, by its ability to cooperate and compete effectively with foreign complementors. In today's vertically competitive ICT, it is not simply negotiations and bargaining between the PPP and its foreign complementors which matter for rents.[3] Rents will stay local only to the extent the PPP entrant builds and maintains a market position that is not vulnerable to the vertically competitive inroads of the global incumbents.

These two consequences of convergence raise new challenges and opportunities for governments and public policy. Lower barriers to entry seem to increase the efficacy of local public policy initiatives to build local rents. At the same time, the need to cooperate with global firms and the potential for global providers to directly compete with local firms suggest limits to policy efforts. Public policy efforts to protect local rents or to use protected local markets as platforms for creating global competitors appear both attractive and unpromising. How can we make sense of these opposite trends in ICT markets from the perspective of rent-steering public policy?

Our approach begins with the broader question of understanding competition in ICT generally. We suggest that the structure of competition in converged markets will undermine the efficacy of traditional government policies to favor national suppliers in home markets and thereby create global competitors. In short, we argue that the history of vertical competition in computing and current dynamics in telecommunications markets suggest there are parallels in the competitive dynamics of computing, of telecommunications, and in converged ICT markets of the present and near future. We see these *parallels in competitive dynamics* in markets an important yet underexplored facet of convergence. Drawing on a body of vertical competition analysis that has been most completely developed for computing, we examine its implications for ICT markets more broadly.

In Sections 2 and 3 we emphasize three fundamentals about competition in these markets: Opportunities for specialized entry, extensive and quick commodification of many layers of the vertically disintegrated industry, and co-opetition between vertical layers. Much as in computing markets since the late 1980s, this structure of competition is likely to advantage global providers that enjoy large economies of scale or define network standards in way that enable them to shape subsequent technological and marketplace trajectories. Our view about the likely structure of marketplace competition in converged markets thus cuts against the efficacy of government policies to protect domestic suppliers as a strategy to capture rents in ICT markets. Our argument is most pessimistic about public policy efforts to use protected local markets as a platform for capturing global rents, but we are also skeptical of the ability of governments to use public policy to steer domestic rents

[3] This is a classic problem in the relationship between PPP and overseas complementors. It has received a great deal of attention in the literature on technology transfer. For a recent contribution and sources, see Markusen (1998).

to favored national champions.[4] Niche opportunities will present themselves in the new ICT markets, and local suppliers may indeed emerge as dominant global players capable of capturing significant rents in global ICT markets. Yet we are skeptical of such outcomes, and in particular of government-led efforts outside the United States.

In Sections 4 and 5, we analyze the efficacy of government policies to steer demand toward domestic producers in ICT markets. We break this simple subject down into four separate steps. *Can government influence domestic demand? Is "influencing demand" related to one of the critical competitive layers? Will rent-earning firms emerge domestically? Will they need to be globally competitive, and if so, can they achieve it?* The core of our analytical argument is that the changed structure of ICT markets brings all four of these distinct questions into play. Policies can fail to be effective at any of the four points, not because of some complex theory, but because real world considerations, now quite routine in converged ICT markets, get in the way. This more detailed policy analysis also permits us to forecast the areas of ICT where government intervention will *not* fail to achieve its goal.

Our first result is that technical and market forces have moved against intervention. The future success of governments in intervening in markets to capture rent—as opposed to low-rent commodity segments—is likely to be far less that what an extrapolation from the history of computing and telecommunications markets would suggest. Our other results can be thought of as qualifications to this general remark. In particular, we suggest there are areas and policies where we expect government initiatives to be comparatively successful.

2. VERTICAL COMPETITION

Vertical competition is the situation in which firms selling complementary products compete with one another.[5] Sometimes called co-opetition,[6] vertical competition is endemic to ICT. More precisely, firms with a strategic presence in ICT, or firms with opportunities to earn rents in ICT, are likely to be drawn into vertical competition with their complementors.[7] The ability of Microsoft to leverage its dominance in PC operating systems into applications software and internet software is currently the most well-publicized example of these dynamics.[8] The efforts of cellular phone and wireless infrastructure into operating systems for third

[4] We assume that governments will continue to seek ways to manage marketplace arrangements to advantage domestic firms in this area, but provide only an analysis of the likely loci of such efforts, not of the political forces that will lead to them.

[5] Bresnahan and Greenstein (1999).

[6] On co-opetition, see Brandenburger and Nalebuff (1996).

[7] See Bresnahan (1998), Cusumano and Yoffie (1998).

[8] From the perspective (as taken in this paper) of an entrant, it does not matter whether the leverage is competition on the merits or anticompetitive; the entrant loses rents in either case.

generation wireless handsets are also illustrative. Yet another example is whether or not SAP, PeopleSoft, or one of the other major ERP software suppliers can use their strategic position to undermine the importance of Andersen Consulting and other implementation partners.

The origins of vertical competition arise out of the structure and technology of ICT. Three dynamics are particularly important. First, ICT industries have become less vertically integrated in supply. The single-firm model of organizing the supply and deliver of a broad range of complementary technologies and services (e.g., IBM) bears little resemblance to today's disaggregated ICT markets. Nonetheless, dominant firms emerge in particular vertical layers. These dominant firms tend to be strategically active vis à vis firms in neighboring layers. Second, ICT industries are often organized by *de facto standards* that determine what is a platform for application (and other complement) development.[9] Usually, network effects mean that these standards are driven by the technological initiatives of the dominant firm in a nearby layer. The importance of interconnection with other technologies in the network reenforce more traditional competencies in R&D and commercialization. Importantly, the extensive rents that accrue to standard-setting firms mean that dominant firms in existing segments and layers will compete particularly vigorously to define standards in new, emergent segments and layers.[10] Third, the boundaries between complementary products in ICT are frequently blurry. When more than one firm among the suppliers to a particular demand has the opportunity to affect the process of standardization, the situation is one of divided technical leadership. When technical boundaries are blurry, the opportunity for moving the boundary (and thus the rents) by technical progress presents itself. The two precursors of vertical competition are thus: (1) Structural, the vertically disintegrated form, and (2) technological, the possibility of conflicts in standard setting.

Vertical competition is amenable to analytical understanding like other forms of competition. We are not thrown back on vapid chatter about how everything is new and different, faster and more competitive, in the new economy. In ICT, vertical competition takes on a variety of forms, including attempting to turn rivals' industry into a more competitive one, attempts to incorporate some or all of rivals' products as features of ones own, manipulating interface standards to rivals' disadvantage, and so on. The consequences of vertical competition vary as well. Rents can be shifted, even to such a degree that rents in one or the vertical layers disappear. Firms can be forced to innovate very rapidly, and in unfamiliar domains, to stay current with rivals and to fend off their attacks. For our purposes, there are two salient questions about vertical competition. When will vertical competition break out (and in how destructive a form)? What positions tend to be winners in vertical competition (and with what reliability can that be assessed ex ante)? While these

[9] This is related to the vertically disintegrated nature of supply: Products from different firms must be able to interconnect with each other. Hence the need for, and emergence of, industry standards.

[10] For a discussion of the economics driving this competitiveness, see Shapiro and Varian (1999). For a discussion of the Microsoft–Netscape battle over browsers, see Cusumano and Yoffie (1996).

questions are addressable using the analysis available in the literature, they are distinct from the purposes to which that analysis is typically put. Here we are concerned with the rents to an entrant, not social welfare.

These two questions apply as much to a PPP as to any other kind of entrant. In our context, they can be posed this way. (1) Will foreign complementors cooperate with the PPP, or will they react in a vertically competitive mode? If they cooperate and accommodate, overseas complementors will function primarily as a cheap source of useful technology. The local partnership will then be able to take advantage of that to develop rapidly in an area that draws on its strengths. On the other hand, the overseas complementors may engage in vertically competitive attempts to control or steal the rents of the local partnership. Indeed, like any other entrant, a PPP that creates a rent-generating position may draw vertical competition. (2) If it does, will the competitive position of the local partnership be a strong (defensible) one? The difference between a local private/public partnership as an entrant and a firm as an entrant is merely in what assets it has to avoid or survive competition. In the rest of this section, we examine the implications of the recent history of computing and telecommunications markets for market-entry strategies of a PPP.

2.1. Changes in Industry Structure in Computing: Vertical Competition Invented

Industry structure in computing has changed in directions that make the possibility of vertical competition in ICT highly likely. Indeed, these changes are far enough along in computing that incumbent firms are quite expert in vertical competition.[11] Accordingly, new entrants, whether PPP or firm, need to be aware of market equilibrium considerations.[12] The purpose of this section is to briefly summarize what these considerations are, and how they shape strategic considerations of potential new entrants.

Interactions between buyers and sellers of computers are organized around platforms, such at the IBM 360, Macintosh, or "Wintel." Platforms have interchangeable components, so many users can share the benefits of technological advance within a single platform. There is a general theory of competition among platforms that applies in this industry in a timeless way. The crucial elements of this theory are positive externalities among producers of technology for, and users, of, the platform. Underlying the positive externalities are users' platform-specific investments and the importance of interconnection and compatibility. These lead to substantial network effects, a powerful force for concentration in platforms. The

[11] Contrast Steffens (1994) and Ferguson and Morris (1993), who emphasize the novelty of vertical competition, with Cusumano and Yoffie (1998) who document the high level to which vertical competition has advanced, and the vulnerability of an entrant to attack from a well-positioned incumbent using both competitive and anticompetitive strategic tools.

[12] For the purposes of this analysis, it does not matter whether we believe the incumbents' responses to PPP entry are anticompetitive attempts to preserve monopoly positions or socially valuable competition. In this paper, we are advising the PPP-entrant, which is dead either way if it loses a round of vertical competition.

general theory is also useful on the subject of standards races between competing platforms, and when these races tend to converge too fast or too slow from society's perspective, though that is not the issue here.[13]

It is often the case that when some new body of demand (or new technology) emerges that a number of new platforms, or hybrids of old ones, are proposed and created. But shakeouts quickly follow. After the shakeout, the successful platform or platforms tend to be around for a very long time. We expect ICT markets to follow this pattern. But of course this means that only a very small number of firms—and usually a single firm in any given vertical layer—will define the dominant standard.

2.1.1. Vertical Disintegration of Computing

While there has long been, and continues to be, concentration in platforms, some important things have changed over time, notably the way platforms are controlled and organized. By far the most important change in competitive dynamics is the emergence of vertical competition.[14] Grove (1996) contrasts the "vertical" structure of the "old" computer industry to the "horizontal" structure of the "new" industry. The vertical structure means vertically integrated suppliers, with IBM's mainframe business as the reigning example. The horizontal structure is characterized by specialized firms; the PC business in the 1980s is the example. This change in the structure of computing has led to changed conditions of competition among the specialized firms in the same layer and, more importantly for our purposes, between firms in adjacent layers.

2.1.2. Vertical Competition in Computing: Implications

2.1.2.1. Opportunities for piecemeal entry. Vertical disintegration can lower certain entry barriers for firms even though platforms tend to be few and long-lived. Incumbents controlling a platform from a particular layer may welcome entry in other, complementary, layers, or may lack the ability to block that entry. New firms (or PPPs) can enter to provide ancillary services or components for the dominant platform, while control—in most cases this means setting the technical standards—remains with the incumbent dominant firm.[15] Providing applications to a small subset of a platform's users will often get this response. Computer services providers, for example, are often welcomed.

[13] See Besen and Saloner (1989), David and Greenstein (1990), David and Steinmueller (1994) and Besen and Farrell (1994) for more careful and complete statements. On networks, see Nicholas Economides and Lawrence White, Networks and Compatibility: Implications for Antitrust, *Euro. Econ. Rev.* **38**(3–4) (April, 1994), and Nicholas Economides, The Economics of Networks, *Int. J. Industrial Org.* **14**(2) (March, 1996). More generally, see Economides site at http://raven.stern.nyu.edu/networks/.

[14] Cf. Bresnahan and Greenstein (1999). A number of recent works contribute to understanding these more detailed and strategic advances. Cf. Shapiro and Varian (1999), Brandenburger and Nalebuff (1996), and Cusumano and Yoffie (1999).

[15] Indeed, as we shall see below in Section 3, potential entrants are well served to have its technology not threaten the control of existing platforms.

The boundary of the low barriers to entry comes when an entrant threatens the core business of incumbents. Today the firms that dominate key segments have a marked tendency to respond very aggressively when it appears that entrants—even those selling complements—might vie for control of their platforms.

There are two public policy issues here. The literature has focused on the global one of whether this system has excessive entry barriers (static or dynamic).[16] Ideally, one would like platforms to be open to valuable new technologies. Policy might help push the industry in that direction. That global issue is only distantly relevant to the PPP's concerns. That leaves the second policy issue: Is this system adequately open to entrants to let a PPP entrant succeed? To attack this question we need to understand more specifics about how control over standards in any given layer emerges, how vertical competition shapes the utility of different competitive assets of the firm, and how government sponsorship can impact these dynamics.

2.1.2.2. Commodification of many vertical layers. One vertical competition strategy is attempts to render the complementor's product less of a bottleneck. A dominant firm might try to have its technology work with all the complementors in another layer, tending to make them more of a commodity. Or, rather than simply bargaining over rents with one complementor, a firm might attempt to strengthen the second or third-place complementor. This kind of strategic behavior has rendered a number of once-strategic layers in the computer industry commoditized and unstrategic. Many hardware layers have suffered this fate, as have many software layers that once vied for the rents that now go to operating systems. Commercialization, systems integration, and custom-software firms are a candidate for future commodification. For a period, it appeared that the applications software development efforts of these firms (Andersen, CSC, EDS, Ernst & Young, and Cap Gemini Sogeti are some of the larger ones, but there are thousands of local firms) would create a strategic layer. The efforts of these firms to create standing customer relationships reinforced this trend. Applications software firms (Oracle, SAP, Netscape, etc.) may now capture rents from the same end customers by commodifying support and installation services (since by implication the software is the strategic asset for customers).

2.1.2.3. Source of rivals even for successful firms in particular layers. Many once-dominant firms in the computer business have seen their rents destroyed by (fair or unfair) vertical competitive initiatives from others. The classic example is the loss of control of the PC business by IBM. Other examples include loss of a dominant position in word processors by WordPerfect and of the dominant position in spreadsheets by Lotus 1-2-3. In these cases, a standard switch was associated with a step-up in technology (cf Breuhan (1998) on the analytical point and evidence on an example). Entrants may expect incumbents to attempt to steal their rents.

[16] See the work reviewed in David and Steinmueller (1994) and also Economides and White (1994).

2.1.2.4. Network effects: Global or failed. The existence of network effects and positive feedback mean that many rent-generating technologies will either be global or they will fail. In particular, any technology whose return depends on technical standard-setting or coordination with other technologies will likely need to be global to succeed. If there is a national variant—as there was in Japanese PC operating systems for a while—it is likely to be swept away by a version of a global standard—as those Japanese operating systems duly were. Scale and scope effects are thus important determinants of the potential success of public policy. National or regional demand-steering policies will work only if they are promulgated by governments that have the scale to back them up. This seems to limit the likely promulgators of that kind of policy to the EU or United States.[17]

2.1.2.5. Pace of change: Increases importance of participating in Silicon Valley or one of the allied centers elsewhere. Finally, the pace of change in technology and competition has increased dramatically as a result of technological and market opportunity and of the new structure of the computer industry. Successful entrants will need access to a wide variety of information and resources to keep up. These are more available in the established centers of multifirm innovation, such as Silicon Valley, than they are elsewhere. There is a clear disadvantage in being elsewhere, one which will need to be overcome by some countervailing advantages.[18]

2.2. Changes in Industry Structure in Telephony

While vertical competition is already well established in computing, it is only now emerging in telephony. The traditional model of organizing telecommunications markets revolved around domestic monopolies connected by an international cartel. Governments strictly limited entry (hence monopoly providers) and relied on comprehensive regulation to establish marketplace prices.[19] Internationally, the traditional telecommunications regime favored the "joint supply" of international phone services using accounting rates.[20] Each national carrier theoretically contributed half of the international phone (or fax) service (for example, taking the international call from a hypothetical mid-point in the ocean and terminating the call to a local household in its country), and was entitled to a fee usually equivalent to half of the accounting rate, known as the *settlement rate*.[21] Not surprisingly,

[17] On the other hand, the example of SAP and the potential for a new non-U.S. application do not completely undermine foreign government efforts.

[18] The large literature on these agglomeration economies is reviewed from the perspective of ICT industries in Bresnahan and Malerba (1998) and in Wallsten (1999) for the incentive to co-locate.

[19] The United States was the exception as AT&T remained a private firm. But competition was strictly limited and AT&T essentially served as the monopoly provider.

[20] On accouting rates, see the Remarks of Robert Cohen, Peter Cowhey and Erik R. Olbeter at the Economic Strategy Institute, "Halting the Accounting Rate Rip-Off," February 5, 1997.

[21] Settlement rates apply to switched international traffic (literally, services requiring the use of telephone network switches) offered on the public telephone network.

settlement rates were not related to the cost of transmitting traffic, but rather set high enough to support the operations of even the most inefficient PTT.

Technology and the rapid growth of data networks as alternatives to traditional switched circuit networks began the end of the traditional cartel in the early 1990s. Technologically, the increase in transmission capacity created by fiber, the rise of the internet, and the increasing role of data networks and computing technology to route and transmit telephony traffic significantly altered both the nature of telephony traffic and the competitive landscape—in particular in wholesale markets.[22] These changes led governments to conclude the 1997 World Trade Organization agreement on basic telecommunications. Signed in February 1997 (effective January 1, 1998), the WTO agreement dramatically restructured the regulatory arrangements governing both national and international telecommunications markets.[23] Most importantly, most major markets agreed to lower or remove domestic barriers to international competition in the provision of local, long-distance, and international telecommunications services, and many OECD states made broad commitments in both wireless and data services. The WTO deal also entailed a commitment to a set of specific, pro-competitive, and transparent domestic regulatory arrangements that the United States believed were essential for effective competition.[24]

Two changes in competition are beginning to emerge in the wake of the WTO agreement. First, inter-network competition is slowly becoming a reality. To be sure, liberalization in the 1980s and early 1990s did much to alter the competitive landscape of both national and international markets. But true end-to-end inter-network competition depended on the 1997 WTO agreement. The second change is the continued blurring of voice and data traffic. IP telephony is only part of the story. A bigger part of the story is the rapid growth in the overall data traffic, and the increasing importance of data as a share of total telecommunications traffic. This rapid growth opens up opportunities for new firms from both the telephony

[22] Many incumbent carriers essentially discounted the value of the cartel in light of the rapid growth of traffic running outside the accounting rate system. In short, the cartel understood that these technologies would inevitably lead to a collapse of the accounting rate system.

[23] The agreement included commitments from sixty-nine countries accounting for more than 90 percent of world telecommunications revenues (some $570 billion per annum) to liberalize their telecommunications markets to varying degrees of competition. For a detailed discussion of the commitments made by the various states, see Drake and Noam (1997).

[24] Although the 1997 WTO agreement was a fundamental shift in the regulation and organization of global telecommunications markets, it did not end the ability of governments to use public policy to subtle guide these markets. For example, many governments opted out of some areas of the agreement, or implmented long lead-in times for adhering to the commitments. Likewise, one of the key areas for competition—inter-connection between incumbent monopolists and new carriers or international competitors—can be delayed as incumbents seek to slow down implementation of the new rules. Finally, limits on the ability of the WTO agreement to quickly create competitive markets can be seen in the U.S. move to unilaterally impose benchmarks on settlement rates to minimize the ability of foreign providers to use their protected domestic positions to subsidize international operations. For a discussion of the limits of the WTO agreement, see Cowhey and Richards (1999).

and computing sectors, and weakens the position of the incumbent telcos (which have networks and business models suitable for voice traffic).[25] This is particularly true given hardware and software advances that allow voice, data, and video traffic to be carried on a single network, and the emergence of totally new value-added applications and services that will be delivered via telephony networks. These changes move telecommunications toward a kind of competition which has already been seen in computing.

Three features of current telecommunications markets stand out. First, vertical competition is nascent in telephony. Competition between fixed line and wireless, traditional telecom equipment suppliers and corporate network suppliers, network services suppliers and the incumbent telcos—all of these are illustrative of the beginnings of vertical competition in the once staid monopolistic world of telecom. Second, the continued blurring of computing and telecommunications means stand-alone telecommunications markets (in the traditional sense of telephony as voice traffic) are likely to converge into ICT markets just as vertical competition blooms. This means that firms experienced with vertical competition in computing may enjoy advantages vis-à-vis their rivals with feet in the telecom world. The incumbent former monopolists are unfamiliar with time-based competition and co-opetition, for example, and even most of the "new" telecom firms are inexperienced with the kinds of rivals they might find in computing. Finally, the convergence of telecommunications and computing into ICT means there will be dramatic growth in telecommunications overall. The stakes involved in ICT markets are thus higher—for both national competitiveness and the viability of individual national telcos—than in the voice-only markets of the past.

2.3. Vertical Competition in Telecommunications Markets

We consider a PPP considering how to earn rents in telecommunications markets as transmission recedes in importance and new value-added services emerge. This is in no small part a vertical market structure question, in particular concerning the potential for entry and the layers in which rents will be earned. Dominating a commodity niche without rents may not help firms enter more profitable segments. Will it be possible to leverage control over transmission into dominance into other segments? Can some segments defend entry once a dominant position has been established? Where will the most value be captured—in supplying equipment to services providers, providing services over the network, in delivering services to the business or home, or in some unique bundling of the three? While these are difficult questions to forecast, there are some analytical points that have implications for a PPP entrant.

[25] See Eric Labaye, "Why IP Makes It Easy for New Entrants," *Réseaux* (France) July 1998. On the problems facing the former monopolists, see Seaberg *et al.* (1997).

2.3.1. Commodification of Many Vertical Layers

One strategy of a vertical competitor is attempts to commodify the layers of rivals. A dominant firm might try to have its technology work with all the complementors in another layer, tending to make them more of a commodity. Or, rather than simply bargaining over rents with complementors, a firm might enter neighboring segments and leverage existing customer knowledge and network expertise to offer better services. The movement of fixed line providers (AT&T, Sprint) into wireless and data services is indicative: These firms have altered the competitive landscape. Rents that once went to local wireless providers or small ISPs may now accrue to the large vertical competitors—which launched their strategic efforts from neighboring segments. Similarly, major telephony firms are now directly or indirectly entering into consulting markets (largely in network services or computer services) that were once the domain of stand-alone computing firms or consulting houses. AT&T Network Solutions divisions now directly competes with Ernst & Young (and others) in this area, for example.

2.3.2. Continuing Source of Competitors Even for Dominant Firms in Particular Layers

Vertical competition means former monopolists now face—for the first time—real competition from both new entrants and incumbents in neighboring layers. The numerous "call-back" and IP telephony firms are only one example of how new entrants are threatening the core business of traditional suppliers. Moves by cable firms and computing companies to provide data services to both consumer and corporate customers are likewise examples of how existing firms in neighboring segments are commodifying the key asset of incumbent telcos (transmission). Indeed, we expect to see firms which offer value-added services to undertake initiatives which weaken the importance of transmission as a layer (and thereby decrease the ability of transmission firms to morph into value-added services), for example. We also expect to see the large facilities-based incumbents bundle their networks with service offerings that offer higher quality assurances than their non-facilities based competitors. Only firms with truly irreplaceable technology or facilities-based bottlenecks or cost advantages can expect to be free from the efforts of vertical competitors to steal their rents.

2.3.3. Network Effects in Some Technologies: Global or Failed

The existence of network effects and economies of scale means that many rent-generating technologies will either be global or they will fail. In traditional telecommunications markets, the partitioning of networks into national bailiwicks limited the potential for globally dominant firms in any given layer. Each country had its' own equipment providers, transmission providers, computer services firms, etc. Liberalization and inter-network competition opens up the possibility for globally dominant firms in particular layers. As in computing, increasing returns to scale associated with telecommunications equipment is likely to produce

concentrated industry structures.[26] If there is a national variant—Minitel to take a specific example—it is likely to be swept away by a version of a global standard. Competition in internet-based messaging services (and for that matter internet services more broadly) also follows and similar logic: network effects suggest a concentrated industry structure. National or regional demand-steering policies will work only if they are promulgated by governments that can steer marketplace dynamics in markets large enough to take advantage of network effects.

2.4. Vertical Competition in ICT Markets

What is important about vertical competition is that firms face competition not only from other firms making the same products or services but also from firms making complements. Firms that provide telecom equipment, for example, are increasingly seeking to capture value by offering local routers that enable IP telephony for large corporate users (thereby eroding the value of POTS). POTS providers also face competition from new forms of POTS (e.g., wireless) and data services firms (e.g. IP telephony). Firms which provide data services now compete to provide complex application services, while software seeks to capture the rents captured by both data services providers and complex applications services providers. ISPs and firms which began doing software for data services, Netscape for example, are increasingly competing against firms which provide software and computing services to corporate clients (e-commerce services). Entrant firms, or entrant public-private partnerships, need to be aware of global competition from complementors.

3. THE DEGREE OF COMPETITION FACING ENTRANTS INTO VERTICALLY COMPETITIVE INDUSTRIES AND THEIR ODDS OF SUCCESS

A local PPP has far better chances of success if it is viewed as a valuable complementor rather than a dangerous potential competitor by global ICT firms. A local complementor can be a route to commercialization of technology in places where that would otherwise be difficult, but attempts to earn rents will appear competitive to global technology firms. To understand a local PPP's chances better, we take up our second broad general topic, the general analysis of when an entrant will face vertical competition or when it will be treated as a complementor.

[26] As in computing and other network industries, any technology whose return depends on technical standard-setting or coordination with other technologies will likely need to be global to succeed. The International Telecommunications Union (ITU) "finessed" this need in traditional telecommunications markets by setting technological standards that were followed by all national providers. Although the ITU continues to serve some of these functions, the marketplace driven standards-setting process of computing and the internet suggest that telephony is likely to follow market-drive dynamics in the future.

3.1. Emergence and Strength of Vertical Competition

When will vertical competition break out, and when will complementors instead pursue cooperative strategies? The *motive* for vertical competition arises if both parties are earning rents from the same customers' end demand. Each sees the other's margins as a profit opportunity and/or as a tax levied on its own customers. Similarly, if one complementor is not yet world-class competent, the other will see its costs (or more likely, its slowness or market unresponsiveness) as a drag to be removed. *Opportunities* for vertical competition arise in a variety of ways. If the complementors' products are technologically similar (both software, for example) the opportunity is obvious. It is equally obvious if the two complements have very largely overlapping markets (rather than, say, one of them being a small subset application of the other) and similar mechanisms for customer contact. A famous example is mass-market PC applications and PC operating systems, which combined both market and technological similarity and had virulent vertical competition. More subtle opportunities arise when the complements are dissimilar but the boundary between them is unclear. This opportunity arises constantly on the borders between packaged software and custom software, and between software of either kind and services. What set of firms will win in the battle between the systems integration houses (Andersen, Ernst, & Young, etc.) be able to stifle the efforts of large ERP software houses (SAP, PeopleSoft, etc.)? Another subtle but commonplace opportunity for vertical competition outbreaks is seen when one complementor's industry is, or could be, more competitive. The other complementor may seek alternatives, other partners, in order to put competitive pressure on the complementor in the more competitive market. A common form when that industry is not structurally competitive but barriers to entry are low is for the complementor to enter by a vertical extension, perhaps by including the other complementor's functionality in its own product. This is particular true in the software, custom software, and services nexus. Unsettled interface standards—or the lack of standard interfaces in a particular services niche (Y2K services, for example) are another kind of vertical competition opportunity.

When both motive and opportunity are present, vertical competition will break out. But strategy can also lead to vertical competition, and is particularly important when rival firms seek to establish their technology as the key standard in a platform. An incumbent will view an entrant as such a rival if there is a plausible future technological or market development that shifts power to the entrant. Vertical competition thus tends to break out more often where technical progress is fundamental or where the applications of technology are uncertain. This means ICT markets will be characterized by a great deal of vertical competition over the next several years.

A second strategic observation is that even slight threats of vertical competition tend to become real when there are substantial rents on the table. If firm A has the opportunity and the motive to go after complementor B's rents, then it will do it. That is obvious. The nonobvious but now routine part of ICT strategy arises in the

converse situation. Suppose A has no strategic goal of vertical competition with B. But if there is a future market or technological scenario, even a remote one, in which A might become a threat, B has the motive to preempt that threat. If B is an experienced vertical competitor earning rents, it is likely to think through the scenario and contemplate highly competitive actions now (or highly anticompetitive ones—either way, A's rents disappear). The large bets currently being made on different scenarios for delivering broadband access and services are one example of this dynamic: the size, shape, and content of this market are unclear, but all rivals have incentives to establish positions and to protect themselves from commodification in their core layer.

3.2. What Is a Strong Vertical Competition Position?

We now turn to a somewhat different topic, that of forecasting winners under vertical competition. Uncertainty and rapid technical change make such forecasts very difficult, and the people who make such forecasts for a living are among the most highly rewarded in the economy. (And few of them are in government service.) In this paper, however, we have the modest goal of distinguishing the strategic circumstances of global technology and service firms from those of local PPP. Their positions are adequately distinct that even weak and contingent observations are quite useful for understanding their respective competitive positions and the implications of these positions for public policy.

Let us begin with technical and market position. Critical technology that is and will remain proprietary is a solid position for vertical competition, as it makes a complementor hard to get rid of. Formal intellectual property protection is one source of that, though it is probably not all that important a consideration in worldwide ICT markets. Unique technological ability is another foundation for vertical competitive success. Then complementors really need the firm, and can't easily replace it in alliances or deals. An even better position is control of a de facto standard, one tightly linked to ones' own technology. Given users and complementors investments in standards, it is very hard to work around an important standard, and complementors will think twice before they try to enter into competition with a strong-standards firm. Standards are not necessarily technological standards, however. Clear interface standards and boundaries with customers also enable firms to drive technological change and capture global rents.

These are all strong starting positions, but not easy to use. Exploiting technological positions is corrosive to relationships with critical alliance partners. (See, for example, Sun's elaborate system of defining property rights for Java that are strong enough to keep Java from being hijacked but weak enough to keep complementors from suspecting Sun's motives.) "Open" systems in general play better with alliance partners. But "open but not open" systems are traditionally more the norm as firms seek to leverage dominance in a given layer into neighboring segments.[27] Microsoft's careful control over and access to Windows code is the

[27] On "open but not open" standards, see Cusamano and Yoffie (1999).

most well-known example, although other software firms practice similar tactics. Meanwhile, tightly controlling the technology of a standard is increasingly less important than maintaining an open standard and encouraging others to make strategic bets and investments around a particular standard. All that said, technologically strong firms, whether through standards or through capabilities or formal rights, will frequently prevail in vertical competition.

Although firms that control a standard or participate in joint control of standards have strong vertical positions, persistence is not guaranteed. To get third party complementors to go along with a firm's attack, or to defend it when it is attacked, is not trivial. These are complex business decisions. The best position involves third party complementors who are both happy and locked in to our technology. There is, of course, some tension between keeping them happy and keeping them locked in. The critical importance of positive feedback and network externalities mean that managing the relationship with third party complementors is critical in incidents of vertical competition. It is not a widespread skill to manage those relationships, and there is considerable advantage to having managers in the firm who are very well networked personally to many other managers in many other firms. This is easiest if the firm is a venture-capital backed Silicon Valley firm. It is not impossible elsewhere, just more difficult.

A second class of strong positions arises from solid and persistent customer connections. Vertical competitors will have trouble dislodging a firm that has such assets. This will be especially true if the customers view their relationship with the firm as strategic. If customers view switching as dangerous and a major change, the firm will have breathing room in vertically competitive incidents. This, too, has its tensions. Again, it is difficult to have both well locked-in and happy customers. The difficulty is exacerbated if the customers are the firms' main revenue source. Exploitative margins, or margins that do not cover development costs only variable costs, make customer defections more likely.

The final set of strong vertical positions revolves around scale and marketplace scope. On balance, scale and scope are advantages in vertical competition. Much of ICT has increasing returns to scale, either within the firm or external to it in standards and other positive feedback. These forces are powerful, and typically go to the global competitor. It would be very difficult for a new entrant to compete against the Nokia–Ericsson–Motorola–Psion or Qualcomm–Microsoft efforts in the OS for wireless data, for example. Scale is also important in regards to finance. Often, one side or the other can force very large costs into the system by racing or attacking standards. This plays to the large, established vertical competitor. Scale is not a panacea, however. Indeed, the converse advantage for local firms is that of close customer connections or market specificity. This is particularly true when there are a large number of new applications that compete against inferior existing services offered by incumbents. Local internet providers have been successful precisely because they are local, for example. "Global" can become "distant" or, even worse, "American." Well-run global competitors attempt to work around this problem, but it is an advantage to the local firm.

Marketplace scope also creates a distinct set of positional advantages that tend to favor large, global firms over more specialized local players. Multiproduct firms have fared well in many recent vertical competition struggles. IBM, for example, has captured an increasing share of the services business at the expense of pure computer services firms such as EDS and CSC. Likewise, both Sprint PCS and AT&T wireless efforts have sought to leverage their long distance customers and use revenues from other segments to finance their wireless entry. Local cellular telephony providers cannot compete against these global entrants, and are rapidly disappearing from the major markets. Part of the reason is that they have sources of finance distant from either the capital markets or the market under competition, both dubious sources. Another reason is that firms with broad market footprints (i.e., products or services in different market segments) can also be quite effective at bringing a large number of different connections and technologies to bear on a single strategic situation. The corresponding advantage for the specialist is depth and focus. Lately, this seems to go to breadth a lot.

3.3. Firm Capabilities

We now turn from strategic position to capabilities. By capabilities, we mean no more than what the firm can do in a technological, marketing, and management sense. And our framework is so simple as to be trivial: more capabilities make it more likely the firm will prevail in vertical competition.[28] The reason for this simple point is that ICT firms vary remarkably in their capabilities. New entrants enter with very different connections with existing firms and capital markets, while established from neighboring segments enter these markets with widely divergent sets of resources and agendas. This should not be so surprising, perhaps, as ICT is still new (or renewed) and the ineffective forms are only now being competed out of existence by the competitive process. But it is important to note because large differences in capabilities, coupled with rapid new entry of small firms, mean that firm capabilities are more complicated than simply size, financial muscle, or technological prowess. Apple's troubles are illustrative of how companies with seemingly strong capabilities can fumble.

In short, technological capabilities alone are not much of a strength unless they can be aligned, through alliance or development, with management or marketing capabilities. Many firms in ICT think that they are technologically fluent and then meet modern ICT competition. But modern ICT competition is vertical competition; it is time-based, complex, and uncertain. This provides a very difficult problem for managers and technologists. At various times in its history, telephony has been complex and (a while ago) uncertain. But it has not seen much in the way of time-based competition for a long time (until very recently). The stresses that appeared in computing when time-based competition broke out suggest that there is a very different set of firm capabilities that are useful in it. Knowledge

[28] Some management scholars understand the word "capabilities" in a far more specific sense, one as narrow and precise as "christian" does to some fundamentalist protestants.

about running the network may do little to help telphony firms be effective vertical competitors.

A firm's, or its backers', connections—in both a marketing and a technological sense—can be very useful in expanding the set of available capabilities. Connections lead to practical knowledge about what markets are doing, what technology is doing, whom to trust and how to decide. Importantly, it helps firm understand and make sense of technological bets and market strategies of firms in neighboring segments, some of which may be complementors. All this knowledge, acquired very quickly, is very useful in vertical competition. Backers' connections can also serve as a "brand name" or as a signal of technological prowess of the firm. When commercialization or interconnection are important (as they are in ICT markets), brand name backers are vitally important in encouraging others to bet on your product via their own technologies. Optimizing for Netscape Navigator or Microsoft Explorer is a choice. Which technologies and firms will succeed? How can these decisions be made ex ante? A firms backers signal key characteristics of new firms (quite apart from financial soundness) and help particular firms and technologies become integrated into the solutions and technologies of complementors. Qualcomm chose Microsoft as a partner in wireless data, for example, no doubt in part because of the difference in having a large and powerful partner like Microsoft will have on the decisions of other firms considering making complements for third generation wirlesss handsets.

This part of our discussion is closely linked to a series of Silicon Valley cliches about finding and acting on external sources of information and technologies as a key to rapid movement at the firm level. A related set of cliches is about the value of managerial and technological experience in fast-paced markets such as PCs. There is, however, a considerable foundation for the cliches. Vertical competition calls for rapid technical progress (while listening to customers) rapid decision-making (while still being right often) and other very difficult tasks. It calls for intelligent understanding of the shifting boundaries of one's own firm, a good understanding of what technological bets are being made in neighboring segments, and the implications of these decisions for continued technological or marketplace leadership. All these are capabilities that were not necessarily well developed at IBM or in a monopoly telco.

3.4. New Technologies, New Applications, and New Competitive Dynamics: New Opportunities to Grab Rents

The commercialization of the internet and the convergence of computing and telephony open up opportunities for new technologies and new applications. As we have already noted, convergence in ICT markets has two features that encourage entry, either by firms alone or when supported by helpful governments. Interestingly, the same features appear, at first blush, to make governmental demand-steering more likely to be effective as a policy. The first feature is that specialized technological firms now face lower entry barriers. The second is that the creation of new

applications areas raises the importance of commercialization (and also promises a growing market). Commercialization-based entry strategies can be quite local. Almost all countries have computer services firms with strong links to customers in a commercialization function, and all have a telco that forms the last links between telecommunications and its customers. Accordingly, governments that steer demand toward domestic firms (or otherwise help national firms) have new opportunities to structure markets in ways that advantage these firms.

3.5. Lower Barriers to Entry: Potential Opportunities

Three changes in recent years have dramatically lowered the barriers to entry in ICT markets. First, regulatory changes mean there is now at least some competition in most national telephony markets.[29] Second, the blurring of computing and telephony and the attendant explosion of the internet as a deliver mechanism for value-added ICT services has opened up entirely new markets for network delivery of new internet-based services. US Web is perhaps the most well-known new service firms seeking to provide online computing services for e-commerce applications; a herd of other computer and telecommunications firms—ranging from Intel to British Telecommunications—are rapidly following. Importantly, there is no dominant incumbent in this new market (and its numerous segments), and large numbers of new firms are jostling for position in this nascent market. Third, the growth of network computing and the success of the internet as a distribution channel for services means that small local firms can compete on a global basis. In computer services markets, for example, the difficult in providing services in different languages or cultures or across great distances means that large segments of computer services markets were accounted for by local suppliers. The ability to deliver these services over the network means that it is now possible to launch global efforts from small local beginnings. And the ubiquity of the internet and the rate of adoption of new technologies and services (witness the growth of GeoCities and eBay, for example) mean that any small new entrant can substantially erode an existing incumbent by offering new, novel, or better services.

Two features of these changed marketplace dynamics are worth noting. First, the inability of incumbent telcos to leverage their close customer relationships and existing networks into more value-added or data services has enabled a large number of new entrants to capture value in particular niche segments. Put differently, lack of implementation (or strategic vision) at telcos has allowed new entrants to capture value and thereby encourage even more entry, particular by the large players in neighboring segments (computing, software). Second, convergence has further blurred the already fuzzy lines between packaged software, custom software, and services. Of particular importance is the ability to supply services to distant buyers—which has eroded the local requirement of many computer

[29] Many developing countries opted out of some markets segments while others delayed implementation of the WTO commitments over a series of years. However, most OECD states opened both voice and data markets to competition, including new rules governing foreign direct investment.

services and enabled new entrants to capture rents that heretofore were captured locally.

3.6. The Nature of Commercialization as a Source of Rents

Using public policy to help national firms to capture rents—either local or global-in ICT markets requires more than just the best technology or astute identification of new entry opportunities. Governments must also be aware of the complex relationship between technical progress and marketplace success. That is to say, ICT has always needed commercialization as well as technical advance. As with many other general purpose technologies, investments in ICT lead only indirectly to valuable outputs. What makes ICT valuable is complementary innovations in how businesses, and, to a lesser extent, households, use information and communicate. Business information systems are complex inventions by users of ICT. The relationship between invention by sellers and "co-invention" by buyers is close and complex. Demand-pull forces are correspondingly important in ICT. So, too, are the institutions of commercialization. Broadly speaking, these are the mechanisms by which sellers' invention and buyers' co-invention are coordinated.

Business information systems are complex artifacts drawing on a wide range of technologies and business knowledge. Take a "primitive" antecedent of today's nascent electronic commerce systems, the airline computerized reservation system (CRS) and its associated network of sales terminals, information terminals (such as those at the gate) and links to many different workers inside the firm and outside it, such as travel agents, salespeople, and travel departments. Technologically, these systems draw on very large computers and pieces of software (DBMS, communications controller, etc.) They draw on very complex telephone and networking systems. They use PCs, switches, specialized terminal programs, and so on. From a business perspective, they automate or improve the jobs of very different workers in very different companies within the same system. They are used in connection with complex decisions about supply chain management, pricing, marketing, and physical operations.

In the case of the airline CRS, much of the activity of coordination was done by aggressively pro-active co-inventing airlines, notably American Airlines. They used the products, technologies and services of a wide number of technology companies in ICT, of consultants, of custom software houses, and of integrators. It was the user, however, that took responsibility for organizing all this innovation.

There is another extreme in how innovation is organized. Consider a "turnkey" business information system that the end user buys as a service—an electronic store hosted at the Yahoo Stores (formerly ViaWeb), for example. The service vendor "hosts" the store, meaning that it is the vendor which obtains all the hardware, software, and networking services. The vendor need do little more than decide what information and functionalities are to be made available to what users and on what basis. The store itself needs to do little more than decide what to sell and at what prices.

Between these extremes lies every form of intermediate model of commercialization imaginable. There are sellers who meet buyers only through arms-length market contact. There are sellers who permanently station employees in buyers' facilities. Customization services firms help in the design and implementation of new business information systems. Specialized consultants are everywhere that there is scarce knowledge. Firms designing complex networks that sit on top of PTT networks "resell" capacity, often adding valuable services to it. Software that incorporates business functionality is licensed to end users; sometimes to one, sometimes to a dozen, sometimes to thousands (consider SAP's R/3). In the old days of vertically integrated telephony and computer market structure, it was very hard to see how large these commercialization services were, and they were not very diverse. Now they are incredibly diverse, and the total sum of their activities is as large (in computing) as is hardware or software. Most importantly, commercialization services are as determinative of success as sheer technological prowess.

3.6.1. Rents to Commercialization

Linking technology and commercialization together has always been one of the largest sources of rents in computing. In the mainframe era, IBM captured the lion's share of industry rents not by being the first to enter computing markets nor always by being the first to introduce new technology. Rather, IBM's success lay in the company's strategy of making the necessary three-pronged Chandlerian investments in R&D, production, and marketing to exploit the economies of scale and provide the coordination functions necessary to succeed. The key to IBM's success was thus not pure technological genius but effective commercialization.[30] The internal economies created by offering a family of similar products assembled differently for individual business needs quickly plus the external economies of user lock in made IBM the dominant firm in the industry. Throughout the period of IBM dominance, IBM relied less on making the best technology but on providing the best answers to buyers' needs. In short, commercialization was at the core of IBM success.

The IBM model at its most extreme links technology and commercialization in a single firm. There are two main institutional *forms* of linking technology and commercialization together, and they are very different.[31] The first form relies on tight bilateral buyer-seller relationships, and is famously associated with the aforementioned success of IBM in mainframes. Most infrastructure (telcos) and computer services firms rely on similar models today. The second form relies on market-level network externalities among buyers, and is associated with the PC. In PCs, market success came to the platforms that most quickly convinced the largest number of buyers and developers that they would succeed. Once a number of buyers had committed to a particular platform, it was in the interest of developers

[30] See Chandler (1997).

[31] By forms, we mean ways in which buyer/seller relationships play out and the resulting mechanism for creating rent-generating positions.

to work with that platform. Once a number of developers made programs for the platform, it was in the interest of buyers to buy it. These "network externality" or "positive feedback" effects lead to a distinct form of commercialization in PCs. It is the market coordination of the efforts and investments of a large number of small actors that is critical in this kind of environment. Within the broad PC form, successful commercialization has been of two very different kinds. Applications commercialization by developers takes platforms as given and serves particular user needs. Hundreds of firms have had great success in this kind of commercialization in PCs. Platform commercialization is a trickier business, involving steering the complex web of participants in the market. Microsoft's success at this activity has far outstripped that of any other firm. Let us call these two forms of commercialization "bilateral links" (the IBM one) and "market" (capturing both the Microsoft and the developer kinds).

Importantly, each of the two forms of commercialization, bilateral links and market, is predictably linked to features of buyers. Large, complex applications or business systems are typically related to the bilateral links form. Simple applications where one person is the customer are typically related to the market form. But commercialization is more complicated than that. In particular, more and more commercialization of complex business systems has been performed by computer services firms in the post-IBM era. Put differently, much of the bilateral links between buyers and sellers in recent years has been provided by custom software houses, systems integrators, and the like.

But as the PC market demonstrates, commercialization need not always be provided by bilateral linkages. Put differently, it is easy to imagine a market level externality driven standard emerging in this space. Indeed, the boundary between custom software and software is as fuzzy as that between custom software and systems integration. It is a new area, however, for vertical competition. For a period in the early 1990s, it appeared that a fundamentally geographically local form of supply, the custom software house (or systems integrator) was going to triumph. Today, however, many of the traditional tasks of this sector are coming under pressure from software. In the enterprise software area, for example, tasks that would traditionally have been performed by custom software are now done, better, by software from SAP and Baan. Many people have seen these European firms as the entry of non-U.S. producers. But that misses the point of vertical competition. SAP does not so much signal the success of the non-American but the success of the global. Equally important, it signals yet another layer of ICT markets that is being driven by market level externalities as opposed to bilateral customer connections. As we noted above, fuzzy interface standards and weak boundaries with customers both undermine efforts to define standards and invite vertical competition. Most computer services firms relied on implementing applications (SAP, etc.) and projects (Y2K, movement to client-server) that did little to define marketplace standards or render the services firms connections with customers particularly strategic. These firms are sitting ducks for global solutions that define technological or interface standards in this space.

Many of the entry opportunities suggested by the conversion of the internet to a platform for business computing and the prospect of growing electronic commerce are commercialization-intensive. That is, they will turn on the invention of new ways to use networks as much as on new network technology. This suggests that local entry initiatives may have particular power in this new area. At the same time, the success of SAP and Baan suggest a triumph of the global in the competition between software and computer services firms. This suggests that network effects may be strong even in layers traditionally driven by more bilateral customer connections. This is particularly true as many network software applications and electronic commerce solutions have characteristics that suggest market-level externalities may drive market structure more than bilateral customers connections. Local entry initiatives thus have the ability to displace local providers elsewhere, even in the United States (where customer links are most well developed), given economies of scale in global production and the importance of network effects for large multinational users.[32] At the same time, this tilts against a government strategy designed to *protect* local players from global competition. Any government effort must thus be geared toward creating a global competitor rather than merely protecting a local technology supplier.

4. GOVERNMENT TOOLKITS AND LOCAL FIRMS

The huge markets created by ICT markets raise new challenges for governments and public policy. The central question is whether the same public policies that steered domestic demand in computing and telephony can be effective in ICT markets.[33] Can public policy capture important value-added segments for local producers? Can protecting the local produce global competitors? How can public policy be most efficacious in ICT markets? In order to understand the requisites for effective government intervention in ICT markets, we break these questions into four distinct steps: (1) can government influence, isolate, or command domestic demand? (2) Is influencing demand related to one of the critical layers in the value chain? (3) Will rent-earning firms emerge domestically? and (4) Will domestic rent-earning firms need to be globally competitive, and if yes can they achieve it? We explore each of these in turn.

4.1. Can Government Influence, Isolate, or Command Domestic Demand?

Governments have a diverse set of tools at their disposal to shape the organization and structure of domestic markets, ranging from trade policy (tariffs, quotas) to domestic regulatory rules which limit entry, define licensing conditions, or set standards. For our perspective, the question is not whether governments possess these tools, but rather can policy tools be effective in shaping the pattern of demand

[32] Large firms prefer to have all operations on a common platform for cost and compatibility reasons.

[33] We assume that governments will continue to seek ways to manage marketplace arrangements to advantage domestic firms.

in ways that advantage local suppliers over their global competitors. Two factors are important drivers of policy efficacy regarding domestic demand: (1) The ability of national regulatory policies to shape entry or competition, and (2) the structure of demand in domestic markets.

National regulatory policies matter because they determine the rules governing competition, most importantly for our purposes the ease of entry for foreign providers. If policy can be used to stifle competitive moves by foreign providers or otherwise advantage local firms on the supply side, governments can do much to steer customers to domestic providers. The extreme form of this is, of course, licensing provisions that preclude foreign entry; standards setting can be used similarly. But it is not always possible that policy can be used in this manner, particularly when there are large incentives to technologically innovate around entry barriers. The success of callback and IP telephony are examples where policy could do little to stifle entry from foreign providers intent on capturing value from domestic suppliers.

The second driver of policy efficacy is the structure of demand in domestic markets. If government ownership, legal requirements, or more informal tools enable governments to force buyers to buy from national suppliers, then demand steering policies are likely to be efficacious. The structure of demand also interacts with national regulatory arrangements by dictating the extent of interventionist policies necessary to steer demand. The fact that state-owned banks, financial institutions, and telecommunications providers represented a large proportion of overall demand for mainframe computers in the 1960s and 1970s, for example, meant policies favoring national champions in computing were quite effective.[34] Today, on the other hand, it would be difficult to achieve similar results for national producers of hand-held computers.[35] Overall, the more diversified and decentralized demand, the more difficult for governments to isolate and steer demand to domestic providers.

4.2. Is "Influencing Demand" Related to One of the Critical Competitive Layers?

Our discussion of vertical competition suggested that there are two competitive positions that are important for success in vertical competition: (1) technological advantages which allow firms to set technological trajectories or define standards, or (2) solid and persistent customer connections. Proprietary technology enables a firm to occupy a space in the value chain from which it cannot be dislodged, while solid connections with customers (which make it costly or risky for these customers to change suppliers) make it difficult for vertical competitors to dislodge a firm that has such assets. Influencing demand by governments is only useful in connection with competitive position (2), the demand-connected one.

[34] Bresnahan and Malerba (1997).

[35] This is not to say that governments are helpless in markets with diffuse demand structures, but only that new tools may be necessary. See our discussion below of where public policy might be effective.

Although one could argue that defining particular standards helps local firms establish the scale and scope necessary for defining technological trajectories in ICT markets, there is no guarantee that the layer for which the standard has been defined will be the critical layer for capturing global rents. This is particular true as the most obvious place for government intervention—customer connections via existing infrastructure (e.g. the bit-pipe)—can no longer be used to retard entry by other firms into value added services on top of the network.[36] Meanwhile, technology-based competitive positions in vertically disintegrated markets are achieved by deep technical excellence on the part of the firm, by racing to good positions, and by paying attention to technological trends in complementors (often called "market orientation."). Worldwide scale is important. Recently, achieving such positions has not been limited to Silicon Valley or even to U.S. firms. Governments have been helpful in some instances, for example, in Israel and Taiwan. However, the mechanism for achieving these positions is not one of protecting a domestic market and hoping a domestic technology will become successfully global. Instead, firms have been outward looking from the beginning, and have focussed on external relationships as much as on domestic demand. Thus many of the successes of Taiwanese firms in hardware are built upon bases of Taiwanese technological advancement, on close linkages to overseas, especially Silicon Valley, firms, and on export and market orientation. Similarly, the large scale success of Israeli firms in selected networking technologies in recent years are largely predicated on technological advancement and technical excellence that make these technologies comparable to world levels and connected to world standards. Government support but not government protectionism was a part of the story. These strategies of pushing technology involve a fairly passive and broadly supportive government, and in that regard are reminiscent of U.S. support of the nascent computer industry in the 1950s.

The other case, (2) of building a demand-linked or commercialization position is far more closely linked to government demand influencing. The local firm desires to build a position in which it has hard-to-remove and valuable. This will be especially true if the customers view their relationship with the firm as strategic. If customers view switching as dangerous and a major change, the firm will have breathing room in vertically competitive incidents. Scale is relevant here given the importance of large multinational buyers in ICT markets and their preferences for compatibility across international operations. The converse advantage for local firms is that of close customer connections or market specificity. "Global" can become "distant" or, even worse, "American." Well-run global competitors attempt to work around this problem, but it is an advantage to the local firm.

4.3. Will Rent-Earning Firms Emerge Domestically?

Computing and telephony are unusual in the key role played by users' complementary investments in human capital, new products, applications, business

[36] This is true because the WTO agreement included rules on inter-connection and what incumbent infrastructure firms can charge for traffic on their networks.

systems, and so on. Demanding and cutting edge users often help develop new technology, and at a minimum help firms translate pure technology into business uses. Having leading edge customers is thus important for competitiveness. It is no surprise that internet firms are so highly clustered in Silicon Valley, for example, or that most mini-computer firms clustered around Boston's Route 128. The implication for public policy is that channeling leading edge buyers to domestic suppliers may be an effective way to prop up demand but also help national firms become internationally competitive. In states lacking such cutting edge demanders, this opportunity may be lacking, and steering demand is likely to serve as a barrier to exit rather than a stepping stone to international competitiveness. The importance of knowledge of the technological bets of complementors also cuts against the efficacy of public policy initiatives in the absence of proximity to complementors in neighboring vertical segments.

The supply of potentially rent-earning domestic firms is not a trivial hurdle in the attempt to create a domestic capability. Crucial areas of potential supply include existing local suppliers of various ICT services, such as the PTT or computer services firms. It is a low hurdle to ask whether there are any such firms that would like protection or a government partner in new areas of service. There will always be such requests. A more difficult question is whether the domestic firms will have the technological and market capability to use public policy handouts as a crutch to global competitiveness. An even higher hurdle is whether there will be multiple, competitive domestic firms that have those capabilities. A higher hurdle still is whether there will be competitive firms in neighboring vertical segments for technological knowledge sharing. These questions are familiar in the evaluation of demand-steering practices in other environments. In the vertically competitive environment of ICT, it takes on a more urgent flavor for governments. Even a domestic monopolist with complete protection of its main market will face vertical competition. And a monopolist lacking vertical complementors at home will find it increasingly difficult to stay abreast of global technological bets and developments.

4.4. Will Domestic Rent-Earning Firms Need to Be Globally Competitive, and If So, Can They Achieve It?

Our previous discussion suggested that there are significant economies of scale in ICT markets. At the same time, local providers may enjoy close customer linkages that offer them defensible positions from vertical competitors. The next key question is whether close customer linkages at home will be enough for local firms to remain competitive, or whether these defensible local positions must serve as bases for global expansion for local firms to remain competitive. In short, can local positions be defended in episodes of vertical competition, or is global competitiveness necessary for local firms to capture rents in ICT markets? If global competitiveness is necessary, are there real prospects for local firms making the advances needed to compete globally?

Whether going global is necessary depends on the trade-off between localization and economies of scale. Economies of scale in ICT markets stem from both cost

savings and the importance of network effects. Network effects are particularly important because large firms (i.e. large buyers of ICT services) have incentives to use the same leading-edge technology across the firm. This cuts against purely local efforts. This is particularly true because buyer's investments more generally also generate network effects through independent but linked investments in compatible technologies. These network effects imply that local advantages, content or delivery mechanisms, may be less important than efficient global solutions. This is particular true as the trend in maturing ICT markets is for more and more functionality to migrate from the specific to the general. Applications which were once used only by single firms become consulting services, then become custom software scaled up to a number of sites, then become services or software that is sold to almost all sites on a large basis. Vertically, more and more of the value added of applications is going to large scale economy infrastructure products, tools, and other software. SAP, Baan, and Peoplesoft are clear examples of this movement toward general solutions emerging out of specific custom software investments. Their efforts to create tools to enable non-technical business users to create their own software applications will only accelerate this trend. Of course, new applications are constantly being invented, so there are constantly new opportunities for localization and specification. But they too will follow the trend toward greater exploitation of global scale economies over time. Thus PPPs seeking to earn rents more and more must answer our first question with "must go global." This raises the bar for successful government intervention at the local level.

The second question is whether local firms have the capabilities for global competitiveness and whether local markets form an effective basis for either horizontal competition entering overseas markets or vertical competition taking overseas complementors' rents. There is a large plateau effect. Domestic firms will have every incentive to treat the assistance they obtain from government as an entitlement to rents in the narrow domestic market. It is a large and risky investment for them to either seek overseas markets horizontally or to compete vertically. And governments have clear political incentives to continue to protect domestic ICT firms. Unless government can make credibly commitments not to continue protection and thereby force domestic firms take those steps, the effect of government action will be to have erected exit barriers. The incentive effects created by government intervention thus cut against effective moves to global competition.

5. IMPLICATIONS FOR GOVERNMENT INTERVENTION

Breaking down the requisites for successful government intervention in ICT markets in the previous section underscored two points: there are more opportunities for entry and larger gains to be had in current ICT markets, but the difficulties in using government policy to capture these rents for local suppliers have grown. These observations flow from our previous discussion of how changes in market structures and regulatory arrangements have altered competitive dynamics in ICT

markets. The purpose of this section is to expand the discussion by explicitly addressing how particular marketplace dynamics will impact the efficacy of public policy efforts. Our general conclusion is that public policy efforts are likely to be ineffective in most—but not all—cases.

5.1. The Importance of the Knowledge Base of Complementors

Our previous discussion of commercialization and co-opetition highlighted the importance of timely access to the knowledge bases of complementors in neighboring technological segments for competitive success. The end of vertically integrated suppliers providing total technological solutions to buyers (the IBM model) and the emergence of large numbers of niche players supplying pieces of the overall value chain has meant that complements must be aware of developments in neighboring segments to make technological bets and ensure compatibility. The "market orientation" of firms is thus increasingly central to competitiveness in vertical disintegrated ICT markets.

The central role of the United States, in particular Silicon Valley, in defining technological standards and trajectories in global ICT markets means that any public policy strategy must enable local firms to tap into the knowledge base of this key node. At a minimum, this implies that singular national or regional strategies will be problematic. Top-down strategies to create global competitors absent interaction or at least orientation toward technological trajectories in Silicon Valley are doomed to be expensive failures. The recent history of Minitel is suggestive of these dynamics: failure to orientated toward global competitors and technological bets of large players doomed even good embedded local technology with existing network externalities. The growth of beta testing as a means for cutting edge technology firms to communicate with and receive feedback from key customers and complementors suggests that co-invention is becoming more rather than less importance in converged markets. Being "part" of Silicon Valley has increased in importance because of this.

This is not to suggest that it is impossible for globally competitive firms to emerge outside the United States, nor that it is impossible for governments to grow local firms into global competitors. As we have already noted, Taiwanese hardware firms and Israeli networking software companies have created nodes of excellence outside the United States. Similar examples might include the software industry in India and Ireland. But these non-U.S. nodes have been successful (in contrast to other failures to create locally competitive firms) precisely because they have been oriented to market and technological developments in the United States. Carving a particular technological niche for local firms to grow into global technological leaders is thus not impossible. But these non-U.S. firms must increasingly be attentive to the technological bets of leading U.S. firms rather than on the bets placed by local complementors or the demands of local buyers (especially if local complementors and buyers are not cutting edge demanders). Traditional government policies that protect local firms are thus likely to be ineffective unless they

encourage or enable these local–global knowledge transfers. In short, cutting off the local from the global is likely to be an invitation for technological backwardness and continued government subsidies to uncompetitive local firms.

5.2. Economies of Scale: Costs and Network Effects

The emergence of dominant firms in particular niches increases the importance of global scale for two reasons. First, there are large economies of scale and learning effects in most segments in ICT markets. In semiconductors and hard disk drives, for example, volume production is central for competitiveness as it enables firms to move down learning curves and dramatically increase yields. Likewise, in software, large up- front development costs mean that global suppliers will be able to price products much lower than small, local players. Splitting large fixed costs over large volume thus advantages the global over the local. Second, network effects created by buyers investments in technology and accompanying training and expertise push markets toward single dominant solutions. Two aspects are worth noting. First, buyers want compatibility. Large buyers want similar technological solutions across the firm (hence the advantage of IBM e-services over local services providers), while small buyers create their own network externalities by making investments in particular technologies. Both large and small buyers prefer Microsoft Office over other software due to these forces, for example. Second, very small global niches are increasingly part of global ICT markets, implying that broad-based competitors lacking specific technological competencies are likely to face competition from global complementors with superior technology in a specific niche. The success of GeoCities and Yahoo (and its' specific local incarnations), for example, is primarily a story about small firms capturing value in niches and quickly eroding the share of local providers. Network effects are increasingly important in the success of ICT firms offering new internet-based services. The Silicon Valley cliché of building "mind-share" reflects these underlying competitive and economic dynamics. The global reach of the internet only increases the potential for new technology to quickly create its own network externalities and thereby make it difficult for local firms to capture value.

The cost advantages of global providers and network effects both of these cut against public policy designed to protect the local unless tied to global systems. They also cut against strategies focussed on extracting rents from local customers, simply because local customers are increasingly tempted to buy from global suppliers (given costs savings and compatibility, as well as new found regulatory freedom to do so). The Japanese push to create a Japan-specific operating system is one well-known effort—and failure—in the face of scale economies in global ICT markets. Today, low barriers to entry and numerous potential new niches in ICT markets, which at first blush might suggest openings for government efforts to support the local, only increases the importance for new entrants to quickly achieve global competitiveness. Put differently, new entrants are increasingly either quickly achieving global economies in particular niches or withering on the

vine. The success of a wide range of ICT firms—ranging from eBay to Amazon to Inktomi to Dell to Oracle applications to IBM—are suggestive of these dynamics. Ultimately, as in the PC era, the importance of network effects implies that market success will come to the platforms that most quickly convince the largest number of buyers and developers that they will succeed.

Public policy efforts focussed solely on the local are particularly ill suited to convincing marketplace players that local bets are likely to emerge as global platforms. Fundamentally, there are two sensible entry points. One emphasizes local demand, and seeks, having learned to satisfy it in a unique way, opportunities to lever that knowledge globally. A firm responsive to local customers could thus ultimately hope to become the next SAP or Baan. The other sensible entry point seeks to get directly into the global technology business. Here the right strategy is to ignore local demand and think about worldwide (especially U.S.) technology and market complementors. Both of these entry points depend on local firms becoming global competitors, however. Equally important, both must convince local demanders that local initiatives have some chance of emerging as global platforms. In a world of network effects and significant cost savings from economies of scale, this is a difficult task.

5.3. Barriers to Entry

Co-opetition means that one is compelled to share important technological knowledge with firms in neighboring vertical segments that would like to steal one's business. Capturing value in markets characterized by such vertical competition, as we discussed above in Section 2, rests on either technological prowess or close (and preferably strategic for the customer) links with customers. But these positions are hard to maintain given the low barriers to entry in current ICT markets. In particular, the ease of new entry from either local or global providers into network-based computing or software means that firms constantly face commodification of their value added from neighboring complementors.

These facts mean that it is difficult for public policy to protect local firms from global competitors. To be sure, public policy can be used to protect local firms in small segments or where computing is close to the regulatory powers of governments. France's announcement that it would only license a single trusted third party (TTP) for verification services for electronic commerce in France is one example of where government control over domestic financial systems can be used in ICT markets. But these niches are likely to be small and unlikely to lead to global competitors in these segments. Rather than a strategy to capture global verification services business for the sole French TTP, for example, French public policy is likely to do nothing more than put a hidden tax (by creating a monopoly) on all network users in France. This is hardly a recipe for using public policy to capture rents in global ICT markets.

Moreover, we believe that these opportunities are likely to be few and far between. The example of Minitel is much more likely to be emblematic of how low

barriers to entry will make local government-firm efforts difficult. Minitel had all the advantages that a local firm could wish for: cutting edge technology, long lead time, government support, and a tremendous installed base and local network externalities. Yet Minitel has been unable to stifle the entry of the Internet and the accompanying suppliers. The inability of Minitel—in many ways a best case scenario for local suppliers—to block the entry of superior global technology is indicative of the difficulty in capturing value even if local solutions are at one point superior

5.4. Easily Influenced Vertical Layers Are Strategically Weak

Our discussion of vertical competition in Section 2 implies that governments can help local firms capture rents in ICT markets in two ways: (1) by helping them develop leading edge technology, or (2) by assisting in developing solid and strategic customer linkages. The question is thus whether or not those segments which governments are most poised to enter are either technologically central or strategic for buyers?

A closer look at the segments of the value chain where governments are best poised to shape markets suggests that government tools may be useful for steering demand in commodity segments to local producers, and less useful for capturing rents in global ICT markets. Take the current debate over standards for third generation cellular telephony. Setting a standard, even on a regional basis, gets you into the game of dominating hardware and telecommunications infrastructure. But this does not guarantee that this segment will capture the lion's share of rents in the wireless business. It could easily be the case that such standards setting actions capture commodity segments for national firms while leaving more rent-producing activities—the variety of advanced wireless services being promised for third generation wireless—open to entry from foreign providers. Indeed, our previous discussion of the importance of co-invention and demand pull in computing markets leads us to be skeptical of claims that dominating hardware and physical connection with customers will ensure that the leading edge and rent-generating segments accrue to those firms with control over the infrastructure.

Moreover, our analysis of vertical competition shows that control over one standard does not guarantee results, if there are complementors/competitors who control other standards. The case remains to be made that transmission standards in the hands of PTTs will be strategically better bets than switching standards in the hands of Cisco or online payments standards controlled by Visa or MasterCard. There are two distinct problems. The first is that the transmission standard is closely related to a low-value activity. While control of both wireline and wireless activity is a bottleneck, it is hard to see how, other than power (that is, direct regulatory restrictions on entry into value-added segments), it is a springboard into higher-value services. Controllers of such a standard will be well posed to avoid being driven to exit. But they will be badly positioned to steal the rents of higher-value complements. The second problem is that the suppliers are PTTs. Optimized by

years of improvement for the regulatory environment, these organizations neither decide fast enough nor market responsively enough to be much of a threat to the rent-earning firms whose products will complement transmission. The inability of most incumbent telcos to implement winning strategies in data services illustrates the point. They will be sitting ducks.

There are other areas of ICT markets where governments could intervene to structure markets. This is the work of national and regional regulatory agencies, agencies that are unlikely to simply go away. The problem in regards to efficacy of capturing rents for local players is that these policy actions are likely to do little more than steer local firms into weak strategic positions in a world of vertical competition. This is true largely due to the importance of economies of scale in global ICT markets and the constant efforts of competing firms to commodify your business. The local telephony switch or local cells or hardware are attractive, for example, because they are within the reach of the local government and local partnership. But they are not attractive as strategic positions because they are easily commodified and do not help local suppliers secure strategic links with buyers. IP telephony, for example, has already begun to erode the position of both POTS and telephony equipment suppliers (as suppliers of data switches, notably Cisco, are rapidly capturing this market).[37] The lack of close customer connections in a strategic sense re-enforces the weak technological position of those areas subject to easy government intervention. The fact that the bit pipe is not strategic for customers means that neighboring firms will be able to dislodge these relationships easily. And in a world where there are large cost economies for global providers, we anticipate that low cost global firms will indeed challenge national providers on their home turf. Whatever the outcome of this battle, the bit-pipe will not likely be a large rent position.

5.5. Where Government Intervention Might Work

We have argued that close ties to knowledge base of complementary firms, economies of scale, and low barriers to entry mean that public policy intervention in ICT markets is unlikely to be effective in steering rents to national firms. But we do not want to suggest that public policy will be useless in all cases. Indeed, we believe that public policy can be effective in some circumstances, despite suggestions to the contrary.[38] Our point is thus not that governments can no longer effect markets, but that public policy will be ineffective in helping national firms reach positions of international leadership in most—but not all—ICT segments. Specifically, we believe there are two areas where public policy can still play an

[37] This is true even if we assume that governments will be ill-behaved about their commitments to open and transparent regulatory rules for national telephony networks.

[38] For example, some analysts suggest that callback, internet telephony, and other technological advances will undermine the ability of governments to regulate telecommunications. We believe, on the other hand, that governments will continue to be important players in the regulation of telephony. Witness the ability of India and Pakistan to block the use of IP telephony on their domestic networks.

important role: (1) By defining technical standards in ways that help local firms secure strategic links with customers, and (2) by facilitating the competitiveness of local firms that have advantages rooted in the distinctive style and content of a particular country.

The first arena where public policy might be effective is in defining technical standards in ways that advantage national or regional firms. Telecommunications networks are the classic example in which network standards can be set such that national or regional hardware manufacturers dominate physical links to customers (or achieve scale economies). This strategy transforms customer linkages into strategic relationships or positions of technological leadership that enable local providers to capture local rents en route to global competitiveness. The downside for public policy is that governments can do little to push local suppliers to innovate in ways that lead from supplying infrastructure and hardware to supplying more strategic assets. IBM has managed to leverage its' dominance in computing technology into a broad range of services offering that are strategic for customers, for example, but there is no guarantee that technical linkages can be used as bridges to strategic customer relationships or technological leadership. Furthermore, as our discussion of the weak strategic position of the bit-pipe above noted, many of the technical or infrastructure standards positions are occupied by firms whose organizational structures are not "market oriented." Firms with organizational structures optimized to working in regulated environments may not move quickly enough to build positions able to fend off vertical competition from complementors. Despite these drawbacks, public policy can still use technical standards to define connections to customers in ways that secure some rents accrue to local firms. Our previous discussed of French efforts in licensing Trusted Third Parties for online value transfers is indicative of how this might work: French public policy efforts could define local customer connections and thereby enable substantial scale and scope effects to push French firms into positions of global leadership. But there is no guarantee that such strategies will work, particularly if protected local firms are not market oriented and do not stay abreast of global technological trajectories. Ultimately, the difficult challenge is in creating policies that support the creation of local firms that can capture rents in global ICT markets as opposed to exit barriers and on-going subsidies for domestic firms.

The second arena where public policy can be effective is in facilitating the competitiveness of firms supplying new applications that draw on the way local firms are organized. That is to say, governments can help firms that have competitive advantages rooted in the distinctive style and content of a particular country. In France, the government encouraged Minitel by defining a technical standard for exchange of messages or networked information services. The success of Minitel rested less on the technical standards than on an understanding of the way in which the French would use the service. Today, differences in the way people buy things in the store may enable local competitors to provide different solutions that may ultimately become international winners. Commercial opportunities, in short, may

arise out of differences in content and style. The success of Baan and SAP reflect this dynamic: they grew out of applications for customers that reflected European buyers demands rather than top-down initiatives by former national champions. These successes are notably because they reflect the importance of close attention to customer needs and are contrary to what governments have the largest political incentives to do (protect old-line computing and telephony firms). The fact that there are naturally occurring differences in style and content between countries ultimately means that there are opportunities for governments to influence the process of co-invention and facilitate the success of local firms in international markets.

Why do we believe that these two segments represent the best opportunity for public policy initiatives? The problem for government initiatives elsewhere in the value chain of ICT markets is that in between technical standards and applications there is commanding dominance by U.S. firms. Imagine a non-U.S. government trying to set an Internet or OS or microprocessor standard. We have already noted the importance of economies of scale and buyers' investments in defining global standards in particular ICT niches. The dominance of the United States means that it is extremely difficult for non-U.S. firms to independently set these standards and achieve the requisite network effects and economies of scale. It would be very difficult for a French GeoCities to displace the dominant position enjoyed by the incumbent, for example. These forces will only intensify as the Internet expands (increasing network effects) and ICT markets mature (i.e. the level of investment increases in existing ICT hardware and software). These forces cut against a reversal of this dominant U.S. presence in the large middle of the value chain in ICT markets.

6. CONCLUSION

In this essay we have considered some of the implications of changing competition in ICT for the efficacy of certain public policies. These are policies that advantage national firms (national here refers to the scope of the protecting government, thus includes EU as well as member states' efforts) by regulating, taxing, influencing, or limiting nationals demanders' choice. We offer an extensive analysis of the changing circumstances of competition in those industries, and with an analysis of the likely competitive position of local firms supported by governments. Our most important message is that such governmental initiatives, while likely to be frequent in the current competitive environment, are not likely to be frequently successful.

This dichotomy in our predictions about policy follows from an underlying market dichotomy. There have never been more opportunities to enter into ICT, nor has the most important local competitive asset, connection to customers, ever been more valuable. A parallel goad to entry is that longstanding local rents, such as those in telephony, are coming under global threat. Thus many local public-private

partnerships will be tempted to enter ICT. At the same time, the competitive environment in ICT has changed. The most important change is to vertical competition. Existing global technology firms will have, over the intermediate term, every incentive and many opportunities to compete for the rents won by new entrants. New entrants seeking to earn global rents will need many of the advantages built up by the existing global successes: speed, a new lexicon of competitive and cooperative management skills, access to the best worldwide technologies and personnel, and close connections to such centers of innovation as Silicon Valley. Some of these things are hard to come by because a PPP is local, others, because it is protected, still others, because of the pace of change in ICT. Thus, we anticipate that PPP entrants will be well represented in the late stages of the ICT entry process in the period following commercialization of the Internet, and very well represented among the losers in the shakeout that follows.

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