Cross-cultural Differences in Entrepreneurship in the Asia-Pacific PC Industry

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Abstract: The invention of the PC enabled many startup businesses. The comparative success of startup and existing firms in four countries — U.S., Japan, Korea and Taiwan — are contrasted with their entrepreneurial environments and home markets to better understand the influence of both on startup ventures in new technology-based industries.

Joel West
University of California, Irvine
Center for Research on Information Technology and Innovations (CRITO)
http://www.crito.uci.edu

Correspondence Address:
332 GSM
Irvine, CA 92717-3125
(619) 721-7500; fax (619) 721-4422
joelwest@uci.edu

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A large subset of new business ventures are born in response to new market opportunities. Many of these opportunities, in turn, are created by discontinuous changes in technology that demark the starting point for the sustained growth of a new industry segment. Few such technological discontinuities have had as much impact in the past two decades as the invention of the microprocessor and the subsequent growth of the personal computer industry.

Establishing the causality for macroeconomic developments (such as the growth of the PC industry) is extremely difficult, given that no two such discontinuities are equivalent and the wealth of confounding economic, social and political factors that are present at any one time. But comparing parallel developments across multiple regions allows us to draw some inferences as to the importance of various environmental factors to the development of new ventures (Eisenhardt and Schoonhoven 1993).

In this case, comparisons are made between the four largest computer-exporting nations of the Asia-Pacific region during this period: U.S., Japan, Taiwan and Korea. These countries are used to explore two general class of hypotheses regarding opportunities for two ventures: those associated with domestic market size (demand-based) and those associated with the entrepreneurial environment (resource-based). The four countries provide for a series of paired comparisons, between two countries with large domestic markets for computers (the U.S. and Japan being the two largest in the world) and two with much smaller domestic markets. At the same time, within each pair of countries, prior research suggests that the entrepreneurial environment was much more favorable in one country than the other (Table 1).

(Insert Table 1 here)

Emphasizing the two largest (and most technologically self-sufficient) countries, the paper reviews the development of the PC industry in each of the four countries. It concentrates on producers of personal computers — a business that did not exist before 1975 — although many of the observations are equally applicable to makers of components, peripherals and software packages, all of which saw explosive growth in sales and new companies because of the new PC markets. Finally, the paper concludes with suggestions for further research on technological change and entrepreneurship.

PC's: Technological Discontinuity, Innovation and Evolution

The invention of the microprocessor was the major technological breakthrough, but it was only when combined with two related innovations — personal computers and packaged software — that there was a personal computing revolution. Although much of the key technology was developed in the U.S., parallel development occurred in Japan, and later diffused to the rest of the world.

Technological Discontinuities and Dominant Designs

Prior research suggests that the transition from an old to new technology is marked by two distinct events: a technological discontinuity that eventually leads to establishment of a dominant design (Utterback and Suárez 1993; Anderson and Tushman 1990).

These two events demark two phases of technological change. The first phase follows a technological discontinuity, which introduces tremendous uncertainty and a multiplicity of implementations into a given market. Eventually a dominant design is established — a benchmark of essential product attributes — and development in the second phase focuses on making improvements to that benchmark. Suárez and Utterback (1995) found that of six industries studied, in four cases the survival rate was lower for firms that entered a market after the dominant design is established.

A technological discontinuity does not have to be an entirely "new to the world" product or technological innovation. It may reflect the introduction of an existing technology to a new industry or geographical market. In all cases, however, the discontinuity marks a paradigm shift or break in the basis of competition before and afterwards. If the technology becomes successfully, it will eventually transform the way that producers and users view existing products. But there is usually a long period of uncertainty, of false starts and trial and error, between invention of a technology and a clear approach for its application emerges in the form of a dominant design. Gaining the dominant design does not assure product success, although dominant designs have often been the most popular product, as with the IBM 360 mainframe or IBM PC.

Personal Computer Invention and Early Innovations in the U.S.

The microprocessor was a technological discontinuity that enabled the creation of the personal computer. The invention of the personal computer, in turn, marked a change in the technological regime (to use the terminology of Nelson & Winter 1982: 259) of the computer industry. (Table 2). Because this change entailed three major shifts in the nature of computing — from institutional to individual *customers*, from limited-run to mass-market *production*, and from industrial to consumer *distribution* — PC advocates are not engaging in their usual hyperbole to term it a "revolution".

(Insert Table 2 here)

The PC revolution was spawned by three related technological developments in the mid 1970's: the sequential invention of the microprocessor, the personal computer and the application software package. As each was commercialized as an innovation[1], it led to the next invention, a and together they enabled the creation of an industry that now registers global sales in excess of $100 billion.

Intel invented the first microprocessor (the 4004) in 1971, but its significant innovation was the first true 8-bit microprocessor, the 8080 in 1974.[2] The low-cost microprocessor changed the economics of computer production by becoming the first central processing unit (CPU) mass-produced in units of millions rather than hundreds or thousands. At the same time, the large market financed R&D such that a typical desktop computer of 1990 had more computing power than the top-end superminicomputer of 1980 or mainframe of 1970.

The Intel 8080 innovation enabled the invention of the personal computer, which is generally attributed to a small New Mexico start-up firm, MITS.[3] The January 1975 *Popular Science* cover story on its Altair 8800 do-it-yourself kit inspired a hacker named William Gates III to drop out of Harvard to co-found Microsoft. But beyond the Altair — a kit computer oriented towards hobbyists — the Intel 8080 architecture evolved into a class of assembled personal computers — based on the Z-80 (a Zilog processor compatible with the Intel 8080) and the CP/M operating

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1 We adopt the distinction between invention and innovation of Nelson & Winter (1982: 263-265)

2 The historical discussion contained herein is intended to contrast to the discussion of the Japanese PC industry; for a more comprehensive summary, see Langlois (1992).

3 Levering et al. (1984: 463) credits Japan's Sord with an April 1974 release of an Intel 8080-based microcomputer.

system, but small variations in the architecture between models made software development difficult.

Instead, the key innovation was the April 1977 release of the Apple II, which enabled the invention of the computer spreadsheet, Visicalc, announced in 1978 for the Apple II. Visicalc was the crucial innovation — the first important PC application software package — in that it provided a reason for non-hobbyists to buy a personal computer. The positive externalities of the available software became the key success factor for PC sales, as makers of innovative PC's lacking software soon found out.

Personal computers necessitated a key marketing innovation, the consumer distribution of computer products. The Apple and CP/M machines fathered a series of computer dealers and chain stores that later enabled distribution of the IBM PC and its clones. Meanwhile, Tandy established its PC's through use of its existing national dealer network.

However, the dominant design (and standard) for the industry was set by IBM's decision to build its personal computer using existing components, resulting in an open standard that did not exclude new entrants. Released in August 1981, IBM Personal Computer used a processor from Intel, an open architecture for expansion boards, and an operating system from Microsoft. This strategy allowed rival companies to build "clones" of IBM's product. In 1984, IBM was the first to introduce a computer based on Intel's faster 80286 processor, but was matched or beaten by "clone" makers in subsequent processors, as IBM attempted to regain control of the technology it created. Instead, IBM's share of the so-called "IBM compatible" market slipped from 100% in 1981 to less than 50% within a few years, until finally, in 1994, Compaq surpassed it as the leading Intel-based maker.

With the authors of Visicalc otherwise distracted, it fell to a new firm called Lotus Development to develop the Lotus 1-2-3 spreadsheet for the IBM PC, which topped the best-seller lists by April 1983 (Levering et al. 1984: 132, 192). Meanwhile, startup firms WordPerfect and Ashton-Tate released word processing and database applications that, together with 1-2-3, provided the network externalities that fueled customer acceptance of the IBM PC.

The other important innovation was the January 1984 introduction of Apple's Macintosh, (incompatible with the IBM standard) which was the first to popularize the graphical user interface developed by Xerox Corp. Although Microsoft responded with its Windows add-on for

MS-DOS in late 1985, Windows was not perfected until 1990, and Apple held a demonstrable ease-of-use advantage until 1995. Apple's introduction of its first laser printer in 1985 combined with its graphics capabilities to create the "desktop publishing" niche market. Despite such advantages, various marketing miscues and technology delays — coupled with the strong externalities accruing to the IBM standard — prevented Apple from increasing its worldwide market share above 10%.

Instead, the vast majority of the world's business computers (except in Japan) had coalesced by the late 1980's around PC's that ran identical MS-DOS and application software to those used by the IBM PC, a standard that created strong positive externalities for both hardware and software producers making complementary products (Langlois 1992).

Evolution of the Japanese PC Industry

In the computers and many related components (including semiconductors), by the late 1970's, Japan had developed technologies comparable to the U.S. It also had one of the world's first domestically-produced PC's and a wide range of products by 1980. Still, the pattern of development — both in terms of industry structure and end-user application — was very different from that of the U.S.

Institutions that Nurtured the Japanese Computer Industry

From the 1950's onward, Japan's Ministry of International Trade and Industry specifically targeted the computer industry, beginning with an aggressive import substitution policy that had shifted by the late 1970's to exporting globally competitive products. Some scholars (Flamm 1988; Anchordoguy 1989) have termed that development a combined government and industry effort to target the world's most successful computer company, IBM. Certainly government policies were an essential part of the development, including government computer procurements and a quasi-public firm established to provide capital to Japanese mainframe makers. Finally, direct R&D subsidies helped Japanese makers catch up to IBM's mainframe computers, and in 1979, Japan became the first (and only) capitalist market where local mainframe makers surpassed IBM (Anchordoguy 1989).

More recently, leadership has shifted from political to economic institutions. Certainly, economic institutions played a role in the development of the computer industry, particularly *keiretsu* industrial groupings, which provided semi-captive markets for producers and sources of patient capital for expansion.[4] Most would agree that the role of government policy has declined with the government's proportionate share in the economy with the growth of private firms. Some (e.g. Callon 1995) go so far as to argue that firms have grown so strong as to be immune to government influence.

So despite their importance in creating and nurturing the Japanese computer industries, it seems safe to say they had little effect on the growth of the Japanese PC industry, for two reasons. First, the level of direct intervention by the government (notably MITI and NTT) during this period and in this industry was much lower than earlier targeting efforts. Secondly, a presumed goal of such policies would be to increase domestic sales, exports and the competitiveness of Japanese makers, something that manifestly did not happen during the period 1975-1990.[5]

Phase I: 8-bit era, 1975-1982

As in the U.S., the early sales of PC's in Japan were aimed at hobbyists. NEC chairman Koji Kobayashi (1986) credits his firm with developing a kit-based PC at the same time as the Altair 8800. Others give the honor to entrepreneur Takayoshi Shiina, who left a job selling DEC minicomputers to write Japanese software for the imported computers: he founded Sord in 1970, which released a series of PC's from 1974-1976 (Levering et al. 1984: 462-472).

Another entrepreneur to recognize the potential of personal computers was Kazuhiko Nishi, who dropped out of Waseda University to found ASCII magazine in 1977, and became Microsoft's exclusive representative in Japan. ASCII later moved into distributing imported and domestic software, as did Softbank, a rival distribution and publishing firm founded in 1981 by Masayoshi Son.

The major Japanese electronics companies — including Toshiba and Hitachi — introduced kit-based computers in 1976-77. The best selling 8-bit machine was the NEC PC8001, which sold 150,000 units. From 1980-1982, NEC held around 44% of the market, with 16% for Sharp and 12% for Fujitsu when it introduced its FM-8 in 1982. Meanwhile, Sord held about 6%,

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4 On the former, "As of 1968, about half the [mainframe] computers in use by firms in the major industrial groups were made by their *keiretsu*-group computer firm." (Anchordoguy 1989: 33). On the latter, most often cited are the billions of yen NEC received from the Sumitomo group in the 1980's to expand production capacity, helping it become the world's leading producer of semiconductors.

5 Anecdotal evidence suggests that the Ministry of Education practiced a form of import substitution, by flatly prohibiting imported computers (notably those of Apple) from K-12 public schools.

having moved up-market to emphasize more expensive machines with 128-1,024K configurations.(Horiguchi 1983: 30-31).

Many PC makers tried to export. Both Sharp and NEC exported their machines in limited numbers, with the NEC's portable — sold by Radio Shack as the Model 100 to countless journalists — the most popular (Mannes & Andrews 1993: 209). More successful still was Seiko's Epson subsidiary, whose dot-matrix printers captured 70% of the Japanese market and became standard issue for both the Apple II and the new IBM PC (Horiguchi 1983: 51). Low-end home machines by Commodore and Sinclair were imported, but IBM sold a Japan-specific IBM 5500 computer rather than one based on the IBM PC sold in the U.S. and Europe.

Phase II: Reign of NEC, 1983-1991

If the IBM PC was the watershed for the personal computer in the United States, then the compatible development in Japan was NEC's PC-9801, released a year later in October 1982. Although it was not immediately obvious that NEC's machine would surpass other 16-bit offerings, NEC held several advantages, including a chain of retail microcomputer stores and close relations with software developers (Fukunaga 1988: 32-33). It won the widest selection of application software. The most important of these was Ichitarō , a word processor that fully supported the Japanese language, which was released in August 1985 by JUST Systems, a company founded in 1981 to sell mid-range office computers.

Early estimates placed NEC's share of the 16-bit market at upwards of 80%, and its success was rewarded in 1987 with the first (and only) clone, from Seiko Epson, which also offered the first PC-98 compatible laptop (Fukunaga 1988: 33).[6]

The PC-98 was based on the same Microsoft/Intel architecture used in the IBM PC, but the MS-DOS operating system had to be extensively modified to support Japanese language processing. NEC's competitors each developed their own, incompatible methods of supporting Japanese characters. The three most successful to do so using Intel chips and the MS-DOS operating system as a starting point were Fujitsu, IBM Japan and Toshiba. Apple also opened a subsidiary in Japan in 1983, and begun selling a *kanji* version of the Macintosh in 1986, and its first Japanese-capable laser printer in early 1989.

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6 NEC filed an injunction against Seiko, claiming copyright infringement (much as IBM did against several 2nd-tier clones in the U.S.), but Seiko modified the product to eliminate the infringement and the two parties settled out of court in November 1987.

Software makers also set up subsidiaries in Japan. Lotus did so in 1985, shipping the first Japanese version of its 1-2-3 spreadsheet in 1986, which jumped to the top of the best-seller list, which it shared with Ichitaro for most of the next decade. Meanwhile, Microsoft ended its agreement with the Nishi — the "Bill Gates of Japan"[7] — to set up its own subsidiary in 1986 (Wallace & Erickson 1992: 330-333).

Phase III: Era of DOS/V, 1992-present

Several attempts had been made by rival PC companies to dislodge NEC from its success. The turning point came with IBM's decision to reduce its costs by selling PC's in Japan that were compatible with those it sold in the rest of the world. To do so, it moved all the Japanese processing from the computer's read-only memory (ROM) to software that ran on an unmodified IBM PC. The result was DOS/V, which it announced and shipped with new PC's in October 1990, and licensed to competing makers (West & Dedrick 1996). DOS/V was aided by Microsoft's decision to release Windows 3.1 in May 1993 as a single version of Windows for all MS-DOS based systems: NEC, DOS/V and English-based DOS systems (Choy 1994: 5).

The end result of DOS/V was twofold. First, makers could sell the same machines as they sold worldwide, reducing their costs by using the components and configurations used for these global markets rather than special Japanese versions. Second, DOS/V removed barriers to new entrants (both in terms of technology and gaining compatible software), thus opening the market to new entrants from the U.S. (Compaq, DEC, Dell, Gateway 2000) and elsewhere (Acer, Olivetti).

The result was a crumbling of the high prices that had characterized the market since the beginning. Price skirmishes came in 1990, when Apple and NEC sought to match prices of a smaller competitor, and in 1992, when Compaq entered the market offered PC's below the ¥200,000 mark (U.S. $1,600), about half the price of existing products (Mori 1993; Choy 1994). But despite exaggerated fears of the "Compaq shock" (explicitly likened to Commodore Perry's "black ships" of 1853), Compaq and the other new entrants never gained more than 3% of the market.

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7 Like Gates, Nishi came from an affluent background dropped out of a prestigious private university to found his firm, and, according to Gates, is "more like me than probably anybody I've ever met" from Japan (Johnstone: 1993). Although the "Japan's Gates" moniker was used frequently in the 1980's for Nishi, recently it has been applied to Masayoshi Son, a Berkeley graduate who, born to a Korean-Japanese squatter's camp, has since become Japan's first computer (dollar) billionaire.

Instead, it was the "Fujitsu shock" of 1995 — drastic price cuts coupled with aggressive investments in distribution and advertising — which increased the market 60% and more than doubled Fujitsu's share to 17.5% (West & Dedrick 1996). In response, even NEC announced plans to support DOS/V machines through its Packard Bell NEC subsidiary. And, having reduced their costs for their home market, in early 1996 several large Japanese makers began new campaigns to enter the crowded U.S. market (Boyd 1996).

Global Diffusion of the PC Innovation

Personal computers gradually diffused to developed countries that featured high per-capita incomes, level of education and technological sophistication, and the interaction of education and technological skill known as "computer literacy". The earliest such countries were those that developed their own computer industry, or had high levels of English fluency — to enable diffusion of PC products and technologies from the United States.

Enabled by its role as the inventor, its large domestic market and rapid diffusion of PC's, U.S.-owned firms have consistently held approximately a 50% market share. As more non-U.S. have succeeded in exporting to U.S. (or bought market share by buying failed U.S. start-ups), more U.S. firms, in turn have expanded operations abroad. Japanese firms have held about a 10% share — primarily for their domestic market, as have European firms in the aggregate, while the rest is split primarily among Canada, Korea and Taiwan (Table 3).

(Insert Table 3 here)

Such statistics measure the ownership of a brand name, not value-added. A given PC may include a processor from the U.S., memory from Korea, a hard disk from Singapore, a CD-ROM from Japan and a motherboard from Taiwan. There have been many debates over which technology provides the key differentiation or long-term strategic advantage, but the comparatively small year-to-year variation (absent significant mistakes in execution) suggest that brand name, reputation, distribution — all determined by the marketing organization's strengths — are at least as important as the actual product content in market success.[8]

[8] Even allowing for this, these figures tend to understate the role of some countries, particularly Taiwan, which exports assembled systems on for distribution under U.S., European and Japanese brand names (Kraemer & Dedrick, forthcoming).

At the same time, a fairly consistent international division of labor has arisen, fueled by positive externalities of geographically localized industries within regions (such as Silicon Valley) or small countries (such as Taiwan). The U.S. produces microprocessors, operating systems and applications; Japan, semiconductors, floppy drives, CD-ROMs, LCD screens and laser printer engines; Taiwan, motherboards, expansion cards and assembled systems and Korea, semiconductor memories. Some technologies shifted from the U.S. to Asian countries in the 1980's, and a similar shift has occurred from Japan in the 1990's.

Comparing Entrepreneurial Environments Between Countries

Various explanations have been advanced to explain environmental effects on new venture success. For example, Roure and Keeley (1990) accounted for the majority of the variance in venture-funded startup success by the experience of the founders, product superiority, availability of buyers and speed to market.

U.S.

The most popular microprocessor and PC operating systems, as well as most of the packaged application software and a large fraction of the world's PC's are today sold by startup U.S. firms. In the late 1970's and early 1980's, the spectacular success of these firms caught the popular attention in TV shows, magazines and books. Sometimes the attention focused on the individual successes (e.g., Levering, Katz & Mostkowitz 1984). In other cases, attention focused on the riches of California's Silicon Valley (e.g., Rogers & Larson 1984) — much as 130 years earlier they'd focused on the riches at Sutter's Fort.

But behind such pop analyses were a number of U.S. environmental advantages:

Capital. Ready availability of venture capital, as well as the liquidity provided by initial public offerings.

Trained work force. As Cooper and Bruno (1977) demonstrated in a study of San Francisco-area startup, the most successful entrepreneurs have previously worked for large companies. Thus, many of the founders of PC startup firms were veterans of large, successful US electronics companies, like Hewlett-Packard and Texas Instruments. Meanwhile, U.S. efforts to diffuse computer technology — to government contractors, large firms and universities — helped the development of computer programming skills (Mowery 1996). So Bill Gates learned to program in eighth grade when his affluent school rented time on a local computer, and he developed

Microsoft's first product using computer time at Harvard before he dropped out (Wallace and Erickson 1993).

Proximity to innovation. The microprocessor, the Altair 8800, graphical user interfaces, the mouse and the major programming languages were all invented in the U.S. In the early stages of the PC industry — before the explosion of computer magazines, trade shows and the world wide web — this proximity to

Regional synergies of Silicon Valley. Most of the early PC makers were located in Silicon Valley (even if most of the post-dominant design entrants have been located elsewhere). Geographic proximity enabled the free flow of information (particularly tacit knowledge) and workers that gave Valley firms a distinct advantage over their rivals in the early periods of greatest technological uncertainty (Bahrami & Evans 1995; Rogers 1985). In addition, the region had within it the key resources (such as venture capital and skilled engineers) that have been shown to be strongly correlated to rates of high-tech firm creation (Schoonhoven & Eisenhardt 1993).

Japan

Japan is generally held to be a hostile environment for starting growth-oriented technology-based firms, at least as compared to the United States.[9] As Masayoshi Son, the most successful computer entrepreneur in Japan, put it:

> In the United States, there is not the negative perception of the entrepreneur that there is in Japan. In general, it's harder to be an entrepreneur in Japan than in the United States. Japanese banks will not loan money to you because they are more conservative. And because of the culture, it's harder to attract the best employees. They like to work for the big companies or the government because Japan is a lifetime employment country. (Webber 1992: 101-102).

But culture is an inadequate explanation of the difference; economic institutions — particularly the *keiretsu* industrial groupings — play a major role. Lifetime employment, for example, reflects a conscious policy of large Japanese firms only since the early 1960's. Methé

[9] So, for example, Eisenhardt and Forbes (1984) found high levels of technical entrepreneurship in the U.S., moderate in the U.K. and low in Japan, as measured on several dimensions.

& Bracker (1994) found that Japanese entrepreneurs sought freedom and independence (like their U.S. counterparts), but often ended up being captive subcontractors to the *keiretsu*.

Other studies focus on the availability of capital. Regulation of initial public offerings mean that the average Japanese start-up firm is much older than the average U.S. firm at time of IPO; this discourages both entrepreneurs and potential early-stage investors, since the payout may be delayed 15 years away vs. five for the U.S. (Borton 1992; Callon 1994; Matsuda et al. 1994). Tax laws both discourage investment by informal investors (so-called "angels") and also the accumulation of capital that makes such investment possible (Callon 1994).

Two booms in Japanese venture capital (1972-1974 and 1984-1986) were relatively short-lived (Borton 1992). A third boom started in 1994, as a reaction to the success of U.S. Internet and multimedia start-up firms; Japanese ministries, financial companies and trade associations have been studying the U.S. venture capital patterns in hopes of encouraging multimedia-related Japanese venture businesses. Some policy reforms — such as loosening IPO requirements — have been enacted, but it's too soon to say whether these changes will be permanent.

Meanwhile, the existence of a few successful entrepreneurs are serving as role models (as Steve Jobs and Bill Gates did 15 years earlier). Informal channels are also developing to encourage entrepreneurs, such as a Tokyo-based club that includes Son, Sega president Hayao Nakayama, and Katsumi Iizuka, founder of new PC maker Akia (Updike 1996).

Korea and Taiwan

The Republic of Korea and the Republic of China are the two largest of what were once referred to as the Asian Newly Industrializing Countries (NICs). Both ended the war in economic devastation, received large doses of U.S. aid as a consequence of the Cold War, and used central economic planning to implement programs of import substitution (Haggard 1990). However, unlike other developing countries like India or Brazil, both successfully switched to a system of export promotion that brought double-digit growth and per capita GDP by the 1990's on par with some Southern European nations.

Both countries placed major emphasis in export-oriented electronics production, using technology licensed or copied from U.S. and Japanese firms. Both have similar growth rates and levels of investment for domestic computer use (Kraemer et al 1996: 242).

But their patterns of new venture creation — and, arguably, their role in PC production — are quite different, due, in part, to dramatic differences in industry structure.

Korea: Land of the Chaebol

Korea was a culturally distinct but economically undeveloped nation that was annexed by Japan in 1910 after its victory in the Sino-Japanese war. The country became a supply and production base for Japan, particularly during the Pacific War from 1937-1945. After the war, the country was partitioned with the U.S. forces occupying the southern portion (Haggard 1990).

During the 1950's, certain well-connected businesses were granted preferential grants, loans, orders and import rights that enabled them to grow far faster than other new Korean firms. These grew into the *chaebol,* diversified industrial groups that in many ways parallel Japanese *keiretsu* groupings, but have a far greater influence on the domestic economy (Amsden 1989). These *chaebol* have become among the world's largest producers of semiconductors, accounting for three of the top seven producers of dynamic random access memories (according to Dataquest's 1994 estimates) and recently expanding into liquid-crystal displays.

Meanwhile, as in Japan, SMEs have limited export capabilities and are largely confined to subcontractor roles (Amsden 1989). Even government IT-promotion policies have favored the *chaebol* firms at the expense of SMEs (Kraemer and Dedrick forthcoming).

Taiwan: Incubator of SMEs

Like Korea, Taiwan was the subject of Japanese occupation that promoted economic development. But unlike Korea, the end of the war did not bring independence for the Taiwan, which was occupied by the Guomindang in late 1945 and became the destination for millions of refugees as the Guomindang lost the Chinese civil war. Because the Nationalist Chinese lacked ties to the rural elites (who were ethnic Taiwanese), they mounted a far more complete program of land reform than they had on the mainland or than was seen in Korea (Haggard 1990).

Unlike Korea, government policy choices favored the creation of many SMEs through, for example, targeted grants and loans. Although venture capital and IPO were (until recently) very rare, small startups were able to procure startup capital up to $20 million through informal networks of friends and relatives (Kraemer et al 1996). On example is the country's largest PC maker, Acer, which was founded by Stan Shih in 1976 with $25,000 borrowed from family and friends (Kraar 1995). Such financial networking — as well as technical spillovers between firms

— enabled Taiwan to share many of the geographical reinforcement benefits seen in Silicon Valley.

Differential Rates of PC Startup Success

Entrepreneurial Environment

Availability of Entrepreneurial Resources

The four countries had differing patterns for the following key resources:

Education: the U.S. and Japan had superior levels of education, particularly during the 1970's.

Experience: all but Taiwan had large firms where potential entrepreneurs could gain experience before starting on their own; however, in Taiwan, workers gained experience working for foreign multinational corporations, both in Taiwan and abroad.

Regional spillovers: both the U.S. and Taiwan were able to enjoy geographic spillovers in compact high-tech production communities.

Capital: although formal capital sources for new ventures were largely unavailable outside the U.S., informal capital was commonly used to fund startups in both the U.S. and Taiwan.

Institutions as Barriers to Competition

Industrial Japan of the past century has been one of "managed competition", in which government intervention was deemed necessary to prevent failures. MITI and other ministries sought to avoid problems caused by "excess competition", and were most comfortable with a stable oligopolistic industry structure that included 5-10 firms (Murakami & Rohlen 1992: 95). As such, the policies and institutions (such as trade associations) specifically sought to discourage new entrants into targeted industries.

In addition to previously-mentioned barriers to new firm formation, two types of barriers serve to maker it more difficult for companies (foreign or domestic) once established to enter existing markets.

The first is the well-known system of *keiretsu* cross-shareholdings, centered around bank, insurance and securities companies that provide financing for the other firms. Of the six major keiretsu, all have affiliated firms that make computers: Sumitomo (NEC), Dai-Ichi Kangyo Bank (Fujitsu), Mitsui (Toshiba) Fuyo (Oki), Sanwa (Sharp), Mitsubishi (Mitsubishi); in addition, Hitachi has ties to several groups (Miyashita & Russell 1994). These groups have a tendency to buy from sister companies — or at least not buy from competing groups.[10] Sales based on *keiretsu* loyalties rather than product quality allowed less successful PC vendors to maintain at least some market share, delaying the consolidation of the various incompatible standards. The same pattern was repeated in Korea with the *chaebol* group companies.

The most difficulty barrier to overcome is the vertically integrated distribution system (enjoyed by both the *keiretsu* and *chaebol* group firms) in which major manufacturers provide financing and other support to large chains of (highly-dependent) exclusive distribution agents. Most major Japanese consumer electronics firms have such systems: Miyashita & Russell (1994: 142-151 and Choy (1994) list this as the single most important factor in NEC's PC success.

Also, it must be noted that the leading PC-maker (NEC) was not the leading maker of earlier generation computers (Fujitsu), although it was the most successful beneficiary of government semiconductor R&D efforts associated with mainframe computers. It is notable that both companies entered the market before 1980, and both are multibillion dollar makers of consumer goods.

These systems of various economic institutions are not unique to Japan and Korea. Similar (though less effective) business groups can be found throughout Latin America, and the groupings are different in degree, but not in spirit, to many combinations in Europe. Instead, it appears that the U.S., Taiwan and the U.K. were unusual in spawning new firms to take advantage of the PC revolution. Even the rare Japanese start-up — Sord, the earliest PC firm — did not survive NEC's PC-98 standard and was bought by Toshiba in 1985.

Home Market Factors

Market Size

Even after two decades of high-speed economic growth, the two NICs lagged considerably behind the two industrialized countries (Table 4). Meanwhile, while Japan lead the other Asian nations in computers per capita, that lead was dwarfed by the diffusion of computers (mostly PC's) in the U.S. This was due, in part, to consistently low prices in the U.S. market, the early entry of many U.S. PC makers, and a variety of technical and product factors faced by the Asian countries.

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[10] Fixing the exact amount of such intra-group purchases has become intensely controversial because of the U.S. decision to target *keiretsu* as a non-tariff trade barrier in the 1980's, so precise figures are hard to come by.

Insert Table 4 here

Technical and Product Factors

A number of product-related factors delayed the development and diffusion of personal computers in the three Asian markets.

Language Representation. All three languages (Japanese, Korean and Taiwanese) utilize the Chinese ideographic characters, which are both more numerous and require higher resolution output to display. For example, the character sets for the Japanese language typically comprise 6,000 characters, as compared to 95 (or 225) printable characters needed for European languages (Lunde 1993). This note only necessitated the development of complex character-handling software for all three markets, but also meant that performance through the 1980's remained painfully slow.

Limited User Skills. The language complexity meant a lack of mechanical typewriters prior to the invention of the PC, and thus a lack of keyboard skills among adults when PC's were introduced. Lower educational levels (particularly among employees of SMEs) as well as lower disposable incomes were also a barrier, especially in Taiwan and Korea.

Fragmented Japanese Standards. As noted earlier, the Japanese PC market was fragmented between multiple, mutually-incompatible standards, which not only hurt PC makers, but, Cottrell (1994) argues, were the key reason why Japan failed to develop a globally competitive PC package software industry.

Availability of Substitutes. In place of PC's, mid-sized Japanese firms bought office automation minicomputers, whose sales increased through 1991, when the economy slipped from "bubble" growth into a recession (JIPDEC 1994: 42). Production of the *wordpro* electronic typewriter (developed in the late 1970's) increased ten-fold from 1984 to 1987, and remained above PC sales until 1993.[11]

Competition Between Established and Startup Firms

There are many alternate explanations, but overall results suggest that established firms pursued similar strategies in each country, particularly among existing makers of larger computers. So the incompatible PC strategy of DEC in the U.S. (as told by Langlois 1992) is

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[11] Domestic sales for word processors are not directly reported, but production generally corresponded to domestic use until the mid-1990's, when Japanese firms began moving production to Asian lower-cost countries.

very similar to the incompatible PC strategy of Fujitsu in Japan. As noted by Flamm (1988: 227), existing firms have incentive to delay innovations. Many established firms, enjoying good reputations and distribution networks, sold high priced PC's that would support their expensive cost structures and the high profits they'd come to enjoy in large computer systems. Even IBM — whose invention of the IBM Personal Computer set the standard for most of the industry — failed in its attempts to re-differentiate its products when it realized its strategy was more successful for Microsoft and Intel than it was for IBM.

The difference between DEC and Fujitsu appears to be competition from entrepreneurial rivals in the U.S. (e.g., Compaq, Dell) which rendered DEC's strategy obsolete long before that of Fujitsu — which did not have to worry about start-up competitors until foreign firms like Compaq entered the market nearly a decade later. In fact, a re-analysis of Langlois's (1992) data suggests that the emergence of major start-up firms was confined to a few countries like the U.S., U.K. and Taiwan and did not include Japan[12] (Table 5). Although later statistics have not been published to the same level of detail, the competition within each domestic market has generally consisted of like firms trading share points, such as NEC losing to Fujitsu and Apple losing to Dell or Compaq.

(Insert Table 5 here)

Another way to measure entrepreneurial success is through the personal wealth created by PC entrepreneurs: non-U.S. entrepreneurs with PC-related fortunes, only Japan's Masayoshi Son has consistently been represented in such lists of global billionaires. This approach, alas, is not only confounded by variations between countries in tax and stockholding institutions, but also by quirks of market timing: for example, of the top 20 digital millionaires profiled by *Forbes* (Microchip wealth 1995), only three are associated with PC makers — all three current shareholder-executives; entrepreneurs who founded larger firms but cashed out earlier (Compaq, Apple) are not represented. Still, it's hard to ignore the entrepreneur's incentive to achieve such

[12] There are major limitations to this analysis, both in terms of the original data and the methodology of this paper's aggregation. The time series extends only to 1991, and later data has not been published. A large percentage of the sales are not assigned to any specific company. The figures are distorting by reporting in total units across market segments, particularly in the early 1980's when $100 home computers from Timex (US) and Sinclair (UK start-up) and $200 home computers sold by Commodore (Canada) and Atari (US start-up) count the same as business systems priced at $3-5,000. Also, this truncated sample shows only rates of company success, not company formation. Still, it reflects the most complete global time series published for this period.

large fortunes — as a measure of success and power, if not as a meaningful differentiator of financial security.

Analysis of Competitive Strategies: Acquisition as a Follower Strategy

The largest PC makers by country include:

U.S. The startup PC makers included Apple, AST, Compaq, Dell, Gateway 2000, Packard Bell; existing firms included computer makers DEC, HP, IBM, as well as retailer Tandy.

Japan. NEC, Fujitsu, Toshiba were all established computer and electronics companies, while weaker PC firms were included established electronics companies like Matsushita, Sharp and Sony. Only Seiko Epson — the computer printer maker owned by the same family as the watch company — represented a new venture by a medium-sized firm.

Korea. Start-up Trigem is a domestic PC maker, although it has links to other Korean companies and Japan's Seiko Epson (Kraemer & Dedrick forthcoming). Other computer makers are large *chaebol* electronics companies including Daewoo, Hyundai, LG (née Lucky Goldstar) and Samsung.

Taiwan. Larger startups include Acer — most successful startup outside the U.S. — as well as Mitac and consumer electronics maker Tatung. Only Acer has pursued a direct-branding strategy, while the remaining Taiwanese firms make PC's primarily on an OEM basis for better known makers (like IBM, Apple, NEC).

Many of the richer but less successful firms have attempted to grow by acquisition. Of 11 major acquisitions of PC makers recorded in an ABI/Inforum search, 8 involved struggling US start-ups; two were struggling UK startups and one involved the exit of an established US firm from the PC business (Table 7). Of the 10 startups acquired, 6 were acquired by Asian companies. In addition, Asian companies have acquired struggling US startups, such as minicomputer maker Altos (by Acer), hard disk maker Maxtor (Hyundai) and a semiconductor division of AT&T (also Hyundai).

(Insert Table 7 here)

The most complex such deal involved NEC, which paid $170 million cash in 1995 for a 19.9% stake in struggling startup Packard Bell. In 1996, it created Packard Bell NEC, which merged Packard Bell, NEC's non-Japanese operations, and Zenith Data Systems owned by

France's Group Bull. But the evidence from prior acquisitions suggests that the acquired firms continued to deteriorate after their acquisition.

Behavioral Explanations

Why are there such dramatic differences in the rate of startup success? Differences between nations this rate of company formation may be specific to the computer industry, or reflect more general national characteristics. Such national differences can include both distinctive cultural and institutional characteristics.

With regards to culture, several studies have attempted to tie differences in international rates of entrepreneurship to Hofstede's (1984) study of employees of IBM in 39 countries. Based on questionnaires gathered in 1971-74, he factor analyzed the responses to identify four distinct values: a power-distance index (PDI), individuality, masculinity and uncertainty avoidance (which we replace here for semantic convenience by an inverse "risk-taking" construct).

- Shane (1993), in a study of per capita trademark creation by firms from 33 countries as corrected for per capita income and industrial mix. found strong support for risk-taking being correlated to innovation, but fairly weak support for PDI and individualism,
- McGrath et al. (1992) surveyed 1,217 entrepreneurs and 1,206 non-entrepreneurial professionals in eight countries. They used discriminant analysis to separate the two groups, finding 25 variable significant. These corresponded to higher PDI, individualism, risk-taking, and masculinity for the entrepreneurs.
- Dubini (1988) surveyed 163 new businesses in six regions of Italy. Of his seven-factor solution, the first corresponded to Hofstede's individuality, the third to PDI and the sixth to masculinity. He then cluster analyzed the respondents into three groups, one of which had somewhat higher levels of individuality, and another that had much higher levels of masculinity.

For each country, Table 6 shows the number of start-up and established companies from Table 5, as well as the percentage of sales (1980-1991) by that country's firms that were made by startup firms. It compares these to the Hofstede's reported values for the countries.

(Insert Table 6 here)

The results can be inferred as consistent with the risk-taking/entrepreneurship link, but not with the hypothesized relationships for the other variables. Individuality — a common attribute attributed to entrepreneurs — has the expected relationship between the U.S. and Japan, but the average individuality for countries with start-up PC firms is dragged down by a lower score for Taiwan[13].

When is a PC not a PC?

Although various 8-bit PC's have been counted in Japanese statistics as personal computers, 16-bit game players from Nintendo and Sega have not. From a technology and marketing standpoint, the distinction is somewhat arbitrary, which leads to the key dilemma: why were their development paths so different?

Both game machines and PC's have microprocessors, RAM, video output and mass storage. And despite being invented in the United States in 1972 by Atari, today all four of the most popular makers of game consoles are Japanese firms (Nintendo, Sega, Sony, Matsushita). It is difficult to explain why companies that previously made playing cards (Nintendo) and pinball machines (Sega) came to dominate the world's video game market, rather than one of the major classes of PC makers, such as established Japanese consumer electronics firms or U.S. start-ups (Battelle & Johnstone 1993; Scheff 1993).

The technology of business and game software is also similar. Video games (PC or cartridge) requires the graphics of a drawing program, the data structures of database and the reliability of a word processor; in some areas (such as speed and the use of low-level programming techniques), the requirements are often more stringent than for business packages. The marketing distinction between game and business is also becoming an increasingly tenuous one, given that the broad class of consumer-oriented software — particularly multimedia titles involving entertainment and "edutainment" — is seen by leading U.S. software makers as the larger growth opportunity than the traditional business productivity applications. The separation of PC games from video cartridge games is also somewhat arbitrary, given that the most popular titles usually appear on both formats.

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13 As suggested by Dubini (1988), it may be a mistake to assume the motivations and patterns of company formation are the same for all entrepreneurs. It may be that risk-taking is a good predictor of company formation, while individuality predicts innovation; if so, this would be consistent with the development of the Taiwanese PC industry emphasizing imitation of existing innovations at lower costs. Also, the high rate of small firms could be the result of industry structure — formed from scratch after the end of Japanese occupation in 1945 and the Chinese Revolution in 1949 — rather than a cultural propensity for entrepreneurship.

Many of Japanese game software developers are — like their U.S. counterparts — successful start-up businesses. So if package software is limited to business applications, or system software (operating systems and utilities), then Japan imports a considerable amount from the U.S. and exports little in return. If, however, software includes video game cartridges (and more recently, CD-ROMs), Japan imports very little from the U.S. and exports a great deal. So, for example, in 1993, Japan's ratio of imports to exports was 20:1 for so-called "basic" software, but 15:1 in favor of exports for game software (JEIDA 1995).

Game software developers often rely on the larger console makers for distribution of their products: in this regard, they resemble the subcontract component suppliers used by other large Japanese firms. Despite this dependence, the success of these startup software developers — along with the successful market entry by medium-sized Nintendo and Sega — suggests that Japanese high-tech markets are not completely hostile to SMEs.

Conclusions

The U.S. had so many advantages that it would be impossible to point to one — such as a favorable entrepreneurial environment or a large home market — to explain the large impact of entrepreneurial startups in its PC industry. Instead, by comparing the very different patterns of industry development in two pairs of countries with comparable technological and economic development, we can draw some tentative conclusions. Such comparisons suggest that two factors — crowding out by larger rivals and favorable resources for entrepreneurship — explain much of the difference between the nations, even after allowing for the unique birth of the U.S. industry and markets.

Limitations

The data presented in Table 5 is limited both in time period (excluding 1992-1995) and depth (omitting 10-33% of the total market). The large number of companies represented in the latest period (40 in 1991) suggests increasing fragmentation of the market (and thus difficulty of measurement), but one can reasonably assume that comparable data has been compiled and is available for purchase from market research firms.

Many of the classifications are somewhat subjective (e.g., is Commodore a Canadian firm or a U.S. firm), and that subjectivity increases as the origins and nationality of firms becomes increasingly blurred (as in the NEC/Packard Bell/Zenith/Groupe Bull combination). Such difficulties suggest a shift from the growth phase of the industry to a mature phase (accompanied by another round of consolidation). For example, the youngest of firms to crack the U.S. or global top 10 lists (Packard Bell) was founded in 1986, and the rate of successful new entrants has slowed to a trickle.

At the same time, the acquisition of previously independent startup firms raises the perennial question of how one defines “success” for an entrepreneurial venture. Is it the firm’s continuing existence as an independent (or dominant) corporate entity? Is it the sales (or profits) of that firm within its new parent company? Is it the creation of shareholder wealth during its existence as an independent entity?

Suggestions for Further Research

The invention of the microprocessor has provided (and will continue to provide) a fertile area for research into the economic results of technological change. It is unusual both for the sharp discontinuity in technology, and also for the enormous economic impact, both directly (in the form of computer industry sales) and indirectly (in terms of PC use by firms and individuals).

Beyond the actual personal computers, such an analysis should be extended across the entire value-added of the industry. Even a cursory examination suggests that the same pattern of startups is not universal across the entire PC industry, where semiconductors, video displays and printers, for example, are primarily made by established countries on both continents. At the same time, production of software is almost entirely confined to North American start-up firms, while production of services tend to be more equally geographically dispersed throughout the technologically advanced countries.

A more economically relevant analysis would be to look at the total value (rather than units) of production for microprocessor-based hardware, software and services, including PC substitutes such as video game consoles, network computers, and personal digital assistants. In addition to the usual problem of getting accurate, proprietary sales figures from private companies, the global nature of supply networks would require that careful adjustment be made for value-added to avoid double-counting (such as with a Canon-produced laser engine used in a Hewlett-Packard printer).

Rather than weight new entrants — either by value or quantity of output — an alternative approach would to consider the births and deaths of the entire (unweighted) population of producers (Hannan & Freeman 1989). Such an approach would allow inferences about the survival rate of entrepreneurial and non-entrepreneurial market entries, as well as any dependency of survival rate upon date of entry.

Finally, in investigating mediators that account for differential rates of entrepreneurial success, future research should consider legal institutions (e.g., bankruptcy law) and cultural values (e.g., attitudes towards loaning money) that would help explain behavioral differences between countries.

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Figures and Tables

Table 1: Classification of countries in the study

		Entrepreneurial Environment	
		Favorable	*Unfavorable*
Home Market	*Large*	U.S.	Japan
	Small	Taiwan	Korea

Table 1: Classification of environment and market in four Asia-Pacific countries

Table 4: Home market characteristics

	Population (millions)	GDP/capita (US $)	Computers per 100
U.S.	263.8	24,400	36.5
Japan	125.5	33,500	14.6
Korea	45.6	7,650	7.8
Taiwan	21.5	10,200	9.8

Source: Petska-Juliussen and Juliussen (1996); All data for 1995, except for GDP/capita (1993)

Table 4: Home Market Characteristics

Table 2: Computer Technological Regimes

	Mainframe	Minicomputer	Personal Computer
Invention	ENIAC (1945)	DEC PDP-1 (1960)	Altair 8800 (1975)
Key Innovation	UNIVAC (1951)	SDS 940 (1966)	Apple II (1977)
Dominant Design	IBM 360 (1964)	DEC PDP-11 (1970)	IBM PC (1981)
Ascendant Period	1960's	1970's	1980's
Programming Language	Cobol	Fortran	C
Software	Custom	Custom	Package
Sharing	Sequential jobs	Time-sharing	n.a.
Market	Large firms; Government agencies	Large, medium-sized organizations	Organizations of all size; Individuals
Purchasing Level	Company	Department	User
Distribution	Direct sales	Direct sales Value-Added Reseller	Retail Mail order
Pricing	Per second of use	Per month	Purchase
Leading Makers	IBM and the "BUNCH"†	DEC, HP, Data General	IBM, Apple, Compaq, NEC
Maker Companies Formed	CDC (1959), Amdahl (1970)	DEC (1957), Data General (1968), Prime (1972)††	Apple (1976), Multitech (1976)§, Compaq (1982), PCs Limited (1984)§§, Packard Bell (1986)
Spin-off Innovations	Disk drives Operating systems Internet	Timesharing UNIX Graphics displays	Packaged software CD-ROMs
Regional Beneficiary	Twin Cities	Route 128	Silicon Valley Taiwan

† The "BUNCH" consisted of Burroughs and Univac (since 1986, merged as Unisys), NCR (from 1991-1996, ATT GIS), Control Data Corp. (since 1992, Control Data Systems) and Honeywell (sold to Bull in 1991).
†† Since 1992, Computervision
§ Since 1987, Acer
§§ Now Dell

Table 2: Comparison of technological regimes in the computer industry

Table 3: Global PC production by country

Region	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
U.S.	46.4	38.4	45.5	42.7	40.3	44.3	39.9	45.6	42.9	41.6	39.6	37.9
Canada	13.0	12.8	18.4	23.9	19.4	13.2	11.4	9.7	8.5	8.1	7.1	8.3
Europe	14.8	24.1	15.1	10.3	14.7	12.3	11.1	10.9	7.3	6.2	6.3	5.4
Japan	10.3	12.4	11.5	8.7	9.0	11.7	14.1	11.3	10.9	13.0	14.0	10.7
Taiwan								0.9	2.0	1.6	2.0	2.4
Korea								0.2	0.8	0.8	2.6	2.6
Unitemized	15.5	12.3	9.6	14.3	16.6	18.5	23.4	21.5	27.8	28.9	28.5	32.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Calculated from Langlois (1992), based on Dataquest data

Note: Figures shown are % of total units sold in that year.

Table 3: Global PC production by manufacturers' home country, 1980-1991

Table 5: PC Sales by Established and Startup Companies

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Start-up companies												
U.S.	18.4	19.0	15.6	15.5	16.4	13.5	15.6	20.6	21.4	21.0	20.9	22.2
UK	14.7	23.9	14.5	9.5	13.2	10.3	8.4	8.3	4.2	2.7	1.3	1.0
Taiwan								0.9	2.0	1.6	2.0	2.4
	33.1	42.9	30.1	25.0	29.6	23.9	24.1	29.8	27.5	25.3	24.2	25.6
Established companies												
U.S.	28.0	19.5	29.9	27.2	23.9	30.8	24.3	24.9	21.5	20.6	18.7	15.7
Canada	13.0	12.8	18.4	23.9	19.4	13.2	11.4	9.7	8.5	8.1	7.1	8.3
Japan	10.3	12.4	11.5	8.7	9.0	11.7	14.1	11.3	10.9	13.0	14.0	10.7
Korea								0.2	0.8	0.8	2.6	2.6
UK					0.4	0.5	0.8	0.1	0.2	0.1	0.2	
Europe (other)	0.1	0.2	0.6	0.7	1.2	1.4	1.9	2.5	3.0	3.3	4.8	4.4
	51.4	44.8	61.1	61.7	54.1	58.0	53.0	49.3	45.4	46.4	47.8	42.0
Total known	84.5	87.7	90.4	85.7	83.4	81.5	76.6	78.6	72.3	71.1	71.5	67.3
Unitemized	15.5	12.3	9.6	14.3	16.6	18.5	23.4	21.0	26.7	27.9	28.0	31.9
% startups†												
World	39.2	48.9	33.3	29.2	35.5	29.3	31.4	38.0	38.1	35.6	33.9	38.1
U.S.	39.7	49.4	34.2	36.3	40.7	30.5	39.2	45.3	49.8	50.6	52.7	58.6
U.K.	100.0	100.0	100.0	99.7	97.3	95.4	91.3	98.6	96.6	95.8	86.8	100.0
Taiwan								100.0	100.0	100.0	100.0	100.0

Source: Same as Table 3

Note: "start-up" defined as companies founded in 1972 or later. Sales of acquired companies assigned to parent company in first full year after acquisition.

† Ratio of (startup for region) / (total known for region)

Table 5: Global PC sales, 1980-1991 for established and start-up companies

Table 6: PC Startup Companies Compared to Measures of Culture

	PC Industry Firms 1980-1991			Culture Measures			
	Number of Firms		% sales	Hofstede's Indices			
Country	Startup	Existing	Startup §	Individ.	Risk	Mascul.	PDI
Taiwan	2	0	100%	17	47	38	58
UK	3	1	97%	89	77	66	35
U.S.	16	13	44%	91	84	62	40
Canada		1	0%	80	65	53	39
Japan		8	0%	46	8	87	54
Korea		3	0%				
Italy		1	0%	76	62	72	50
France		1	0%	71	47	41	68
Total	21	28	36%				
Mean entrepreneurial countries				65.7	69.3	55.3	44.3
Mean non-entrepreneurial countries				68.3	45.5	63.3	52.8

Source: Table 5; Hofstede (1984)

† Masculinity corrected for proportion of females in the population sample, and Uncertainty Avoidance as corrected for age, s presented by Hofstede (1984). Values shown for Risk-taking is calculated as 120-(Uncertainty Avoidance) to invert the ordering of scores ranging from 8-112 on Uncertainty Avoidance since low uncertainty avoidance is associated with entrepreneurship.

§ Of identified producers from the specified country, the percentage of sales accounted for by startup firms.

Table 6: PC sales for startup firms vs. hypothesized entrepreneurial measures of culture

Table 7: Acquisition of Major PC Producers

	Acquired Company		Buyer	
Date	Company	Country	Company	Country
1988	Grid	US	Tandy	US
1989	Acorn	UK	Olivetti	Italy
1989	Everex	US	Formosa Plastics	Taiwan
1989	Leading Edge	US	Daewoo	Korea
1989	Wyse	US	Mitac	Taiwan
1989	Zenith	US	Groupe Bull	France
1990	Apricot	UK	Mitsubishi	Japan
1993	Tandy	US	AST	US
1995	AST	US	Samsung	Korea
1995	Leading Edge	US	Manuhold	Germany
1996	Packard Bell	US	NEC	Japan

Table 7: Event history for mergers by major PC producers