

OPENING THE DOORS OF INVENTION: INSTITUTIONS, TECHNOLOGY AND DEVELOPING NATIONS

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ABSTRACT

What can the knowledge economy offer developing countries? Can developing nations hope to transform existing social and economic relations into an information society? What are the roles of trust, social forces, laws, internal governance structures, financial and information intermediaries, regulators and civil society? Does the creation of an information society represent a paradigm shift in development that requires different thinking and a different path from that taken by agrarian societies that have industrialized? This article explores these questions, investigating the path that developing nations can follow to build a knowledge-based service economy.

INTRODUCTION

The gap between the haves and have-nots is widening both between nations and within nations.¹ This divergence is due to the ability of certain countries to harness technology and scientific knowledge to build commercially viable products.² However, developing countries are finding that the social organizations necessary to engender trust, transmit information, and establish norms of reciprocity present a larger hurdle than mastering the engineering component of the new knowledge based technologies.

Even after acquiring the technical know-how of wealthier nations, many developing nations find it difficult to establish institutions to transform knowledge into useful products.³ They quickly discover that the institutions necessary to generate knowledge are different than the ones required for creating products demanded by the market. To remove the ceiling on growth, poorer nations must design institutions that bring together technology and market.

An exploration of the institutions that emerged in the United States, namely in Silicon Valley, offer illustrations that breach the gulf between technical innovation and market demand. Silicon Valley may no longer be the beacon of high tech prowess as it was in the 1990's, but it offers many examples of the link between social institutions that foster trust and technological progress.

LESSONS FOR THE NEXT TECHNOLOGICAL POWERHOUSE

With its abundance of cheap engineers, its many venues for group research spending and abundant onsite foreign intellectual property, China is groping to build a solid foundation for its high tech sectors.⁴ Technology parks have sprung up throughout China. Beijing, Shanghai, Nanjing, and Hefei are among the 60 Chinese municipalities that have spent impressive amounts of money to build state-of-the-art facilities. These provincial efforts to be the next Silicon Valley include attractive benefit packages and on-site recreational and housing facilities. For China, Silicon Valley's misfortunes are an opportunity to lure back Chinese ex-patriot engineers whose ambitions are thwarted in the U.S. The central Government is offering handsome financial incentive packages to lure Chinese engineers home from overseas to the new centers.⁵ Yet, a high concentration of successful high tech companies still eludes China. Is it enough to build the right structures, employ people with the right credentials, and then hope the rest will follow?⁶

The entrepreneurial roots of China's high tech sector are shallow. The value of most high tech goods produced in China comes from foreign companies.⁷ China's track record at sustaining high tech companies is poor. One reason China is slow at climbing the high technology ladder is that start-up companies cannot find capital. Duplicating technology seems easier than creating necessary financial institutions. China's difficulties at creating self-sustaining technology clusters to become a transmission belt of knowledge in the global economy mirror those of other developing country hopefuls.

ANATOMY OF A KNOWLEDGE DRIVEN COMMUNITY

The vertically integrated corporation is responsible for much of the great increase in the standard of living of Americans during the twentieth century. It typically controls a large set of unique assets through a command and control hierarchy. This way it internalizes many of the risks of transacting across markets, allowing it to capture the benefits of scale economies and to establish market control. Yet, between 1975 and 1990 Silicon Valley generated some 150,000 new technology jobs by challenging the organizational legacy of the vertically integrated firm.⁸ By 1990 it exported more than \$11 billion in electronics, more than one third the U.S. totals, creating a post-industrial production format that is the prototype for the information age.

Silicon Valley is comprised of diffuse production networks, surmounting the boundaries of individual firms, and spanning the entire industry. This openness promotes learning and knowledge sharing among specialist workers of complex, related technologies. Companies compete intensely while learning from each other. Staff moves about relentlessly. Firms exchange managers, owners, and creditors just as easily as they exchange labor and parts, allowing competitors to be highly informed about the activities of rival firms. How unlike the traditional corporate model in which workers passively accept goals set by a central management!

The traditional corporate structure failed to develop new products fast enough to compete with the Silicon Valley model. This is why Silicon Valley eventually surpassed

the technology corridor of Route 128 in Massachusetts where production activities were internalized among large well-capitalized firms, fattened on government contracts, operating according to the traditional model of autarky, secrecy, loyalty and stability; the traditional corporate hierarchy ensured centralized information flows and control by a few senior corporate executives. Route 128's large firms internalized most skills and technology and tightly police boundaries between firms and local institutions to prevent ideas from leaking out. Secrecy and loyalty to hierarchy are a cardinal virtue; the only networks that matter are internal, those who leave are deserters: collaborating with the outside is suspect, learning and exchanging with others is treason. The formidable hierarchies of the past were self-contained, stand-alone systems, not suited to production that depends significantly on information access. Competitiveness in technology requires shortening information pathways so that the right information gets to the right person at the right time. Vertically integrated firms have the disadvantage that in inter-company transactions, the performance and contribution of the each constituent component of the enterprise is difficult to assess. This model was not organized for continuous innovation in an industry that required it. Its formal decision-making procedures lacked flexibility and responsiveness to fast changing markets.

Information technology project completion can be faster in a small start up company than in a large established firm in which the idea originated.⁹ To compete with the start-ups established Silicon Valley producers decentralized their operations, creating inter and intra-firm production networks to capitalize on the regions social and technical integration. Although not a Valley firm, the breakdown of the mammoth IBM into decentralized profit centers is an example of the forces of decentralization at work within the industry.¹⁰

The importance of open industry architecture is captured in the often-repeated phrase, "The story in Silicon Valley is that people work for the Valley: they do not work for the firm".¹¹ High value-added activities require high quality information that must easily jump over the walls of corporation, ethnicity, clan, class, race and nation.

THE STRENGTH OF WEAK TIES

Silicon Valley's experience provides a strong case for the counter-intuitive idea that weak social ties enable strong market forces. Weak ties allow new ideas to enter into the network and are more likely to encourage innovative thinking than are tightly knit communities. This is why Richard Florida finds that the density of gay couples and artists closely correlates with the density of patent requests.¹² He observes creative people with low social capital flocking to cities where they fit in quickly and find others to engage their ideas. Comparing social capital with levels of innovation by the number of patents filled he finds that areas with high levels of social capital tend to be low on innovation. Seattle, Washington, Boulder, Colorado, San Francisco, California, and college towns in general, all with low levels of social capital, are more innovative than cities with strong ethnic enclaves, single industry towns or those with stable population bases.¹³ The poorest people in the world even when their communities enjoy high social capital have limited access to new ideas, trapped by primordial loyalties, they are often more concerned with correcting the past than creating the future.

Silicon Valley capitalized on weak social ties to both stimulate and finance new ideas. In contrast to many successful developing country economies that depends upon strong social ties to encourage relationship-based investment. Weak social ties can actually inspire innovation by providing novel connections and diverse perspectives. Unrelated industries or remote analytical disciplines are where the danger to established certainties may be lurking. The Valley's great innovators came from all over the world and represented a range of intellectual disciplines as wide ranging as anthropology, literary criticism and nuclear physics. They shared few prior ties and rarely had links to inherited wealth or government connections. To learn how to cooperate, they defied the limits of finance, social organization, religion, ethnic rivalry, and nationalism.

Strong social ties among members of a team can suppress innovation, stifle creativity and memorialize existing certainties. Highly cohesive groups tend to maintain existing local hierarchies and seek concurrence discouraging the frank exchange of views. Strong communal ties can insulate members from outside information and challenges while promoting conformity.

NO SPECIAL TREATMENT FROM GOVERNMENT

In developing countries, businesses typically enjoy close ties with government. Ideally, this should help steer private investment into socially productive channels. Unfortunately, government officials often take private interest in the projects they oversee. For example, licensing loopholes allow officials to use administrative discretion to gain shares in productive activities under their jurisdiction, forcing would-be entrepreneurs to spend time and money courting government officials. Cross-country studies of competitiveness bluntly assess the time and maneuvering it takes to register a legitimate business and to obtain the permits necessary to stay in business.¹⁴In Silicon Valley very little time is spent pursuing licenses, subsidies and permits.

Historically, the Valley's companies did not take advantage of licenses or legal opportunities; in fact, many company leaders were foreign born and had no political ties to Washington. They were not political entrepreneurs like business leaders in developing countries, such as Thailand's president Thaksin Shinawatra. They were market entrepreneurs seeking ways to produce cheaper, better goods and services. They had virtually no political representation and did not engage in collective action for the enforcement or reduction of competition. Government never directly involved itself in company decisions, and Silicon Valley was never a preferred region. Silicon Valley firms were never picked as winners and did not enjoy the status of national champions backed by government largess.

From the perspective of finance, Silicon Valley represents an anomaly, an exception to all the tried-and-true lessons in finance. In banker parlance, the Valley's enterprises lack collateral in the form of fixed assets, bricks and mortar, plants and equipment, and, as a result, are un-bankable. Moreover, deep social allegiances do not exist from which to raise funds from established social networks. Valley firms are generally a stranger to government patronage, and do not employ vertical integration as a means to overcome market uncertainties. How is this novel system of industrial relations funded?

INVESTMENT FOR ENTREPRENEURIAL GROWTH

Efforts by the government of South Korea to create a homegrown Silicon Valley are instructive of the obstacles other developing societies face. South Korea has brainy young kids, well trained in engineering, willing to risk everything to start their own companies, and the country has institutional investors with abundant funds. Throwing money at ideas is not enough; creating viable companies that manufacture and market a finished commercially viable product requires a wide range of intermediary skills. The missing middle stage of enterprise promotion is frequently filled in the US by venture capitalists.¹⁵

Venture capitalists are financial intermediaries who manage funds contributed by other financiers, especially those of institutional investors, who know very little about the industry in which their funds are operating. Many of these investors have never visited the Valley and would not know a hard drive from a CD-ROM. The venture capitalists possess knowledge about how to create a company or to commercialize a product that neither the investors nor the innovators possess. They pick opportunities for growth, having broad experience in company and product development, finding suppliers, writing contracts with distributors, dealing with lawyers, marketers and ensuring that a market exists when the product is ready for production. Thus venture capital is value-added investment. Advocates of the venture capital industry like to point out that it costs more to train a venture capitalist than a jet fighter pilot, except that VCs learn most from their ventures that crash.

Since 1987 venture funding grew from small boutique operations to major industry status investing \$103 billion in 2000, more than all the foreign direct investment into China in any given year to date.¹⁶ Two essential roles explain why this industry grew so rapidly.

American venture capitalists find the dominant cause of venture failure to be founder egotism that leads to poor senior management.¹⁷ The start-up firm's founder will typically use the firm's resources to enhance his or her personal well-being rather than to maximize return on investment. Founders are known to like four of the five essential 'P's', perks, power, prestige and pay but not the essential P, performance. Egotism often has free reign in start up technology firms because the founder has obtained funding for which the capital contributor has no recourse. There are no assets to repossess if the founder fails to perform.

At the outset, when the firm's ownership structure is still amorphous, the founders are likely to dominate all the firm's relationships with the outside. Although personalized authority may make the small firm work well, it creates barriers to future growth. When the founder has too much power, outside financing is harder to obtain. Countervailing against 'founder egotism', venture capitalists seek to impose a governance structure on the firm to prevent the founder from employing the firm's financial resources idiosyncratically, or for private gain, via asset stripping or transfer pricing.¹⁸ Future investors look for governance structures to ensure that the firm manager is constrained by rules to act in the interests of investors. To protect their initial investments, venture capitalists like to ensure the professional management of the firm to make future financing easier and to facilitate the eventual sale of the firm.

The expectation of an Initial Public Offering (IPO) is critical to attracting the entry of venture capitalists; IPOs represent an effective and often lucrative prospect for exit.¹⁹ But a company will be more difficult to dispose of if potential investors fear an entrenched tyrant, undisciplined by a governance structure that ensures accountability to shareholders. This is why professional venture capitalists generally seek to strengthen the management team as a condition of their investment. To be sure that the five P's are in place, starting with performance in terms of returns on capital, they typically take a seat on the company board.²⁰

Venture capitalists also play a critical role in preventing the wasteful selection of projects. Each industry success creates more investment capital for future ventures but costly mistakes are a burden the entire industry must bear. To reduce waste, venture capitalists have developed an expertise in selecting projects by tournament. Before a project is completed, projects are funded in installments, and funding requests are subjected to repeated tournaments that test progress and product viability.²¹

Venture backed firms compete for each infusion of capital by convincing their backers that they will develop new products that markets want. Thus, expensive mistakes are avoided; potential white elephants are caught before becoming a heavy burden on the entire industry and soak up funds that might have otherwise sponsored more commercially viable activities. Government-sponsored projects, by contrast, typically have powerful political sponsors, who will fight to preserve financially non-viable projects until they become expensive white elephants. If government acts to stop an ongoing project, vociferous coalitions are likely to stop them. By contrast, Silicon Valley producers must live with the continuous but uncomfortable threat of project termination, because, with their own money on the line, venture capitalists cannot afford to borrow more money to paper over previous mistakes.

In these two capacities, firm governance and tournament management, the venture capitalist seeks a management and product structure that will be sensitive to market signals, ensuring a high correlation between value-added and investment. There is little role for venture capital when political access is the key to enterprise success.

THE DEBT TO SOCIETY SILICON VALLEY WILL NEVER REPAY

Talented, highly trained engineers are not unique to Silicon Valley; many live in Russia, in Asia and in other parts of the world. They may be by their training and disposition natural risk takers, but not to worry, generally they have no money to risk. Someone else has to put up the funding because a rich aunt or distant relation may not be available. In technology, that someone is usually unknown to innovators because having started a project they quickly exhaust friends and personal contacts. Typically, they are no longer sure about being invited to Christmas dinner by the time they turn to external sources for support.

Having come to the end of personal resources does not mean a project has come to the end of the line. The innovator can take advantage of a well-established commercial infrastructure that offers many prospects of finding outside investment.

The refinement of the investment process occurred because institutions exist that transfer risk to those most capable of managing it. A wide diversity of capital instruments enables people to take chances on new ideas and to match money with talent. The capital market options that exist for entrepreneurs to borrow against future earnings include junk bonds (high yield, high-risk debt instruments), not as important for technology start-ups as for operations that have a steady cash flow (hotels, giant department stores and phone providers). Securities (ownership of equity in the corporation), by contrast, are particularly important for tech start-ups because of the intense cyclical nature of the industry. Angels (professional investors using their own money to make early stage investments), venture capital (investors of their own and other people's money; their high risk, high reward portfolio is a small part of the larger portfolio held by other, usually institutional investors), initial public offerings (first time shares sold publicly), and leveraged buy-outs (using existing assets and cash flow as collateral to obtain funds to buy out a portion or all of the existing management).²² The decentralization of capital instruments allows risk to be matched with opportunity to those most willing and most able to carry it. Companies can choose the kind of financing most suited to market structure. If not for the diversity of instruments available investors, the U.S. standard of living would be very different from what it is today, and much talent would have been wasted.

The government, implicitly backed by taxpayers, is not exposed to risks that are best managed by those closer to the market. The risks are assumed by the investors who stand most to gain and are in the best position to manage those risks. Capital markets enable perfect strangers, fund providers, to give their lifetime savings over to other perfect strangers, fund users, often through an intermediary they have never met. Fund users then create companies with the savings of individuals who know virtually nothing about the industry in which they are investing. This event would be remarkable if it happened occasionally but it is reenacted, not thousands of times, but millions of times in a single day of trading on the NASDAQ, creating billions of dollars of value. New industries provided with the resources to wire the entire planet and launch satellites into space have resulted, allowing every human being to communicate at low cost directly with any other. Even if the firms that undertake this investment do not prosper, society gains from the expansion of industrial capacity that otherwise would not exist.

ON BEING BORN LUCKY

Why are capital markets essential for technological progress? Compare the diversified capital markets in Silicon Valley to the options would-be entrepreneurs face in developing countries. One option is to seek funding from thousands of independent individuals, going door-to-door, person-to-person, in the hope of collecting a nickel here and a dime there. This scenario is highly improbable, we rarely hear of businesses being started by people knocking on the doors of their neighbors. Alternatively, an entrepreneur can turn to existing financial intermediaries but here the choices are similarly dismal. Financial institutions in developing countries are owned by the government or by someone with close ties to the government. If the state does not own the banking system outright, market entry is restricted and the right to acquire or establish a financial institution only granted to certain groups with political or family connections. Such institutions are unlikely to take risk because they do not face competition for the savings they disperse.²³

Financial institutions in developing economies are careful to lend to individuals or enterprises to which they share prior direct or indirect connections. Many loans are transacted through an intermediary who is a friend or family member of the borrower because, without recourse to impartial law enforcement, the promise of repayment relies greatly upon trust.²⁴ By lending to familiar faces, the banking system, immersed in informality, compensates for the informational deficiencies of the faceless market. However, the resulting financial concentration immobilizes capital and prevents risk from being absorbed by those most capable of doing so.

Dependence upon banks as the sole source of capital is by itself a considerable obstacle to development. To bankers, ideas are as ephemeral as dreams. Since they require tangible collateral, real estate or cash flow, to service obligations, bankers find high-tech start-ups unattractive. A *techie* is likely to have only ideas to offer and may not have rich relatives to substitute for missing capital markets.

When sources of capital are limited, the funding for new technology will be limited to the needs of already established social interests. This is why social spending in Latin America on information technology and education has been disappointing. Elites that derive their wealth from resource extraction are insensitive to the possibilities of creating new employment in other sectors.

Knowledge-intensive production constitutes a paradigm shift in development; it is different than traditional industrial production or resource extraction. Unlike a natural resource, accessible to anyone lucky enough to acquire information privately through discreet channels or to use visible government infrastructure for extraction, technology opportunities come from the inventiveness of a single human brain. No secret treasure map exists to the source of this wealth. Political access or institutional muscle cannot force someone to have an idea. An army is not needed to ensure that products are smuggled across borders to paying customers. The difference between wealth creation in the industrial age and in the information age can be illustrated by the following story of George Bush Senior's initiation in the Texas oil fields.

Being born lucky, George Bush Sr. came to Texas in pursuit of something tangible in the ground that is depleted by use and one party's use is at the expense of another's. The oil I burn in my vehicle is not available for use in yours, which makes measurement easy. Value creation in traditional industries differs from knowledge age formats such as the internet because the more you use my internet network, the more value you create for me, making measurement of the value added difficult.²⁵

Let's get back to Texas in the 1950s. To get the oil out of the ground, George Bush Sr., like many of his counterparts, depended upon a comparative advantage that serviced yesterday's production handsomely – a number of wealthy personal relationships. Having rich relatives in Greenwich, Connecticut, whose ancestors were fortunate to be on one of the first ships carrying immigrants to North America was useful.

It was about \$300,000 when they added it all together.²⁶

Finally, one night, Bush said: "Geez, if I could raise some money, do you think we could do that? Maybe get in business?" Overby considered the proposition for about thirty seconds before he said, Yeah, he figured they could.

In the short run, money was equal to or better than know-how. And money—to be precise, OPM, Other People’s Money—was the calling card of the best young Yalie independents. Earle Craig was playing with Pittsburgh money. So were Ashmun and Hilliard. (H.T. “Toby” Hilliard was actually Harry Talbot Hilliard, of the Talbots of Fox Chapel, where the Mellons and friends had their houses,) Hugh and Bill Liedtke were keyed into oil money from Tulsa. Without outside money, you could spend a long while hustling leases before you could call any oil your own. So Overbey would be happy to show Bush everyone he knew... Bush happily flew back east to talk to Uncle Herbie. And Herbie Walker was delighted to place a bet on his favorite, Poppy, and to tell his Wall Street friends all about the doings of Pres Bush’s boy. Pres himself went in for fifty thousand, along with Herbie, and some of Herbie’s London clients, who all got bonds for their investment, along with shares in the new company—Bush-Overbey, they called it. Herbie Walker had decreed the name. After all, it was his money.

In most of the developing world, relationship-laden finance – similar to what underwrote the Texas venture of the young George Bush Sr. - is the only kind available. However, the future will be one of creating wealth through ideas. Cozy contacts that could build oil wells in Texas are yesterday’s solutions because such contacts of a single individual, no matter how well connected, cannot adequately match tomorrow’s opportunities with today’s capital. Silicon Valley has depended mostly on private individuals that invest their own wealth in start-ups of entrepreneurs unrelated to them through family or prior friendships.

The great wealth of the future is not in the ground; it is in the heads and on the drawing boards of well-trained scientists seeking to escape the slums of Delhi, Manila and Philadelphia. Of course education is essential if these prospects are to see the light of day. Building schools and hiring teachers is the easy part; these exist in some of the most repressive cultures and regions in the world. But people must also be provided a sense of self-efficacy gained from having future disposal over what they create.

Transforming abstract ideas into products that people value represents the most important path by which poverty will be conquered in the twenty-first century. Knowledge based production is not only for rich countries, consider the enormous risks that must be surmounted before ordinary working people in the world’s poorest nations will buy future shares in productive enterprises, not managed or owned by family relations.

To appreciate the value of social and institutional assets to development, consider the contrast between a young, untested, penniless innovator who has just graduated with an advanced degree in engineering from an American University and an equally entrepreneurial soul in the Middle East who similarly dreams of starting a business of his own. Upon opening a stall in the local bazaar, this unlucky individual must fight off tax -collectors and government officials to protect any surplus wealth that can be confiscated.²⁷ Is it a lack of talent or an understanding of markets that keeps entrepreneurs from appearing? Malfeasance and corruption create uncertainty that makes it difficult to build a business larger than a market stall in many parts of the world.

Consider the lack of entrepreneurs in the former Soviet Union where the most astonishingly creative people with the most ingenious ideas are unable to match their

ideas with finance. The insurmountable obstacle is that some gangster will grab the surplus profits not seized by the government. This is the threat those fortunate to live in Silicon Valley never have to face and it is the invisible, rarely acknowledged debt they owe to American social and political institutions that function while asking nothing in return. An investor from Omaha, Nebraska, that purchases stock from a broker in New York never worries if he really owns or can be defrauded of his shares. This is why China's highflying internet companies, NetEase, Sohu, and Sinaq are traded on the Nasdaq.²⁸ How did the division of labor occur between the venture capitalist and the investing public? That speculation depends upon an elaborate infrastructure of contractual enforcement mechanisms that are embedded in social institutions that evolved over generations.

Innovation must be protected from both private and governmental malfeasance. It requires a reliable set of public goods and services that facilitate contract enforcement at reasonable cost. This protection must include well-defined property rights and bankruptcy rules that are clearly specified in law and a judicial system that can reliably implement collateral repossession, execute guarantees and deter breach of contracts. Most importantly, investments in high value-added activities require high quality information about the assets and liabilities of companies.²⁹ Government can be the greatest insurance of the integrity of that information or it can be the most important source of its contamination, by virtue of the fact that government is often the largest creditor and the largest borrower in any economy. How it discloses its own financial management fundamentally influences quality of financial data available to the private sector.

INSTITUTIONS AS INCUBATORS

In conclusion, Silicon Valley provides a simple but compelling message about the possibilities of value creation in today's world. Success in the knowledge age cannot be accomplished by the simple transference of technical know how. The notion that "if we build it they will come" is unrealistic. If it were realistic Silicon Valleys would crop up everywhere. Trust, laws, social forces, internal governance structures, financial and information-intermediaries, regulators and civil society all make critical contributions.³⁰ Silicon Valley prides itself on independence from the outside; on its reputed ability to pull itself up by its own bootstraps but it depends upon a legacy of public institutions that mitigate market risk.

This leads us to an important conclusion about the role of social institutions in development. It has often been argued that the rule of law is not important in the early stages of development when exchanges are usually conducted in the context of traditional relationships. The implication being that only as countries scale up and develop professionally managed companies does it become necessary to establish impartial rule-making bodies. But this neat dichotomy between stages of development does not apply to countries like Brazil, China, or India with high tech ambitions to be part of international technology flows.³¹ In these developing countries that seek to become centers of technology-intensive production, the emergence of the underlying social institutions will be the greatest challenge for future prosperity.

China has done best when it builds factories that use lots of people. Its labor will remain cheap for decades and it needs to generate millions of new jobs to maintain social stability. However to sustain technological development and excel in the long term China faces a hurdle most developing societies face. Success requires legal and financial infrastructure as much as it requires training and facilities.³²

From the legacy of Silicon Valley, China can learn to appreciate the parts played by the individual, investor and inventor, who saw a glimmer of the future and then acted on their dreams. Silicon Valley owes much of its success to individual investors who joined individual inventors to make bets on the future based on vision, imagination and confidence in the future. An innovator must trust being able to appropriate the value invested in discovery and innovation. When their dreams failed to materialize, government liabilities or public malfeasance was not involved. The cost of the Internet bubble fell on those best able to afford it, leaving the government and the taxpayer out of harm's way.

When will citizen investors and innovators be invited to play a major role in China's future? Individual innovators in China are still unable to capture the rewards of tomorrow's productivity because they have difficulty gaining access to today's capital. In a world dependant upon government or vested interests for capital, what makes the story of Silicon Valley so poignant for China is the prominent role it extends to the hopes, dreams, predilections and taste for risk of private investor and innovator alike. China, like its developing country counterparts, has no shortage of dreamers who imagine a better future. What they need are the institutional bridges between ideas and money to turn their dreams into products demanded by the market.

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NOTES

¹ Warschauer, 2004. To create knowledge using information technology, social inclusion and social development are essential

² Wilson III, 2004. Discusses the links between information revolution and social and political change in Brazil, China and Ghana.

³ Mokyr, 2002: 284 - 297. Useful knowledge requires institutions that link technology with sources of financing.

⁴ China's technology anxieties run far deeper than those of Western societies, which have survived technology bubbles before. China has not been as fortunate. The gap between technology and the market is historically China's Achilles' heel. Between the 10th and 14th centuries China was the technology hub of the world, but its cutting edge technologies were not put into commercial use and never entered the mainstream of people's lives.

⁵ In Shanghai alone more than 30,000 returnees are working for start up businesses; 90 percent with advanced degrees from overseas. Shanghai authorities expect the number to reach 120,000 by 2010 (Kaufman, The Asian Wall Street Journal, March 6, 2003).

⁶ On the global mania to create Silicon Valley's around the world see Koepp, 2002:1-4. A website that traces global "siliconia" registers over 100 locations. The Netherlands has a Silicon Polder, Taiwan is known as Silicon Island, Bangalore is called the Silicon Valley of India.

⁷ Economist, January 6th 2005.

⁸ For an analytical narrative of Silicon Valley's evolution, see Koepp: 27-128.

⁹ Saxenian emphasizes the blurring of individual company boundaries (1994).

¹⁰ IBM decentralized its structure, to make fast decisions based on closeness to performance and to accurately assess the cost of outcomes.

¹¹ Vives: 193.

¹² Richard Florida, Regions that rank high on the gay and bohemian indexes are likely promoters of innovation.

¹³ Richard Florida, 2002 Chapters 13-17.

¹⁴ World bank, 2003.

¹⁵ Venture backed firms represent 11% of all new jobs but 1% of the capital.

¹⁶ In 2001, after the dot com explosion, venture capital investments shrank to \$31 billion, this return to more normal levels still represents significant level of funding. (National Commission on Entrepreneurship, 2002, page 25). A major turning point is considered to be the Tax Reform Act of 1986 that reduced the number of tax shelter schemes for individual investors. Their disappearance sent individual investment dollars seeking other high return options such as venture funds or direct equity investments in entrepreneurial companies. Another milestone in the growth of equity capital was regulation in 1978 that taxed stock sales at lower rates than ordinary income rates, which changed the mind-set of individual investors who started to seek out entrepreneurial companies that offered high returns. Also critical were changes to bankruptcy laws also in 1978 that protected individual creditors, whose business had failed from losing house and home, thus removing a stigma of failure.

¹⁷ Venture capitalist surveyed by Gorman and Sahlman had replaced an average of three CEOs during their careers. (1989)

¹⁸ "We found that in more than half of all venture capital backed companies the CEO was removed by the time we observed them (when they were 6.5 years old, on average)." Hellman in Chong-Moon Lee ed., 282.

¹⁹ "At the height of the dot-com boom, fully half of all the companies that made an initial public offering of their stock were venture backed"; 2002 National Commission on Entrepreneurship: 25.

²⁰ For models that treat control issues in venture contracting see Chan, Siegel, and Thakor (1990) and Berglof (1992).

²¹ Admati and Pfleiderer discuss how venture capital arose to solve a financial contracting problem in which several stages in project development exist requiring a decision about whether to continue and invest additional capital (1994).

²² Black and Gilson: 1998: 243-277.

²³ In India the socialized banking system created an excessive demand for funds with below the market interest rates but Rafiq Dossani explains "bankers extended the loans to their safest customers. These were primarily the large firms owned by the government, which operated the largest steel, coal electrical and other manufacturing industries. The other large bank borrowers were the giant family conglomerates such as the Tata and Birla group. This increased the group's economic power, but did not lead to economically efficient decisions about how to deploy capital. Small firms were starved for capital. Thus the Indian banks provided no resources for entrepreneurial firms" (Dossani and Kenney, 2002:234-35).

²⁴ Banks will be reluctant to lend to people they do not know when their expectations of repayment are not supported by independent judges and good commercial laws.

²⁵ Most assets have diminishing marginal returns. For example, as more laborers join the labor market, returns to existing laborers decline. Networks by contrast, do not have diminishing returns caused by crowding out. For example the advantage of owning a network increases with each new member in the network. Once an airline reservation

system is developed its usefulness is limited only by the size of the market not by its own use. Strong positive spillovers exist in knowledge networks because new knowledge compliments existing knowledge. Use by one party does not crowd out by the use of another party as in the case of manual labor. Knowledge is more valuable the more society already knows. Romer (1994, 1998) elaborates the theory of the nonrival or nonscarcity attributes of intangibles such as software. His belief that intangible inputs or negligible opportunity costs exist beyond the original investment led him to put his own economic textbook on the web. Once written further investment is not needed to ship a book to yet another customer over the web.

²⁶Richard Ben Cramer: 28

²⁷In a study across Italian regions Rajan and Zingales report that a more developed financial system enables people to become self-employed. "Even after controlling for other regional differences, an individual living in the most financially developed region is 33 percent more likely to start out on her own than an individual with the same characteristics living in the least financially developed regions. By reducing the importance of initial wealth financial development also allows people to start out younger on their own." Rajan and Zingales, 2003: 121.

²⁸ In Egypt, Hernando de Soto (2000) reports, 88% of the businesses are informal because it takes at least two years to establish a legal business. 92% of the buildings are illegal including those built by the President because of the difficulty in establishing property rights. Egypt has eight different property systems. Four billion people around the world have the potential of owning 3 trillion dollars in real estate if only they could establish rights to what they use.

²⁹ The lessons of the American experience are not lost on these companies that emphasize making money and retaining profits. They hope to eschew the excesses of the American model by depending on advertising revenues from old-economy mainstays and avoiding dependence on revenue from dotcoms. They pay software engineers a fraction of their U.S. counterparts and they operate with higher profit margins.

³⁰ Many technology firms offer share options to make it easier to obtain and retain skilled workers. To be appealing these shares must be portable and the firm must maintain high standards of financial transparency to determine the value of shares when an employee or manager leaves the firm.

³¹ One of the reasons Silicon Valley thrived was an inter-firm social interactions and customer network tie that facilitates knowledge acquisition. These ties also produced inter-firm trust, which added to firm performance. China's weak civic capabilities will affect the productivity of its firms and reduce overall productivity.

³² In a paper that studies how economic development promotes the rule of law Chong-En Bai et al. argue that the social benefit of establishing a rule of law is greatest at high levels of development. In the early stages of economic growth development occurs despite the lack of rule of law. The conundrum facing the large developing economies like India and China is that they seek to develop sectors of the economy like computers and software that require significant use of external funds in the first decade of their

existence (Rajan and Zingales, 1998). The costs imposed by weak of law will adversely impact financial development, which in turn will hinder industrial development in sectors dependent on external finance. Thus these economies find themselves needing the rule of law at a time when they do not have the social forces to promote its rapid development. (McMillan and Woodruff, 1999). Without an existing modern sector a group will not gain adequate political support to overcome the incumbent interests that benefit from the lack of rule of law (Chong-En Bai et al., 2002).

³³ Of Asian societies Singapore is well placed to follow the open industry architecture of the Silicon-Valley model. Singapore has relatively strong financial governance, a developed financial service sector, a multi-cultural character and a large expat community that functions effectively on the basis of weak social ties buttressed by a reliable legal system.

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