The Emerging Economies in the Digital Era:
Market Places, Market Players, and Market Makers

BRIE Working Paper 167

Naazneen Barma
Department of Political Science
and BRIE
University of California, Berkeley
naaz@berkeley.edu

March 17, 2005

Prepared for inclusion in John Zysman and Abe Newman (eds.) *How Revolutionary was the Revolution? National Responses, Market Transitions, and Global Technology in the Digital Era*. (Stanford University Press: Forthcoming 2006)
This research was generously supported by the Pacific Rim Research Program.

Abstract

This paper directs analytical focus to the roles that emerging economies can and do play in global digital innovation. In doing this, it challenges the conventional wisdom that developing countries are merely market places for digital products innovated in the industrialized world, sketches out some key patterns in the roles of emerging economies in the processes of global digital innovation, and examines their innovative potential by assessing their capacity in terms of research and development and innovative activity. Emerging economies are fast-growing and hence increasingly important market places, with their increasingly sophisticated users just beginning to exercise their power in dictating the future of digital consumer products. Emerging economy enterprises are also increasingly relevant market players, having leveraged their success in home markets into inroads in global markets through a number of distinctive competitive advantages. Finally, emerging economies also have great potential as market makers: they have the opportunities to shape future global digital markets as a result of their own prowess in digital innovation and the complementary resources they have to offer.

In terms of the innovative potential of emerging economies, this paper argues that while advanced countries are the main purveyors of radical, breakthrough digital innovation, emerging economies will continue to find that their strength in shaping global digital markets, at least in the short and medium term, lies in the experimental modular innovation that is achieved through improvements in specific applications driven by on-the-job learning-by-doing and user-driven product modifications. While different forms modular innovation in emerging economies may not necessarily pose a direct challenge to currently dominant digital producers, they do, however, have the potential to alter the structure of future global digital markets. Thus, both in terms of their market power and their production and innovation possibilities, emerging economies are positioned to increase their presence in the digital era.

The Emerging Economies in the Digital Era:

Market Places, Market Players, and Market Makers

Introduction

The fast-changing global digital economy presents enormous prospects for emerging economies. They have the opportunity to reap the dramatic gains available in the world's fastest-growing markets and the chance to participate in cutting edge technological activities through cross-national production networks. Many assume that advanced countries, fueled by dynamic innovation, hold an incontrovertible economic and technological lead over the poorer parts of the world. This paper, however, challenges the view that developing countries are merely passive market places for digital products innovated in the industrialized world and directs analytical focus to the roles that emerging economies can and do play in global digital innovation. It illustrates how explosive market potential in poor countries translates into new innovative forces there, sketches out some key patterns in the roles emerging economies play in the processes of global digital innovation, and examines their innovative potential by assessing their research and development capacity. While recognizing the significance of the digital divide between industrialized and developing countries as one of the central features of the international political economy, this paper's approach runs against the conventional academic view that the divide is about usage or access, issues to which much empirical and policy attention has already been devoted (Box 1).

Box 1: The "Digital Divide"

The international "digital divide" can be conceived of as the gap between developed and developing countries in terms of information and communication technology (ICT) implementation, access, and usage rates.[1] It is a phenomenon that has inspired a great deal of assessment. Hundreds of reports have attempted to take stock of the gap in ICT diffusion across countries, and particularly between the North and South.[2] Conventional wisdom, as

[1] I follow Dunning's (2003) definition of the "digital divide". See bridges.org (undated report, pp. 88-91) for a discussion of different possible conceptualizations and measurements of the digital divide.

[2] Bridges.org, in taking stock of the state of knowledge about the digital divide, lists over fifty reports, surveys, and assessments (undated report, pp. 92-97).

represented in newspapers and magazines, development organization perspectives[3], and the scholarly literature[4], tells us that information technology may have tremendous implications for economic development. The most Pollyanna of such views are techno-determinist, treating ICTs as a silver bullet for slaying developing country woes, with the potential to vault the poor of the world into virtuous cycles of development. In such formulations, emerging economies can "leapfrog" along developmental paths aided by the potential wealth of a successful and growing information technology sector and the beneficial spillover effects it has on other sectors of the economy. A gloomier mindset has begun to emerge also, however, as numerous attempts to enact IT-driven development strategies have stalled in implementation as they meet unforeseen obstacles. This more pessimistic view emphasizes the fact that the digital divide is growing between industrialized and developing countries, further miring the latter in poverty as IT-driven productivity continues to spur economic growth in the former.[5] In particular, as developed economies continue to create networked production systems that depend on advanced digital systems, the countries that are not connected on these terms may be deeply disadvantaged. In this sense, "fairly sophisticated information technology capabilities should be thought of now as prerequisite to effective interaction with the world economy."[6]

It is essential to note from the outset that the developing world comprises a large and extremely varied group, individual members of which respond in very diverse ways to the digital economy. The optimal uses of information and communication technologies (ICTs) vary widely across developing countries, as does ICT-related government policy[7]; consider, as an exaggerated example, the need to distinguish between the state of ICT use and access in sub-Saharan Africa versus East Asia. Yet, for the purposes of considering the production possibilities represented by the digital era for the developing world, it makes sense to focus analytic attention on those newly industrializing countries, or emerging economies, that are increasingly able to break into digital production networks. Indubitably, modes of innovation and production profiles vary within this smaller subset of the developing world. Nevertheless, these emerging economies as a group adjust to the new economy in patterns that are different from those in advanced economies.[8] This paper seeks, therefore, to shed light on discernible patterns at the micro – firm or market – level, as well as considering the national and international dimensions of an innovative environment.

While advanced countries are the main purveyors of radical, breakthrough digital innovation,

[3] See for example, World Bank (2002), UNDP (2000), UNCTAD (2002), DOT Force (2001).
[4] See, for example, Kramer and Dedrick (1994), Yue and Lim (2002), Braga, Daly, and Sareen (2003).
[5] Bridges.org (undated report) documents the growing international inequality represented in the digital divide.
[6] Weber and Barma (2003): 17
[7] On this topic, see, *inter alia*, World Bank (2002), UNDP (2000), UNCTAD (2002), DOT Force (2001).
[8] Building on Weber and Zysman (2002): 2

emerging economies are likely to find that their strength in shaping global digital markets, at least in the short and medium term, lies in a different manner of innovation. In particular, emerging economies have begun to pursue two main avenues of non-breakthrough innovation that are increasingly significant in the digital economy. The first type of non-breakthrough innovation comes in the form of improvements to specific modular applications within a digital production chain that often come from on-the-job learning-by-doing. The second form of non-breakthrough innovation that emerging economy enterprises have successfully introduced into the global economy center around modification of the production and distribution of modular applications to meet the unique needs of their home markets.

I characterize these non-radical forms of innovation as "*modular innovation*." The concept builds on the insight that the prevalence of networked production in digital sectors has enabled the producers of modular applications in global production chains to become the innovative center of the digital economy.[9] The modular innovations purveyed by emerging economy firms can and have come in both improvement of the product itself as well as organizational and marketing modifications, particularly those that take into account the characteristics of new emerging economy consumers and commercial infrastructure. Modular innovations can hence be both *product*- and *process*-oriented. In dynamic terms, they can cumulate over time into a trajectory that matches or even surpasses the impact of innovations on the technological frontier. The global economy is comprised of comparative advantages that map to different sources of innovative potential. Capital-rich advanced countries have the means to finance the expensive research and development (R&D) necessary for radical innovation. Newly industrializing economies can rely on their rich human resources , track record of organizational innovation, and huge markets of increasingly sophisticated consumers to make technological advances through processes of learning-by-doing and user-driven innovation.

[9] Borrus and Cohen (1998) argue that the growth of networked production and thereby the commodification of a growing range of advanced intermediary products is a major structural change in the competitive dynamics of the digital industry in the past fifteen years.

This paper is organized to examine the different roles that emerging economies can and do play in the global digital economy and in ICT innovation. They are indeed market places, but fast-growing ones with explosive potential; thus, rather than being passive recipients of ICTs innovated in the advanced world, they have the power to dictate the future of digital consumer products. In addition, they are increasingly relevant market players, particularly in terms of their niches in the cross-national networks of digital production and in their role of producing and distributing modular applications for home market uses. Finally, and most recently, emerging economies also have great potential as market makers: they have the opportunities to shape future global digital markets as a result of their own prowess in digital innovation and the complementary resources they have to offer.

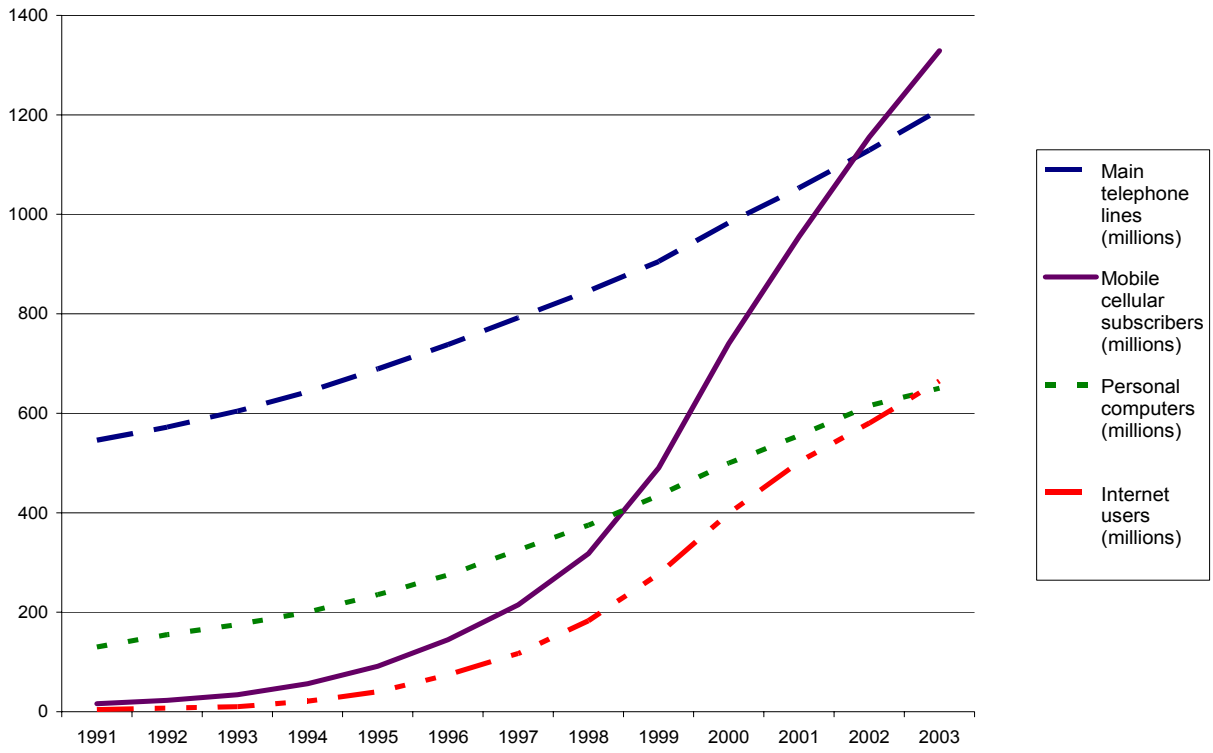
Market Places: The Next One Billion Digital Consumers

While the digital economy continues to grow globally, poor countries represent the market potential of the future. And they are no longer simply the passive recipients of products and services innovated by and for the advanced world. They have their own very specific needs and tastes, and their buying power is sufficient across a number of different market segments to warrant the supply of customized products. Hence poor consumers are increasingly driving modular innovation in production technologies, business models, organizational management, and marketing and distributional strategies. These modular innovations are an essential type of the new value creation patterns required in the global digital economy, where the levers of advantage are constantly shifting.

It is instructive to place the market power of the emerging economies within an international context. Global growth in information and communications technology use has been robust over the last decade (Figure 1). Most strikingly, mobile cellular subscribers numbered 16 million in 1991, and shot to 1,329 million by 2003, overtaking mainline telephone lines at the turn of the millennium. While computer users have increased steadily, from 130 million in 1991 to 650 million in 2003, Internet connectivity has

grown much faster, from 4.4 million users in 1991 to 665 million in 2003.

Figure 1: Global Information and Communications Technology Users (in millions)[10]



Yet growth in digital industries is far from even across the world. It has become almost axiomatic in ICT business strategy that the newly industrializing economies offer fast-growing and incompletely tapped markets. The thirty advanced, industrialized countries that make up the Organization for Economic Cooperation and Development (OECD) count for less than one-fifth of the world's population. On the other hand, China and India together make up more than one-third of the world's population, an ever-increasing share due to population growth rates.[11] The emphasis on emerging markets comes from a pragmatic need: as the traditional markets of the digital era mature, companies must reach out to a new set of customers. During the last fifty years, about one billion people have come to use computers, the vast majority of them in North American, Western Europe, and Japan. Yet these markets have slowed in

[10] Data are from the International Telecommunications Union (ITU): World Telecommunication Indicators Database.
[11] Population data are from the U.S. Census Bureau (mid-2004 statistics) and the OECD (2003 statistics).

growth: computer industry sales in the U.S. are expected to increase on average only 6 percent per year for the next five years; while emerging market demand is expected to increase at an average rate of 10 to 11 percent over the same time period.[12] Thus, in order to continue to grow, digital industries must reach out to "the next one billion customers"[13], who will come not from the industrialized world but rather from newly emerging markets. Digital era growth opportunities for rich country businesses thus seem to be shifting inexorably to the developing world.

As Prahalad and Hart have argued convincingly, "low-income markets present a prodigious opportunity for the world's wealthiest companies."[14] Already, tech companies are scrambling to make their mark in the emerging economies and cash in on the next big growth wave of the digital revolution. In 2005, annual IT-related investments are expected to grow about 15 percent to $32 billion in China and 21 percent to $8.5 billion in India.[15] Emerging markets – led by China, India, Brazil, and Russia – are expected to see ICT sales surge 11 percent per year over the next five years, to about $230 billion. These markets are so appealing to rich country companies not just because of sheer population size, but particularly because of the growing ranks of the middle class – a new base of consumers for digital products, estimated at 60 million in China and 200 million in India and growing fast.[16] A.T. Kearney has estimated that the number of people with equivalent to $10,000 in annual income will double to 2 billion by 2015, with 900 million of these new consumers in emerging markets.[17] Prahalad estimates the potential profits from serving the poorest five billion people in the world – a group he dubs the "bottom-of-the-pyramid" – at $13 trillion per year globally.[18] He values the purchasing power parity (PPP) of a fast-growing group of emerging economies – China, India, Brazil, Mexico, Russia, Indonesia, Turkey,

[12] IDC data, cited in Hamm (2004): 82, 86
[13] Hamm (2004): 82
[14] Prahalad and Hart (2002); see also Prahalad (2005).
[15] IDC data, cited in *South China Morning Post* (2005).
[16] IDC data, cited in Hamm (2004): 84
[17] Hamm (2004): 86
[18] *The Economist* (2004)

South Africa, and Thailand, together representing 3 billion people or 70 percent of the developing world's population – at $12.5 trillion, or 90 percent of the PPP of the developing world. This is larger than the combined PPP of Japan, Germany, France, the United Kingdom, and Italy.[19]

In terms of emerging markets for digital products, more specifically, China had an installed base of 250 million cellular phones at the end of 2003. [China Telecom is the largest mobile cellular operator in the world in terms of usage, with an annual growth rate of cellular subscribers in the past few years upwards of 60 percent.[20]] India had an installed base of about 30 million cellular phones, growing at 1.5 million handsets per month, with the expectation that Indians will own 100 million handsets by 2005. Brazil already has 35 to 40 million cellular phones.[21] Table 1 demonstrates that while ICT usage per capita remains much lower in emerging markets than in the richer countries, growth in ICT usage has been torrid over the last decade in the countries Prahalad and others name as the emerging markets to watch out for.

Table 1: Growth in Information and Communication Technology Use in Select Countries[22]

	Telephone mainlines (per 1,000 people)		**Cellular subscribers** (per 1,000 people)		**Internet users** (per 1,000 people)		**Personal computers** (per 1,000 people)
	1990	**2002**	**1990**	**2002**	**1990**	**2002**	**2003**
United States	547	646	21	488	8	551.4	658.9
Japan	441	558	7	637	0.2	448.9	382.2
Finland	534	523	52	867	4	508.9	441.7
Mexico	65	147	1	255	0	98.5	82.0
Russian Federation	140	242	0	120	0	40.9	88.7
Brazil	65	223	..	201	0	82.2	74.8
Thailand	24	105	1	260	0	77.6	39.8
Turkey	121	281	1	347	0	72.8	44.6

[19] Prahalad (2005): 11
[20] International Telecommunications Union (ITU).
[21] Prahalad (2005): 15
[22] Source: United Nations Development Program (UNDP) Human Development Indicators 2004; calculated from the International Telecommunications Union (ITU) World Telecommunications Database, 7th ed. Personal computer data are taken directly from ITU.

China	6	167	..	161	0	46.0	27.6
Indonesia	6	37	..	55	0	37.7	11.9
South Africa	93	107	..	304	0	68.2	72.6
India	6	40	0	12	0	15.9	7.2
High income	420	584	13	653	3.1	445.8	
Middle income	49	168	..	176	0	59.5	
Low income	6	28	..	17	0	13.0	

Digital industry giants have declared emerging markets a top priority, and are pushing their products there aggressively, vying with each other for lucrative government contracts as well as for new middle-class consumers. For example, Sun Microsystems, Microsoft, and IBM have competed ferociously for deals with telecommunications and software firms in India, as well as for enormous state-by-state government contracts. Microsoft famously got off on the wrong foot in China: while it owns the desktop market there, it earns little money because 97 percent of its software is illegally copied. Every time Microsoft pressures the government to crack down on piracy, however, the state makes a move to support Linux, the open source operating system rival to Windows. [See Box 2 for more on the role of governments in the use of open source and free software in the developing world.] Yet Microsoft is pouring in $750 million in aid to China over the next three years to help develop a software industry infrastructure, on top of the $1 billion it spends there annually in running its business.[23] IBM's revenues in Brazil recently surged past the $1 billion mark; the company plans on hiring 2,000 people in Brazil and spending an additional $100 million on market development there.[24]

Box 2: Government as IT Customer – A Case Study of Open Source and Free Software in the Developing World

As the newly industrializing countries continue to modernize, their governments are increasingly important information and communications technology customers. In these nascent markets, governments act very much as lead users who, with their choices, may push countries toward particular ICT trajectories. For example, in India, over half of all ICT purchases are made by the government or the public sector, which are required to use indigenous sources when available. At the very least, since government is such a large consumer in proportion to private interests in many emerging economies, government purchasing decisions may tip a market toward one particular form of a product over another.

Developing countries have multiple, sometimes conflicting objectives vis-à-vis their positions in the

[23] Leander (2004)
[24] Hamm (2004): 84

international economy. Simply put, "catching up" to the industrialized world is an obvious developmental objective, but it is not the only one. A number of poorer countries have adopted aggressive policies to beat the industrialized countries at their own game.[25] And, harking back to the Marxist and *dependencia* writings of the mid-1960s and 1970s, a desire for independence and autonomy from advanced country influence is still a powerful driving force for many developing country governments. Furthermore, national security objectives continue to be fundamental in a world of sovereign states. It is certainly possible that an alternative model towards information technology strategies is evolving in the developing world, particularly one based on the goals of developmentalism and national security rather than liberal democracy.[26] These objectives may sometimes be conflicting, but they are not mutually exclusive.

An examination of the adoption and potential impact of open source and free software (OSFS) applications in the developing world is instructive in understanding these broader political motivations.[27] The availability of OSFS on specific non-proprietary licensing terms offers economies an alternative to proprietary software, along with what are often critical decisions that affect possible IT trajectories in a country.[28] Over the past five years, governments around the world have begun to consider legislation that requires the use of OSFS whenever it provides a feasible alternative to proprietary software.[29] This phenomenon has been particularly pronounced in the developing world as poorer nations, struggling with limited IT budgets, look to the potential gains from deploying OSFS solutions in the public sector. Researchers have concluded that lower labor costs and higher licensing fees tilt the debate about the total cost of ownership in favor of OSFS over proprietary software in most developing countries.[30] Proponents of OSFS have also articulated its advantages in dealing with mounting security concerns by providing public data accountability and transparency. In addition, as with other IT strategies, governments have considered the potential contribution of OSFS deployment to nascent local software industries and IT human resource capacity building, as well as potential spillover effects into other sectors of the economy.

As mentioned earlier, government moves to mandate the use of open source operating systems in the public sector have been sufficiently threatening to rich country companies that they have made counter-moves to address the issue. Microsoft is to begin selling a cheaper Windows version in Thailand, Indonesia, and Malaysia in an attempt to beat back the open-source threat in those countries. Sun Microsystems has, on the other hand, signed a deal with the Chinese government to supply its Linux desktop operating system and office program to as many as a million personal computers.[31] It remains to be seen which of these strategies will be more successful in cornering these lucrative markets.

What makes the emerging economies crucial in terms of innovation, however, is not just their sheer market volume potential. In developing countries, the world's wealthiest companies find consumers with unique needs and varied tastes. These middle-class emerging economy consumers may have lower incomes, but there is sufficient buying power across the huge numbers of people in these growing market segments to drive demand for products that are customized to their needs and tastes. These sub-markets are thus significant enough to drive modular innovation, particularly in specific

[25] Consider, for example, the inflamed passions and rhetoric surrounding the rise of the East Asian tigers, such as the trade disputes and the "Asian values" debate.
[26] Winter, W., as cited in Ayish (1992): 500.
[27] The discussion of motivations surrounding the adoption and use of open source and free software (OSFS) applications in the developing world is adapted from Weber and Barma (2003).
[28] See Weber (2003) and Weber and Barma (2003) for a definition of open source and free software and a discussion of the economics and political implications of OSFS solutions.
[29] See Weber and Barma (2003) for a catalog of such initiatives.
[30] Leander (2004): 3
[31] Leander (2004).

digital applications and in organizational form to respond to the existing commercial infrastructure. The innovative challenge lies in tailoring new products to these consumers and taking advantage of their uniqueness, and this requires wholesale change. As an example, emerging market consumers are younger and less loyal to brands than their Western counterparts. Brown and Hagel report that these new demographics and consumer patterns are forcing companies to rethink the manner in which they design and deliver their products, and a growing number of established digital vendors acknowledge that returning to the drawing board is the only option in the emerging markets.[32] Furthermore, advanced country companies are increasingly recognizing that if they are not competing in the growing emerging markets, they are not developing the capabilities they will need to remain viable back home in the near future. Providing goods and services for poor consumers forces companies to innovate in the ways that will continue to promote long-term success.[33]

As Prahalad points out, "If we stop thinking of the poor as victims or as a burden and start recognizing them as resilient and creative entrepreneurs and value-conscious consumers, a whole new world of opportunity will open up."[34] As he further argues, and as rich country companies have learned the hard way, firms cannot profitably serve emerging market consumers with the products designed for advanced country consumers. In particular, in order to be profitable in the developing world, firms cannot simply provide hand-me-down products developed for rich customers. Rather, Prahalad argues, they will need to thoroughly re-engineer products in order to reflect the different customer needs and production and distribution economics at the bottom-of-the-pyramid: the demand for small unit packages that can be paid for with the limited cash-in-hand of poor consumers; and the necessity of a cost structure that can produce goods and services in high volume to compensate for the low margin per

[32] Brown and Hagel (2005): 37
[33] Brown and Hagel (2005): 43-44
[34] Prahalad (2005): 1

unit.[35] [Note that lower prices in emerging markets will likely put pressure on prices worldwide, which may mean that the ICT industry will not be able to sustain the revenue growth rates or profit margins of its past.[36]] In short, emerging markets are not implicitly stuck relying on commoditized, hand-me-down innovation from the developed world.[37] They have their own lead users who pull technology development towards applications that fit specifically their indigenous needs and demands.

In addition, selling to the world's poor requires investment in market development and, in some cases, the very creation of a commercial infrastructure that can unlock the latent purchasing power in emerging markets by creating buying power, shaping consumer aspirations and improving their access, and developing locally-tailored solutions.[38] For example, in recognizing the enormous business and development opportunities in emerging economies, Hewlett Packard has articulated its "e-inclusion" initiative, which focuses on providing technology, products, and services appropriate for the world's poor. Intel has a team of ethnographers traveling the world to provide input into designing or redesigning products to fit different cultures and demographic groups. This, in turn, leads rich companies to develop innovative new mechanisms and strategies for allying with other stakeholders on the ground in the developing world: non-governmental organizations, international financial institutions, and governments, as well as catering to local stakeholders and conditions and undertaking locally-tailored research and development. Following this logic, IBM has developed a $12 microprocessor and simple network computer that it supplies to Chinese companies that then sell computers and Internet access services in rural parts of the country; Hewlett Packard has agreed to install Poland's new computerized drivers' licensing system using a pay-as-you-go scheme.[39] In these ways, poor consumers can and will drive modular innovation in production technologies, business models, organizational

[35] Prahalad (2005) and Prahalad and Hart (2002).
[36] Hamm (2004): 85
[37] Weber and Barma (2003): 22
[38] Prahalad and Hart (2002).
[39] Hamm (2004): 84-85

management, and marketing and distributional strategies.

Market Players: A New Ecology of Competition in the Emerging Economies and the World

The demand of poor consumers for customized, low-cost, and well-distributed products and services has created a new ecology of competition and innovation in emerging markets. The industrialized world's most successful companies are finding tough competition on the unfamiliar terrain of emerging markets in the form of home-grown companies who know their local markets intimately and have grown up supplying to them. Furthermore, these enterprises from emerging economies have been able to leverage their home market advantages into larger inroads into worldwide markets. Yet a number of questions arise in examining emerging economy firms as market players. Are they actually competing directly with advanced country companies in their home markets, or are they targeting different market segments? Are rich country companies adequately addressing the evolving needs of lower income middle class consumers in developing countries, or are domestic companies successfully catering to their home markets in a vacuum of competition from overseas? From a survey of the anecdotal evidence available, it appears that emerging economy companies are competing quite directly with their overseas competitors, and that the former appear to have the edge on the latter in successfully gauging what their consumers want and need. At the same time, however, examining where emerging economy companies have been successful demonstrates that they may have specific skill sets and advantages that make their forms of competitiveness distinctive given the structures of the global digital economy.

First, emerging economy enterprises seem to be competing successfully in their home markets and making inroads into global markets on the basis of cheaper pricing structures and lower production costs. In China, for example, the new networking company Huawei can charge 50 percent less for gear than Cisco. It has captured a 16 percent home market share in routers, second only to Cisco, and is

starting to make inroads into global networking gear markets from Russia to Brazil, already ranking number two worldwide in broadband networking gear. Domestic service companies in India provide stiff opposition to foreign challengers. I-Flex Solutions, an Indian company which provides banking and software services, has built the world's top-selling software suite for managing consumer, corporate, Internet, and investment banking needs; its revenues grew 26 percent in one financial quarter in 2004, in a slow-growth worldwide enterprise software industry. I-Flex sells in over one hundred countries, with large competitive advantages from its Internet-based systems and low-cost Indian programmers.

Second, it appears that closeness to market allows emerging economy enterprises to capitalize on the demands and increasing purchasing power of their home market consumers. The South Korean companies Samsung Group and LG have taken advantage of the advent of the wireless age in East Asia to make their move away from the personal computer-centric era that has been dominated by US companies. While 30 million computers are expected to sell in Asia in 2004, this figure is dwarfed by the 200 million Internet-enabled cellular phones expected to sell there. Samsung and LG are taking advantage of their cellular phone lines rather than their personal computer lines; in the past four years they have risen to become the third and sixth largest mobile-phone makers in the world. TCL Mobile is one of the top two Chinese mobile handset makers, and its solid position in the largest cellular market in the world has given it an edge in other developing markets in Africa, Asia, and the former Soviet Union.[40]

For digital industry powerhouses, these different forms of competition in newly industrializing economies means that they will likely have to invest substantial sums of money to succeed in emerging markets. In addition, they will have to dramatically alter the very business strategies that made them so successful in the advanced world. Dell, for example, introduced a consumer PC in China, the SmartPC, that was different from anything it had sold before: "It came preconfigured rather than built to order, and it was manufactured not by Dell but by Taiwanese companies. At less than $600, the SmartPC has helped

[40] Examples of specific emerging economy companies in this section are from Hamm (2004).

Dell become the top foreign supplier in China. Its share of the PC market there rose from less than 1 percent in 1998 to 7.4 percent today."[41] Yet local Chinese companies Lenovo Group and Founder Electronics both rank ahead of Dell and other foreign hardware suppliers to remain the top PC sellers with market shares of 25.7 percent and 11.3 percent respectively. They have an advantage in reaching Chinese customers through vast retailing operations; when Dell set up retailing kiosks for the SmartPC and other products it faced competitors selling stripped down PCs for about $360 and had to withdraw from the consumer market.[42] IBM recognized Lenovo's potential when it sold its PC business to the Chinese PC maker in December 2004. The move signaled a recognition by IBM that its future in China will probably be most successful in close partnership with a local market leader. At the same time, the deal offers the Chinese the chance to tap into overseas markets and management and technological expertise, reflecting "the rising global aspirations of corporate China."[43]

Emerging economy companies have increasingly been able to beat out rich country competitors on their own home turf, with intimate local knowledge and low-cost, low-margin products. At the same time, some domestic firms are finding their strengths lie in niches in cross-national production networks as they take advantage of the constantly shifting determinants of competitiveness in the global economy.[44] This is the strategy that East Asian manufacturing firms used with great success in the 1980s as the East Asian Tigers became the original newly industrializing economies (NIEs) of the postwar era. South Korea, Taiwan, Hong Kong, and Singapore pursued economic growth strategies with important differences, but all were successful in responding to the major shifts that continue to determine competitiveness in the world economy today. Lall identifies these successful competitiveness adaptations as: a new pattern of competition marked by knowledge- and technology-based advantages

[41] Hamm (2004): 86
[42] Hamm (2004): 86
[43] *The New York Times* (2004).
[44] Borrus and Zysman (1997) identified the importance of cross-national production networks in the digital era, as the production organizational counterpart to "Wintelism", or the struggle over de facto product standards throughout the value chain.

rather than on factor endowments; the emergence of new, less hierarchical organizational structures where firms are embedded in dense technological and productive networks; and the restructuring of old industries driven by radical technological change.[45]

What all the East Asian Tigers did successfully was to move away from relying on low labor costs, and hence away from static sources of comparative or cost advantage, by moving up the technological ladder and the economic value chain. They diversified into complex technologies, not just adopting more capital-intensive technology but also moving into more advanced technological functions within activities. For example, they moved from being key nodes for simple assembly in cross-national electronics manufacturing networks to manufacturing their own goods with local content, and finally into more intensive design, innovation, and product development.[46] The challenge is structurally the same for emerging economies hoping to make their mark as market players in the digital era today: how to move from static advantages to more dynamic innovation.

Box 3: Case Study – The Innovative Potential of Body-shopping and Offshoring in India

One of the most talked about phenomena in the digital era is the practice of "body-shopping" in India, whereby programmers are sent abroad on a contract basis. India has emerged as an important player in global digital markets as a result of its huge reserve of well-trained software engineers and one of the largest pools of engineering and scientific manpower in the world. In the 1990s, 70 percent of India's software export revenues came from body-shopping. Yet as a long-term strategy, this practice has questionable potential. On the one hand, some have argued that young Indian engineers benefit immensely, learning technological, business, and organizational management skills abroad. In turn, they represent an important source of knowledge and technical transfer back to India, as the human capital developed overseas remains in Indian brains when they return home. On the other hand, however, India's software industry has competed internationally on the basis of low-cost skilled professionals, which becomes less viable as the growing demand for programmers increases their salaries. Thus body-shopping may not likely be the basis on which to build innovation in shaping future markets. Rather, the practice of body-shopping may resemble component assembly for final sale in that it is reflective more of a short-term trading focus rather than a longer term focus on building a manufacturing base and product innovation. In addition, increased human capital in the form of returned body-shoppers may yield very little in terms of innovation if there are no domestic outlets for the returned skills. Time will reveal the long-term potential of body-shopping, and India's lessons will be instructive for other developing countries following suit.

The lessons of East Asia indicate, and Indian entrepreneurs seem to agree, that if India is to continue to succeed and indeed to innovate in global digital markets, its domestic industry will have to emphasize quality and enter into higher value-added markets such as systems design and integration and packaged software, as did I-Flex solutions, mentioned above. Dedrick and Kraemer point out that there are strategic reasons for focusing initially on domestic markets to develop capabilities and experience: it allows companies to develop close ties with users who

[45] Lall (1999): 7
[46] Lall (1999): 13

can provide valuable input into the product development process; and revenues from the domestic market can support export sales and investment in R&D. Body-shopping, on the other hand, fails to develop project management capabilities or to develop packaged applications for large numbers of users, and it is difficult to institutionalize even the technological knowledge from the practice.[47] In this sense, the future of innovation in emerging economies lies exactly where it did in the past – the original newly industrializing economies (NIEs) of East Asia moved away from a static comparative advantage in cheap labor into building dynamic comparative advantage as they moved up the value chain.

The outsourcing and offshoring of IT services provides an interesting contrast to body-shopping, in terms of future innovative potential. 16 percent of the work done by the world's IT services industry is carried out remotely, away from where those services are consumed, and India's business process outsourcing industry is large and projected to continue growing at a steep rate. Yet even here, the leading companies in India are fighting to win higher value-added activities. A distinctive brand of Indian competitiveness is emerging: the top companies perform well by improving the quality of their carefully defined, rule-bound, and repetitive white collar work. The top Indian IT companies hire 1,000 graduates a month from Indian technical colleges, and India's continued success at winning white collar IT work will continue to depend on the supply of high quality technical graduates. Although China's IT industry is much less organized and of patchier quality than India's, this may change in the near future, as China already churns out more IT engineers than India. Russian and Eastern European engineers are as well-trained and cost about the same as their Indian counterparts.[48] As the competition from these other parts of the world heats up, India may be forced to move up the value chain to continue to compete in and innovate for global digital markets.

Borrus and Cohen discuss more specifically the structural changes in the competitive dynamics in the global digital industry in the past decade.[49] First, the ICT industry has been increasingly characterized by the growth of networked production, where a growing number of core functions are contracted out, including production and final assembly itself. This phenomenon encapsulates the increasing modularization of digital production discussed earlier. It has commodified a growing range of advanced intermediary products, has disaggregated the organizational form of the major, integrated producers (beginning with U.S. firms), and has shifted the geography of production toward emerging economies, particularly centering many cross-national production networks in Asia. Second, the ICT industry has seen a shift in power from integrated producers to major users such as banks, insurance companies, and automobile manufacturers. These consumers have increasingly pushed the changes in ICT policy, such as telecommunications deregulation, a demand for interoperability of standards, and no proprietary standards and systems. In addition, these major users have pushed the development of new applications that have become large new markets in data communications, including corporate private

[47] Dedrick and Kraemer (1993): 487-488
[48] Data on the offshoring of IT service are from *The Economist* (2004b): 4, 10-12
[49] Borrus and Cohen (1998): 1006-1008

networks and intranets, for example. These new networked applications have increasingly driven the personal computer industry and propelled growth for hardware and software companies. Borrus and Cohen suggest that this is the model that emerging economies should follow in seeking to develop competitive domestic ICT industries. Third, there is new competition to set market standards in the ICT industry, which has shifted value-added, and hence power, in the production chain from integrated producers to holders of a standard located anywhere in the production chain. This means that new ICT product markets are increasingly characterized by rivalry to set de facto market standards. Although U.S. companies have to date dominated this rivalry, it does provide emerging economy enterprises with remarkable opportunities in entering global digital and ICT markets.

The implication of structural shifts in global digital production for emerging economies can be tied to the micro political economy of innovation. Developing countries are not doomed to a lifetime of technological catch up through the "stages of growth" of a single trajectory of industrialization and modernization.[50] This paper instead supports a perspective that is more able to account for and elaborate different trajectories of digital innovation in the developing world. The appropriate micro-institutional political economy model is captured in the "varieties of capitalism" approach that emphasizes the importance of the set of relationships the firm is embedded within and the characteristics of those relationships.[51] A varieties of capitalism perspective yields the insight that there are indeed different mechanisms at work, at the firm level, in responding to various production and innovation challenges. In terms of innovation for the global digital economy, in particular, we see a wide array of experiments being carried out in the market place. Successful innovations in the form of improvements to modular applications and user-driven product modifications come from these varieties of experimentation in emerging economies.

[50] Rostow (1962).
[51] See, for example, Hall and Soskice (2001).

Market Makers: Innovative Potential in the Emerging Economies

It is worthwhile at this point to take a step back and consider again the different dimensions of innovation. The concept is conventionally associated with breakthrough or radical invention, financed by expensive research and development operations. Yet in emerging economies these characteristics are not often to be found. This does not mean, however, that there is no innovation occurring in the developing world. Lall points out that the view of technological innovation as major breakthroughs, where a technological lead emerges from a completely new production or process, is misleading.[52] Rather, the correct scope of technological activity is much wider, including what are characterized here as modular innovations. These are sometimes considered "incremental" improvements; nonetheless, they account for the larger share of production increases even in the advanced, industrialized world. This form of innovation in the developing world includes the gaining of "technological mastery" over imported technologies; that is, it includes learning the tacit elements of foreign technologies and building the ability to modify technology for domestic applications, for example, through imitation and reverse engineering. The modular innovations in the global digital economy that have been discussed in this paper represent this type of non-frontier technological innovation.

There is much to be learned about the processes of and potential for digital innovation in emerging economies today by examining the industrial technological innovation paths followed by the original NIEs of East Asia. As Kim and Nelson point out, reverse engineering and imitation were the basis of the creative innovation that propelled the rapid industrialization of the East Asian NIEs in the 1960s and 1970s.[53] Hobday concurs that innovation is qualitatively different between emerging and advanced countries:

> The innovation paths of the NIEs make an interesting comparison with Western innovation models, which stress new product development, dominant designs, and R&D. … In contrast with normal Western models, the NIEs began with mature, standardized manufacturing

[52] Lall (1993).
[53] Kim and Nelson (2000).

> processes and gradually moved to more advanced stages of technology. … Typically, firms graduated from mature to early stages of the product life cycle, from standard to experimental manufacturing processes, and from incremental production changes to R&D. In this sense, the NIEs progressed "backward" along the normal stages of the product life cycle.[54]

The R&D efforts of South Korean latecomer electronics firms in the high-growth 1970s and 1980s, for example, were mostly applied, targeted at improving manufacturing technology and, to a lesser extent, developing new designs.[55] Lall states, even more forcefully, "The process of technological change in developing countries is one of acquiring and improving on technological capabilities rather than of innovating at frontiers of knowledge."[56] The assimilation and adaptation of a given technology can involve just as much technological effort in developing countries as more radical innovation, and often requires formal R&D. It is this gaining of technological mastery, which often comes from on-the-job learning-by-doing and the production of modular applications catered to users in home markets (i.e., the two forms of modular innovation), that explains most innovation in and much of the dynamic comparative advantage of emerging economies.

The overall competitiveness of companies in terms of the scope for innovation in turn depends on a host of different factors. These can be thought of as comprising a *national innovation system*, the supporting resources and policies that increase national absorptive capacity for technological innovation. The core characteristics of a national innovation system are: public agencies that support or perform R&D; universities, which perform both research and training; firms that invest in R&D and application of new technologies; public programs intended to support technological adoption; and laws and regulations defining intellectual property rights (IPRs).[57] For the purposes of examining the innovative potential of a group of emerging economies, I focus on: (1) the level of human capacity; (2) research and development activity and funding, both public and private; and (3) the enforcement of IPRs.

---

[54] Hobday (2000): 158
[55] Hobday (1995): 1176
[56] Lall (2000): 13
[57] Mowery and Oxley (1995): 80. The authors distill the considerable literature on national innovation systems.

A few key emerging economies are gaining on core advanced country innovators in terms of the elements for the research and development that is essential to innovation. Table 2 illustrates several of the core arguments of this paper. High-tech exports provide a measure of international competitiveness, and the figures in the last column show that the developing countries in question have indeed emerged on the global scene in the past decade. Patenting activity and royalty and licensing receipts are dramatically lower in the emerging economies than in the advanced countries represented. Thus, advanced countries are indeed the major purveyors of radical, breakthrough digital innovation. Yet these figures represent only the types of breakthrough innovation that developing countries do not engage in for the most part. Emerging economies are instead likely to find that their strength in shaping global digital markets, at least in the short and medium term, lies in the modular innovation associated with improvements to specific applications through on-the-job learning-by-doing and user-driven product modifications. Emerging economies are indeed equipped with the resources necessary for these types of innovation. The comparative figures shown in Table 2 on tertiary science, math, and engineering students and R&D expenditures and researchers are far more encouraging in indicating the modular innovative potential of the emerging economies.

Table 2: Research and Development Potential

	Tertiary students in science, math and engin. (% of tert. students)	**Patents granted to residents** (per million people)	**Receipts of royalties and license fees** (US$ per person)	**Research and Development (R&D) Expenditures** (as % of GDP)	**Researchers in R&D** (per million people)	**High-technology exports** (% of merch. exports)	
	1994-97*	2000	2002	1996-2002*	1990-2001*	1990	2002
United States	..	298	151.7	2.8	4,099	33	32
Japan	23	884	81.8	3.1	5,321	24	24
Finland	37	5	107.5	3.4	7,110	8	24
Mexico	31	1	0.5	0.4	225	8	21
Russian Fed.	49	99	1.0	1.2	3,494	..	13

Brazil	23	0	0.6	1.1	323	7	19
Thailand	21	3	0.1	0.1	74	21	31
Turkey	22	..	0.0	0.6	306	1	2
China	53	5	0.1	1.1	584	..	23
Indonesia	28	0	..	..	130	1	16
South Africa	18	0	1.0	..	992	..	5
India	25	0	..	..	157	2	5
High income	..	350	82.9	2.6	3,449	18	23
Middle income	..	5	0.5	0.7	751	..	19
Low income	..	..	..	..	..	..	9

* Data refer to the most recent year available during the period specified.

Source: UNDP Human Development Indicators
Calculated from: World Intellectual Property Organization (WIPO) 2004 Intellectual Property Statistics; UNESCO 1999 Statistical Yearbook; United Nations 2003 World Population Prospects 1950-2050; and World Bank 2004 World Development Indicators.

In assessing a country's research and development activity, however, it is not just the quantity that matters. The sector in which R&D is performed and whether it is linked to specific consumer demands or product development are also significant. Mowery and Oxley point out that public sector R&D investments have expanded to complement increases in private sector R&D, but, citing Thailand and Argentina as examples, they add: "Efforts in developing countries to build up public sector R&D programs in the absence of demand from the private sector often fail to produce results."[58] In Latin America, for example, the model of national councils of science and technology "… underestimated the relationship between market and technology, and the importance of the management of innovation at the enterprise level."[59] Table 3 breaks down the sector of R&D performance between the productive sector and higher education, and the source of R&D financing between the private and public sector. The figures demonstrate that the countries we conventionally identify as important innovators – i.e., the advanced countries, and the East Asian NIEs – perform and finance more of their R&D in the private sector than in the public sector. The slower growth emerging economies, however, such as those in South Asia and Latin America, tend to rely more on government financing of R&D and conduct less R&D in the

[58] Mowery and Oxley (1995): 84
[59] Correa (1995): 833

private sector than in the public sector.

Table 3: Sector and Source of Research and Development Performance

	Sector of R&D performance (%)		Source of R&D financing (% distribution)	
	Productive Sector	Higher education	Productive enterprises	Government
Industrialized market economies (a)	53.7	22.9	53.5	38.0
Developing economies (b)	13.7	22.2	10.5	55.0
Sub-Saharan Africa (exc. S. Africa)	0.0	38.7	0.6	60.9
North Africa	N/A	N/A	N/A	N/A
Latin America and Caribbean	18.2	23.4	9.0	78.0
Asia (exc. Japan)	32.1	25.8	33.9	57.9
NIEs (c)	50.1	36.6	51.2	45.8
New NIEs (d)	27.7	15.0	38.7	46.5
South Asia (e)	13.3	10.5	7.7	91.8
Middle East	9.7	45.9	11.0	51.0
China	31.9	13.7	N/A	N/A
European transition countries (f)	35.7	21.4	37.3	47.8
World	36.6	24.7	34.5	53.2

Source: Sanjaya Lall and Carlo Pietrobelli. (2002) *Failing to Compete: Technology Development and Technology Systems in Africa*. Cheltenham, U.K.: Edward Elgar Publishing Ltd.: 42. Calculated from UNESCO (1997).
Notes: (a) USA, Canada, West Europe, Japan, Australia, and New Zealand; (b) Including Middle East oil states, Turkey, Israel, South Africa, and formerly socialist economies in Asia;
(c) Hong Kong, Korea, Singapore, Taiwan; (d) Indonesia, Malaysia, Thailand, Philippines; (e) India, Pakistan, Bangladesh, Nepal; (f) including Russian Federation

Emerging economy governments often favor basic research facilities that are oriented toward frontier technologies. Instead, it is important to link public labs with private funding in order to reorient the research agenda and activities such that public R&D has good linkages with private firms. For example, business R&D only accounts for 13 percent of the total in India; the rest is conducted by the public sector and universities, where it may not be relevant to economic applications.[60] In an effort to combat this effect, the government has established "science cities" around prominent research institutions, to create centers for high-technology industrial development through stronger ties between research and industry. Mowery and Oxley argue that the optimal sequence for public investment in research and

[60] Kraemer and Dedrick (1993): 473

development is initially to target technical schools and universities that emphasize training, rather than to encourage basic research. Government investment in more basic frontier-technology research in public laboratories and institutes seem to hold promise for economic returns only at a later stage of economic development.[61]

This logic holds at the micro or firm level as well. Hobday concurs that the key to competitiveness for latecomer firms runs contrary to theories which stress R&D or place R&D at the beginning of the innovation process.[62] Rather than radical innovation, behind-the-frontier innovation through imitation and reverse-engineering was essential in allowing catch-up development so that latecomer firms could narrow the technology gap between themselves and market leaders. Hobday debunks conventional wisdom in stating: "East Asian latecomers did not leapfrog from one vintage of technology to another. On the contrary, the evidence shows that firms engaged in a painstaking and cumulative process of technological learning: a hard slog rather than a leapfrog."[63] Hobday also emphasizes the importance of home-market consumer-driven innovation in analyzing the success of electronics latecomer firms in East Asia. He points out that latecomer firms located in developing countries have two major disadvantages in terms of innovation: they are dislocated from the main international sources of technology and R&D, and dislocated from leading-edge markets and demanding users. In order to succeed, therefore, the latecomer firm must devise ways to overcome market barriers to entry and then forge the user-producer linkages that stimulate technological advance.[64] With growing and increasingly sophisticated domestic consumer bases, emerging economy enterprises may find that catering to their home market will further propel them onto global markets. These arguments reinforce this paper's claim that experimental innovation in modular applications and user-driven product modifications is central in shaping economic success in emerging economies.

[61] Mowery and Oxley (1995): 88
[62] Hobday (1995): 1185-1186
[63] Hobday (1995): 1188
[64] Hobday (1995): 1172

A closer examination of patenting data allows further analysis of whether emerging economies have built indigenous technological and entrepreneurial capabilities. Mahmood and Singh find that the original East Asian NIEs – Taiwan, South Korea, Hong Kong, and Singapore – have much higher US patenting activity than other emerging economies, which they attribute to different sources of innovation in each country. While it is important to bear in mind that patenting activity reflects bursts of innovation, rather than the types of modular innovation we have been discussing, their data nonetheless demonstrate significant growth in innovative capability across the emerging economies over time (see Table 4).

Table 4: US Patents Granted to Emerging Economies

Recipient countries	1970-1974	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999
Newly industrialized economies						
Taiwan (ROC)	1	176	397	1,772	5,271	12,366
South Korea	24	43	91	424	2,890	11,366
Hong Kong	59	75	113	177	279	570
Singapore	21	9	20	47	148	499
Emerging Asian economies						
India	83	67	40	64	126	316
China	61	2	7	129	239	332
Indonesia	19	5	5	10	26	18
Malaysia	2	13	6	13	43	89
Thailand	4	3	7	11	15	56
Emerging Latin American economies						
Mexico	243	246	191	202	189	257
Brazil	86	100	110	156	260	353
Argentina	126	113	100	82	109	183
Chile	22	20	12	18	21	44
Venezuela	36	35	50	103	121	145

Source: Table 2 in Mahmood and Singh (2003), p. 1034. Data are from US Patent Office.

Interestingly, the sources of innovation differ quite dramatically across the countries they analyze in depth. The relative contribution to innovation by multinational corporation (MNC) subsidiaries is highest in Singapore and India, minimal in Taiwan and South Korea, and in between for Hong Kong and

China. Business groups have been behind more than 80 percent of patenting from South Korea in the 1990s, compared with less than 4 percent in Taiwan. Individual inventors' importance is declining across all countries over time, but they still hold 59 percent of recent patents in Taiwan.[65] Thus there is interesting evidence to support the proposition that a country's industrial policy and profile shapes its innovative fabric. The predominant sector of innovation is business groups in South Korea versus other domestic firms or organizations in Taiwan; this maps to the well-documented difference in industrial profile between the two countries, with *chaebol* dominant in South Korea while small and medium enterprises are dominant in Taiwan. Further reflective of industrial profiles, the predominant sector of innovation is foreign MNCs or organizations in Singapore; and a combination of domestic firms or organizations and foreign MNCs or organizations in Hong Kong, India, and China.[66] The figures further demonstrate that research institutes appear to play an important role in all countries. In China and India, however, private sector R&D is not yet fully developed, evidenced by a disproportionately high number of research institutes and government-affiliated organizations in the list of the top 50 inventors.[67]

It would be impossible to discuss the potential for digital innovation in emerging economies without considering in some way the relationship of intellectual property rights to innovation. Lax IPR enforcement in developing countries permits the forms of learning-by-doing modular innovation that emerging economies have used most successfully in making their mark in global markets, namely imitation and reverse engineering. This is true most recently with the East Asian Tigers, but, as Maskus and Reichman point out, "few now-developed economies underwent significant technological learning and industrial transformation without the benefit of weak intellectual property protection."[68] They cite Japan as an example: from the 1950s through the 1980s, Japan pursued an industrial property regime that favored incremental innovation and technology adaptation and diffusion. On the other hand, stricter

[65] Mahmood and Singh (2003): 1032
[66] Mahmood and Singh (2003): 1044-1045
[67] Mahmood and Singh (2003): 1052
[68] Maskus and Reichman (2004): 290

IPRs may facilitate technology transfer to developing countries, as well as the local diffusion of that technology. Thus stronger IPRs, since they promote local frontier technology innovation, are most likely beneficial for leading newly industrializing countries that are launching into serious R&D activity.

On balance, Lall argues that the effects of IPRs vary according to countries' levels of industrial, technological, and economic development, with the need for and benefits from stronger IPRs rising with income and technological sophistication.[69] As the World Bank points out: " Interests in encouraging low-cost imitation dominate policy until countries move into a middle-income-range with domestic innovative and absorptive capabilities. … Least-developed countries devote virtually no resources to innovation and have little intellectual property to protect."[70] Thus there is an inverted U-shaped relationship between the strength of IPRs and income levels: IPR intensity first falls with rising incomes as countries allow slack IPRs to build local capabilities through adaptive innovation, then IPR intensity rises as countries begin to engage in more innovative effort. Lall concludes that the income per capita threshold at which innovative activity begins is fairly high, $7750 per capita in 1985 prices.[71] Innovative capacity is the constraint here – if a country has little indigenous innovative capability, IPR strengthening cannot stimulate domestic innovation, and stronger IPRs have no stimulating effect on incremental innovation through absorptive and adaptive technological activity.[72]

IPR enforcement also affects where emerging economies may position themselves in cross-national production networks. Global production networks have made it possible for countries to move up the ladder of technological complexity and value-added without necessarily building a local technology base. Lall argues that this is the case with many of the East Asian countries: while the global

[69] Lall (2003): 1658. See Lall (2003) for an excellent discussion of technological differences among countries. He has developed sophisticated country classifications of domestic innovation and national technological activity based on R&D financed by public enterprises and the number of patents taken out in the United States; which he then maps against an index of competitive industrial performance.
[70] World Bank (2001): 131-132, as cited in Lall (2003): 1658.
[71] Lall (2003): 1661. Maskus and Reichman (2004): 289; agree with the threshold effects of per capita income on IPRs.
[72] Lall (2003): 1659

electronics production network encompasses only a few developing countries, almost all situated in Asia, few of these countries have strong domestic technology bases in electronics.[73] The emergence of integrated cross-national production systems does not necessarily force emerging economies to better enforce IPRs: "Most TNC [trans-national corporation] assembly activity in the past has gone to countries that have isolated export-processing zones from the rest of the economy without having changed the IPR regime."[74] In the longer term, however, stricter IPR enforcement may be beneficial for countries hoping to locate themselves in cross-national production networks:

> IPRs in developing host countries may be growing in importance as, with technical progress, more complex technologies have to be deployed by high-tech systems even at the assembly level, raising the cost of technological leakages. Moreover, when competing host countries offer stronger IPRs it may be an essential prerequisite for all aspirants to offer similar protection. Countries that have high-tech assembly operations may need to strengthen IPRs to induce TNCs to move into more advanced functions like R&D and design. At the highest end of TNC activity, where developing countries compete directly with advanced industrial countries, the IPR regime would have to match the strongest in the developing world.[75]

Countries with stronger IPRs may indeed be able to attract those transnational corporations with higher technology activity to be offshored. Yet, as integrated systems remain highly geographically concentrated, these considerations may not apply. Thus the optimal level of IPR enforcement varies by country, according to the specific income level, sectoral composition of economic activity, and production profile.

The global intellectual property regime, embodied in the World Trade Organization's Agreement on Trade-Related Aspects of Intellectual Property Rights (the TRIPS agreement), necessarily affects the prospects for technology transfer and innovation in developing countries. Maskus and Reichman point out that the global regime could, very simply, reduce the scope for emerging economy enterprises to break into global digital markets by compounding technological backwardness and inhibiting innovation. This danger is heightened by the process of world market regulation in knowledge goods, which is

[73] Lall (2003): 1671-73
[74] Lall (2003): 1673
[75] Lall (2003): 1673

driven by the lobbying of powerful private interests in advanced countries rather than by a global consensus on the public good dimensions of knowledge.[76] International flows of technology transfer and its successful integration into domestic production processes are essential for firms in developing countries to be able to compete in the global economy. Product imitation and reverse-engineering and temporary migration of students, scientists, managers, and technicians are important non-market forms of international technology transfer. International IP standards can make the task of reverse engineering by honest means and the transfer of technology through people more costly, even impossible.

In this way, private capture of the global process for IP regulatory standard-setting "undermines the ability of governments in developing countries to devise and promote their own national systems of innovation."[77] Maskus and Reichman urge developing country governments to integrate international IP standards into their own national innovation systems in order to maximize the benefits. Emerging economies could, for example, become the promoters of a transnational innovation system in which properly balanced IPRs were not an end in themselves but rather the means of generating more scientific and technological innovation in a healthy competitive environment; they could preserve the ability to reverse-engineer routine innovations by honest means, and foster the exchange between innovators at work on common technologies.[78]

The idea of national systems of innovation has been central to the logic of this section. It has become quite clear that there are country-specific drivers of technological activity and innovation; that is, technological specialization and modular innovation are heavily dependent on the resources embodied in national systems of innovation. In addition there is wide variation across countries in the productive and innovative roles played by different economic stakeholders such as multinational corporations, business groups, small and medium enterprises, research institutions, and the public sector. Nevertheless, in

[76] Maskus and Reichman (2004): 282, 302
[77] Maskus and Reichman (2004): 304
[78] Maskus and Reichman (2004): 311

examining the innovative potential of emerging economies as a group, a few broad patterns have also emerged: the centrality of experimental modular innovation in emerging economies as they attempt to close the digital production divide; the significance of having some proportion of R&D funded and conducted by the private sector; and the dual relationship of intellectual property rights to innovation.

Conclusion

This paper has examined the different roles that emerging economies can and do play in the global digital economy and ICT innovation. They are fast-growing and hence vitally important market places, with their increasingly sophisticated users just beginning to exercise their power in dictating the future of digital consumer products. Emerging economy enterprises are also ever more relevant market players, having leveraged their success in home markets into inroads in global markets through a number of distinctive competitive advantages. Finally, emerging economies also have great potential as market makers: they have the opportunities to shape future global digital markets as a result of their own prowess in digital innovation and the complementary resources they have to offer.

In terms of this innovative potential of emerging economies, this paper has argued that while advanced countries are the main purveyors of radical, breakthrough digital innovation, emerging economies will continue to find that their strength in shaping global digital markets, at least in the short and medium term, lies in the experimental modular innovation that is achieved through improvements in specific applications driven by on-the-job learning-by-doing and user-driven product modifications. Modular innovation in the emerging economies is both product- and process-oriented, coming in combinations of innovations in production, organization, and distribution. At this point in time, modular digital innovation in emerging economies is fueled to a great degree by the growing consumer base of the developing world. At the same time, however, the changing structures of the global digital economy provide unique and varied opportunities for emerging economy enterprises to make their mark by

leveraging their innovative potential.

The future of digital innovation promises to continue to hold varieties of experimentation. One particular area to watch for new advances is the nexus forged between local business ecosystems in emerging markets and the broader cross-national networks that are the bedrock of the global digital economy. Understanding the trajectories of modular innovation in emerging economies will continue to be central to an analysis of the role that these countries can and will play in the global digital economy. While different forms of modular innovation in emerging economies may not necessarily pose a direct challenge to currently dominant digital producers, they do have the potential to alter the structure of future global digital markets. Thus, both in terms of their market power and their production and innovation possibilities, emerging economies are positioned to increase their presence in the digital era.

Bibliography

Ayish, Muhammad I. (1992) "International Communication in the 1990s: Implications for the Third World", *International Affairs* 68 (3), pp. 487-510.

Borrus, Michael and Stephen S. Cohen. (1998) "Building China's Information Technology Industry: Tariff Policy and China's Accession to the World Trade Organization." *Asian Survey* 38(11): 1005-1017.

Borrus, Michael and John Zysman. (1997) "Wintelism and the Changing Terms of Global Competition: Prototype of the Future?" BRIE Working Paper 96B. Berkeley, California: Berkeley Roundtable on the International Economy (BRIE).

Braga, Carlos A. Primo, John A. Daly, and Bimal Sareen. (2003) "The Future of Information and Communication Technologies for Development", ICT Development Forum.

Bridges.org, "Spanning the Digital Divide." Undated report. Available at: http://www.bridges.org/spanning/

Brown, John Seely and John Hagel III. (2005) "Innovation Blowback: Disruptive Management Practices from Asia." *The McKinsey Quarterly*, 2005 No. 1: 34-45.

Correa, Carlos M. (1995) "Innovation and Technology Transfer in Latin America: A Review of Recent Trends and Policies." *International Journal of Technology Management* 10(7/8): 815-846.

Dedrick, Jason and Kenneth L. Kraemer. (1993) "Information Technology in India: The Quest for Self-Reliance." *Asian Survey* 33(5): 463-492.

DOT Force. (2001), *Digital Opportunities For All: Meeting the Challenge*, Report of the Digital Opportunity Task Force, available at: http://www.dotforce.org/reports/DOT_Force_Report_V_5.0h.pdf

Dunning, Thad. (2003) "The Political Economy of the International 'Digital Divide': A Tentative Outline of Some Issues and Concepts." Unpublished manuscript. Berkeley Roundtable on the International Economy (BRIE).

Hall, Peter A. and David Soskice. (2001) *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*. New York: Oxford University Press.

Hamm, Steve. (2004) "Tech's Future" *BusinessWeek*. September 27, 2004: 82-89.

Hobday, Michael. (1995) "East Asian Latecomer Firms: Learning the Technology of Electronics." *World Development* 23(7): 1171-1193.

Hobday, Michael. (2000) "East Versus Southeast Asian Innovation Systems: Comparing OME- and TNC-led Growth in Electronics." in Linsu Kim and Richard R. Nelson, eds. *Technology, Learning, and Innovation: Experiences of Newly Industrializing Economies*. Cambridge, U.K.: Cambridge University Press. pp. 129-169.

Kim, Linsu and Richard R. Nelson. (2000) "Introduction." in Linsu Kim and Richard R. Nelson, eds.

Technology, Learning, and Innovation: Experiences of Newly Industrializing Economies. Cambridge, U.K.: Cambridge University Press. pp. 1-9.

Kraemer, Kenneth L. and Jason Dedrick. (1994) "Payoffs from Investment in Information Technology: Lessons from the Asia-Pacific Region." *World Development* 22(12): 1921-1931.

Kraemer, Kenneth L. and Jason Dedrick. (2002) "Information Technology in Southeast Asia: Engine of Growth or Digital Divide?" in Chia Siow Yue and Jamus Jerome Lin, eds. *Information Technology in Asia: New Development Paradigms*: Singapore, Institute of Southeast Asian Studies. pp. 22-47.

Lall, Sanjaya. (1993) "Promoting Technology Development: The Role of Technology Transfer and Indigenous Effort." *Third World Quarterly* 14(1): 95-108.

Lall, Sanjaya. (1999) "Promoting Industrial Competitiveness in Developing Countries: Lessons from Asia." Commonwealth Economic Paper Series, No. 39. London, U.K.: Commonwealth Secretariat.

Lall, Sanjaya. (2000) "Technological Change and Industrialization in the Asian Newly Industrializing Economies: Achievements and Challenges." in Linsu Kim and Richard R. Nelson, eds. *Technology, Learning, and Innovation: Experiences of Newly Industrializing Economies*. Cambridge, U.K.: Cambridge University Press. pp. 13-68.

Lall, Sanjaya. (2003) "Indicators of the Relative Importance of IPRs in Developing Countries." *Research Policy* 32: 1657-1680.

Lall, Sanjaya and Carlo Pietrobelli. (2002) *Failing to Compete: Technology Development and Technology Systems in Africa*. Cheltenham, U.K.: Edward Elgar Publishing Ltd.

Leander, Tom. (2004) "Does Microsoft Need China?" *CFO.com*. August 10, 2004.

Mahmood, Ishtiaq P. and Jasjit Singh. (2003) "Technological Dynamism in Asia." *Research Policy* 32: 1031-1054.

Maskus, Keith E. and Jerome H. Reichman. (2004) "The Globalization of Private Knowledge Goods and the Privatization of Global Public Goods." *Journal of International Economic Law* 7(2): 279-320.

Mowery, David C. and Joanne E. Oxley. (1995) "Inward Technology Transfer and Competitiveness: The Role of National Innovation Systems." *Cambridge Journal of Economics* 19: 67-93.

Prahalad, C.K. (2005) *The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profits*. Upper Saddle River, New Jersey: Wharton School Publishing.

Prahalad, C.K. and Stuart L. Hart. (2002) "The Fortune at the Bottom of the Pyramid" *Strategy and Business* Issue 26.

Rostow, Walt W. (1962) *The Stages of Economic Growth*. Cambridge University Press.

South China Morning Post. (2005) "Outlook merry as IT industry leaves long downturn behind."

Technology section, January 11, 2005.

The Economist. (2004a) "Profits and Poverty" *The Economist*. August 19, 2004.

The Economist. (2004b) "A World of Work: A Survey of Outsourcing" *The Economist*. November 13, 2004.

The New York Times. (2004) "Sale of I.B.M. PC Unit is a Bridge Between Cultures" December 8, 2004.

UNCTAD. (2002) *E-Commerce and Development Report 2002.* New York: United Nations.

UNDP. (2000) "Driving Information and Communications Technology for Development: A UNDP Agenda for Action 2000-2001." New York: United Nations.

Weber, Steven, and Naazneen Barma. (2003) "Open Source and Free Software: Development and Policy Implications." Draft chapter. Published in *UNCTAD E-Commerce and Development Report 2003*, United Nations: New York.

Weber, Steven and John Zysman. (2002) "The New Economy and Economic Growth in Developing Countries: Speculation on the Meaning of Information Technology for Emerging Markets." Draft manuscript. Berkeley, California: Berkeley Roundtable on the International Economy (BRIE).

World Bank. (2001) "Intellectual Property: Balancing Incentives with Competitive Access." in *Global Economic Prospects*. Washington D.C.: The World Bank. pp. 129-150.

World Bank. (2002) *Information and Communication Technologies: A World Bank Group Strategy*. Washington D.C.: The World Bank

Yue, Chia Siow and Jamus Jerome Lin, eds. (2002) *Information Technology in Asia: New Development Paradigms*. Singapore: Institute of Southeast Asian Studies.