Global Takeoff of New Products:
Culture, Wealth or Vanishing Differences?

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Abstract

The authors study the takeoff of 16 new products across 31 countries (430 categories). They test the effect of 12 hypothesized drivers of takeoff using a parametric hazard model. The average time-to-takeoff varies substantially across nations, cultural clusters, product class, and calendar time. On this metric of time-to-takeoff, Japan, is the most innovative country, followed by the Nordic countries and Anglo American countries. Newly developed countries of E. Asia (e.g., South Korea) are more innovative than established economies of Western Europe (e.g., Italy). The authors find that takeoff is driven by culture and wealth plus product class, product vintage and prior takeoffs. Most importantly, time-to-takeoff is shortening over time and converging across countries. The authors discuss the implications of these findings.

Keywords

Diffusion of Innovations
Global Marketing
Consumer Innovativeness
Marketing Metrics
New Product
Hazard Model
Product Life Cycles

Introduction

Markets are becoming increasingly global with faster introductions of new products and more intense global competition than ever before. In this environment, firms need to know how new products diffuse across countries, which markets are most innovative, and in which markets they should first introduce new products.

Recently, studies have introduced and validated a new metric to measure how quickly a market adopts a new product: the takeoff of new products (e.g., Agarwal and Bayus 2002; Golder and Tellis 1997; Tellis, Stremersch and Yin 2003). Takeoff marks the turning point between introduction and growth stages of the product life cycle. When used consistently across countries, this metric provides a valid means by which to compare and analyze the innovativeness of countries. However, the existing literature on takeoff suffers from the following limitations.

First, prior studies analyze takeoff of new products primarily in the U.S. and Western Europe. Hence, they exclude some of the largest economies of the world (Japan, China, and India) and many of the fastest growing economies of the world (China, India, Korea, Brazil, and Venezuela). In fact, this limited focus on industrialized countries is seen as symptomatic of much of the prior research on product diffusion with several calls for broader sampling for new insights into the phenomenon (Dekimpe, Parker and Sarvary 2000)

Second, researchers disagree about what causes differences across countries. Takeoff has been portrayed to be primarily a cultural phenomenon with Wealth not being a significant driver (Tellis, Stremersch and Yin 2003). Yet, some studies cite Wealth to be the primary driver of new product diffusion (Dekimpe, Parker and Sarvary 2000; Stremersch and Tellis 2004; Talukdar, Sudhir and Ainslie 2002).

Third, researchers have debated about which countries have the most innovative consumer markets and are thus the best launch pads for a new product. The international strategy literature has long held that the US is the pre-eminent origin for new products and fads (Chandy and Tellis 2000; Wells 1968). Within Europe, Tellis, Stremersch and Yin (2003) find Scandinavian countries to be the most innovative. In contrast, Putsis et al (1997) find Latin-European countries to be the most innovative while Lynn and Gelb (1996) find Mid-European countries to be the most innovative. Note that most empirical studies focus on Europe.

Fourth, researchers have debated about whether diffusion speed is accelerating over time. While Bayus (1992) found no systematic evidence of accelerating diffusion rates over time, Van den Bulte (2000) finds evidence for accelerating diffusion. Golder and Tellis (1997) find time-to-takeoff to be declining for post War categories as compared to pre-War categories but neither Golder and Tellis (1997) not Tellis, Stremersch and Yin (2003) find a significant effect for the year of introduction in hazard models, after controlling for other variables.

Fifth, there has been a lot of debate in other disciplines whether countries are converging in terms of economic development (Barro and Sala-i-Martin 1992; Sala-i-Martin 1996) or culture (Dorfman and House 2004). There has been no effort made in marketing to determine whether there is convergence or divergence across countries over time in their ability to adopt new products.

This paper seeks to address these issues. In particular, it seeks answers to four specific questions: First, how does time-to-takeoff vary across the major economies of Asia, Europe, North America, South America, and Africa? Second, what drives the variation in time-to-takeoff across countries? Third, are differences in time-to-takeoff constant or varying over time? Fourth,

if varying, is time-to-takeoff converging or diverging across countries? We examine these issues by studying a heterogeneous sample of 31 countries across 16 categories.

The subsequent sections of the paper describe the theory, method, results, implications, and limitations of the study.

Theory

This section explores why time-to-takeoff of new products may vary across countries. We use the term, product, broadly to refer to both goods and services. Time-to-takeoff can differ across countries due to one of two broad drivers: Economics or Culture. Economics can be thought of as differences in opportunities and wealth, which limit consumers' ability to purchase new products. Culture can be thought of as differences in attitudes or inclinations, which accelerate or slow consumers' acceptance of new products. This section explores the role of various dimensions of these two drivers plus that of several control variables.

Culture's Consequences

What is Culture? Triandis (1995) defines *Subjective Culture* as shared beliefs, attitudes, norms, roles and values found among speakers of a particular language who live during the same historical period in a specified geographical region. Major changes in climate and ecology, historical events, cultural diffusion (migration or exposure to products from other countries) may drastically affect Culture (Triandis 1995). However, national cultures are generally thought to be stable over time (Dorfman and House 2004; Hofstede 2001; Yeniyurt and Townsend 2003).

How does Culture influence behavior? When people are immersed in a certain Culture, they develop a common pattern of thinking. This influences the degree to which the behavior of individuals, groups, and institutions are viewed as legitimate, acceptable, and effective (Dickson, BeShears and Gupta 2004; House and Javidan 2004).

Cross-cultural researchers have documented several different dimensions of national Culture. We discuss five of the dimensions that are likely to affect the time-to-takeoff of new products: In-Group Collectivism, Power Distance, Performance Orientation, Religiosity and Uncertainty Avoidance. The specific roles of In-group Collectivism, Performance Orientation and Religiosity have not been addressed in the prior literature on takeoff or diffusion.

In-Group Collectivism

Gelfand et al (2004) define *In-group Collectivism* (subsequently referred to simply as Collectivism) as the degree to which individuals express pride, loyalty and cohesiveness in their organizations or families. Collectivist societies consist of closely linked individuals who are primarily motivated by the norms of and duties imposed by the collectives, are willing to give priority to the goals of these collectives over their own personal goals, and emphasize their connectedness to the members of these collectives (Triandis 1995). This attribute is in contrast to low Collectivism (or Individualism), which refers to a society of loosely linked individuals who view themselves as independent of collectives. These individuals are primarily motivated by their own preferences, needs, rights and contracts established with others (Triandis 1995).

What is the effect of Collectivism on time-to-takeoff? Collectivism is thought of as making for adults who are compliant but not innovative (Triandis 1995; Yeniyurt and Townsend 2003). In countries that have high levels of Collectivism, there may be less independence and freedom. As such, individuals may be less likely to sample or try new products, adhering instead to the norms and traditions of their society. Hence, we hypothesize

H1: New products may takeoff slower in countries that are high on Collectivism than in countries that are low on Collectivism.

Performance Orientation

Performance Orientation is the extent to which a community encourages and rewards innovation, high standards and improvement in performance (Javidan 2004). Though originally thought of as a byproduct of the "Protestant ethic', researchers argue that this dimension is not related to religion and societies with high Performance Orientation may consist of diverse religions (McClelland 1976; Javidan 2004). Societies with high levels of Performance-Orientation are characterized by a thirst for knowledge and improvement. This dimension is also related to a high need for achievement (McClelland 1976), leading to greater willingness to experiment with new products.

What is the effect of Performance Orientation on time-to-takeoff? Because performance is associated with self-improvement, achievement, and a thirst for new ideas, the speed of takeoff may be positively associated with Performance Orientation. Hence, we hypothesize

H2: New products may takeoff faster in countries that are high on Performance Orientation than in countries that are low on Performance Orientation.

Power Distance

Power Distance is the extent to which the less powerful members of organizations and institutions accept and expect that power is distributed unequally (Hofstede 2001). Power Distance is related to the concept of social inequality and may be fostered by an emphasis on experience, tradition, heredity, class roles, and spiritual leadership (Carl, Gupta and Javidan 2004).

What is the effect of Power Distance on time-to-takeoff? Countries with low Power Distance typically have low inequalities of power and wealth. This situation may ease communication between different sections of the population, leading to faster diffusion of new products. When Power Distance is low, the underprivileged have fewer barriers to the acquisition

of new skills and are thus more likely to also acquire new products (Carl, Gupta and Javidan 2004). Hence, we hypothesize

H3: New products may takeoff faster in countries that are low on Power Distance than in countries that are high on Power Distance.

Religiosity

A superficial reading of religion has led some to assert that the "protestant ethic" is different from Catholicism and other religions in that it encourages work, industriousness, and innovation (e.g., McClelland 1976). The percentage of Protestants in a country has been positively related to speed of takeoff of new products (Tellis Stremersch and Yin 2003). However, a focus on the Protestant-Catholic distribution may confuse a superficial distinction between some religions with a more basic underlying trait of Religiosity. For example, many researchers argue that certain core religious values, such as form or frequency of worship, religious practices, and religious laws that are *common across different religions*, constitute deep cultural traits (Lindridge 2005). These traits may drive overt behavior associated with consumption and innovation (McClelland 1976). For instance, Hossain and Onyango (2004) argue that an opposition to biotechnology is not specific to any one religion but reflects conflict between mainstream religious beliefs and the acceptance of scientific principles, experimentation, and learning. We refer to this underlying trait as Religiosity, which we define as the extent to which individuals rely on a faith-based, non-scientific body of knowledge to govern their daily lifestyle and practices.

What is the effect of Religiosity on time-to-takeoff? Countries with a high level of Religiosity are likely to emphasize spiritual benefits and de-emphasize material possessions and progress. In these countries, people are likely to be less interested in or even skeptical of

innovations. They are likely to adopt new products only when they become mass products and are considered routine possessions of individuals or households. For instance, Miller and Hoffman (1995) find a negative correlation between Religiosity and attitude toward risk. Hence, we hypothesize

H4: New products may takeoff slower in countries that are high on Religiosity than in countries that are low on Religiosity.

Uncertainty Avoidance

Uncertainty Avoidance deals fundamentally with the level of anxiety about the future and the consequent need to protect society through traditions, rules, and rituals (Sully de Luque and Javidan 2004). Cultures with high Uncertainty Avoidance are characterized by a tendency towards orderliness, structured lifestyles, clear specifications of social expectations, and rules to regulate uncertain situations.

What is the effect of Uncertainty Avoidance on time-to-takeoff? A society characterized by low Uncertainty Avoidance may create an environment more encouraging toward the adoption of innovations. In such societies, people are more open to change, new ideas, risks, and diversity (Nakata and Sivakumar 1996; Steenkamp, Hofstede and Wedel 1999; Yeniyurt and Townsend 2003). Hence, societies with low levels of Uncertainty Avoidance may see a faster time-to-takeoff. However, authors have also noted that societies with high levels of Uncertainty Avoidance look toward technology to ward off uncertainty (Sully de Luque and Javidan 2004). This might create an environment that encourages the adoption of new high technology products. Hence, we do not hypothesize a specific effect of Uncertainty Avoidance on time-to-takeoff.

Wealth of Nations

We examine the impact of Economic Development, Information Access, and Trade Openness on time-to-takeoff of new products.

Economic Development

We consider two aspects of Economic Development: the absolute level of Economic Development within a country as well as the level of Economic Disparity within a country. Receptivity to new products is likely to be higher in countries that have a high level of Economic Development for at least two reasons: First, consumers in richer countries are better able to afford new products early on when the prices are relatively high (Golder and Tellis 1998). Indeed, innovators in general, have higher incomes (Rogers 1995). Second, new products have uncertain performances. Richer consumers can better afford the risks of buying such products.

Economic Disparity in a country refers to the extent that a country's wealth is concentrated in the hands of a few. As a result, some consumers are wealthy while others are poor. This can prevent the latter group from being able to afford new products (Tellis, Stremersch and Yin 2003, Talukdar, Sudhir and Ainslie 2002, Van den Bulte and Stremersch 2004).

Hence, we hypothesize,

H5a: New products takeoff faster in countries that have a higher level of Economic Development than in countries with a lower level of Economic Development.

H5b: New products takeoff slower in countries that have a higher level of Economic Disparity than in countries with a lower level of Economic Disparity.

Information Access

We consider two aspects of Information Access: mass media availability and mobility. We expect products to takeoff faster in countries that have a higher level of Information Access than countries that with a lower level of Information Access for two reasons. One, a greater level of mass media availability can greatly aid manufacturers in spreading knowledge about new products via advertising. Availability of mass media can also aid consumers in seeking out knowledge about new products or make them aware of the availability and spread of new products (Gatignon and Robertson 1985; Horsky and Simon 1983; Talukdar, Sudhir and Ainslie 2002). Two, prior research suggests that the presence of better infrastructural facilities enhances mobility and promotes interpersonal communication and the spread of information within local systems (Gatignon, Eliashberg and Robertson 1989; Tellis, Stremersch and Yin 2003). Hence, we expect

H6: New products to takeoff faster in countries that have a higher level of Information Access than countries with a lower level of Information Access.

Trade Openness

Trade Openness reflects economic linkages across countries and may influence both the demand and supply of new products. Advocates of neo-liberal reform argue that greater openness encourages efficiency, productivity, and competitiveness (Perkins and Neumayer 2004). Trade, foreign direct investment and technology flows help in knowledge spill-over across countries leading to awareness about new products and greater availability, which in turn lead to faster takeoff (Perkins and Neumayer 2004; Talukdar, Sudhir and Ainslie 2002; Tellis, Stremersch and Yin 2003). Hence, we expect

H7: New products take off faster in countries that have a higher level of Trade Openness than countries with a lower level of Trade Openness.

Control Variables

We control for three important variables: Product Class, Product Vintage and Prior Takeoffs. In addition, we also examine the impact of Population Density as another control variable. Here, we discuss the rationale for the first three variables.

Product Class

The time-to-takeoff may vary depending on the Product Class. We use the term Work Products for products that help consumers work efficiently, such as microwave ovens and washing machines. We use the term Fun Products for those products that provide consumers with information, pleasure, or enjoyment, such as personal computers and DVD players. The former groups have also been called time-saving and the latter time-consuming products respectively. Fun products may takeoff faster than work products because they appeal to more individuals in the household, are on public display, are often discussed in social circles, and provide instant gratification and stimulation (Bowden and Offer 1994; Horsky 1990; Tellis, Stremersch and Yin 2003). Hence consumers are willing to adopt the products soon after introduction even if the prices are relatively high.

Product Vintage

Bayus (1992) argues that product diffusion rates are not accelerating over time. If that is true, then the vintage of the product would not have any impact on its time-to-takeoff. However, Van den Bulte (2000) argues that diffusion speed has been accelerating over time due to systematic increase in purchasing power, demographic changes, and changing nature of products. We believe that products maybe taking off faster now than in prior periods for several reasons. First, recent decades have witnessed a liberalization of markets within countries, which have stimulated growth, openness, and investment rates within countries (Wacziarg and Welch 2003).

This is likely to lead to increased manufacture, supply, and trade of higher quality products. Second, several media, especially TV, telephony, and internet are rapidly increasing in penetration globally allowing faster diffusion by news, advertising, and word-of-mouth. Third, technology is evolving faster in recent periods than in prior periods (Sood and Tellis 2005). All these factors can shorten the time-to-takeoff. Thus, we expect Product Vintage to have a negative effect on time-to-takeoff i.e., products of recent vintage to takeoff faster than products of older vintage.

Prior Takeoffs

Researchers have argued that consumers learn about the product from its prior diffusion (Ganesh, Kumar and Subramaniam 1997; Kumar, Ganesh and Echambadi 1998). Also, imports from, travel to, and news reports from a country where a new product has already taken off may facilitate its acceptance in a neighboring country where it has not. We expect new products to takeoff faster when there are a greater number of prior takeoffs in neighboring countries.

Method

This section describes the sampling, sources, measures, and model for the analysis.

Sample

Two criteria guide our selection of products. One, they should include a mix of both work and fun products. Two, they should include a mix of products studied in prior research and others not studied before. Based on these criteria, and data availability, we collect market penetration data across 16 products and services. Work products are microwave oven, dishwasher, freezer, tumble dryer and washing machine. Fun products are CD player, cellular phone, personal computer, video camera, video tape recorder, MP3 player, DVD player, digital camera, hand-held computer, Broadband and Internet. Broadband, DVD player, digital camera, hand-held computer, and MP3 player, commercialized after 1990, may be considered contemporary new

products while the others may be considered to be established categories. Cellular phone, Internet, and Broadband may be considered as three generations of telecommunication services.

Two criteria guide our selection of the sample of countries. First, the sample should be representative of major cultures and populations of the world. Second, the sample should include major economies of the world. Using these criteria, we obtain data on 40 countries of the world. Since, for some countries, we had very little data, to avoid data-specific biases, we retain countries where we have data for at least 10 categories. As a result, we had to drop Argentina, Australia, Colombia, Hong Kong, Malaysia, New Zealand, Singapore, South Africa and Turkey.

In total we collect market penetration data for 430 product x country combinations, which comprises 90% of the possible combinations. On each such combination we have time series data ranging from 4 to 55 years. This is probably the largest data set assembled for the study of the diffusion of new products across countries.

Sources

We collect this data from a variety of sources: subscription-based sources (Euromonitor Global Marketing Information Database, World Development Indicators Online, Fast Facts Database), archival search through secondary sources (Historical Statistics of Japan, Historical Statistics of Canada, Electrical Merchandising, Merchandising, Merchandising Week and Dealerscope journals for US, OECD statistics), and proprietary data (Database of Tellis, Stremersch and Yin 2003), over several hundreds of research hours.

Measures

This section describes the measures for Market Penetration, Year of Commercialization, Year of Takeoff, independent variables and control variables.

Market Penetration

For market penetration, we use the measure, where available, of possession of durables per 100 households. For four categories (DVD player, digital camera, MP3 player and hand-held computer) where only sales data is available for most countries, we used the following formula to obtain Market Penetration

$$Penetration_t = Penetration_{t-1} + (Sales_t - Sales_{t-r}) / NumberofHouseholds * 100 \quad (1)$$

Where 'r' is the average replacement time for the category. We use an average replacement cycle of 4 years for DVD player, MP3 player, and hand held computer and 5 years for digital camera. We checked robustness of these assumptions by varying r by plus or minus 1 year. The year of takeoff varies insignificantly with the changes[1].

Year of Commercialization

There are two inherent problems in identifying the exact year of introduction of products in countries. One, this date is not explicitly published in journal articles while various data sources provide conflicting dates. Two, most databases include a product only when it has achieved non-trivial sales. Hence, there is an inherent survivor bias. Following Agarwal and Bayus (2002), we use the word commercialization to reflect the fact that data bases seem to include a product only when it has become available to the mass market or achieved some minimal level of sales or penetration.

We use a combination of rules to obtain reasonable estimates of the approximate year of commercialization that best reflects individual categories. For work products, we look for the

[1] We also use this formula to obtain market penetration data for work products from historical manufacturing statistics of Canada and Japan . We use accepted measures of replacement (from Appliance Magazine, Report on 'The U.S. Major Home Appliance Industry In 1996: Domestic Versus Global Strategies', 1996 by J. David Hunger) for 5 observations.

earliest year of commercialization for *each country* from the data published in the various sources viz. Euromonitor Inc. journals and databases, various issues of Merchandising, Merchandising Week, and Dealerscope, published dates in Agarwal and Bayus (2002), Golder and Tellis (2004, 1997), Talukdar, Sudhir and Ainslie (2002), and by examining our own data.

In the case of telecommunication products (Cellular phone, Internet and Broadband), the year of commercialization is dependent on the national regulatory policies and hence we use varying dates made available from reliable secondary sources. For Cellular phone, we use the date of first adoption of Cellular technologies reported in Gruber (2005) and reports in the OECD web-site (www.oecd.org) for the EU countries and secondary reports by market research firms on the ISI Emerging Markets Database for emerging markets. For Internet, we use the date of the initial NSFNET connection by OECD countries as obtained from OECD reports[2] and dates of first internet services launch for emerging markets from the ITU database and by market research firms on the ISI Emerging Markets Database. For Broadband, we look for the earliest commercial launch of either the Cable or the DSL service in each country, as reported in the reports in the OECD web-site[3] and the ISI Emerging Markets Database.

For four fun products (personal computer, CD player, VCR and Video Camera), the data as well reports and published dates in secondary sources reflect a common date for North America, Europe, Japan and South Korea. We use the earliest year of commercialization based on our data and published sources (Talukdar, Sudhir and Ainslie 2002) for each remaining

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[2] Information Infrastructure Convergence and Pricing: The Internet, Organization For Economic Co-Operation And Development, Committee For Information, Computer And Communications Policy, Paris 1996

[3] The Development of Broadband Access in OECD Countries, Directorate For Science, Technology And Industry Committee For Information, Computer And Communications Policy, 2001

individual country. For products introduced after 1990, i.e., DVD players, digital camera, MP3 player, hand-held computers, where validation from secondary reports is not as yet available, and the data-derived years of commercialization seem similar across countries, we use a common year of commercialization across all countries.

We further validate each of these dates by checking that penetration in the year of commercialization has not exceeded 0.25%, which is a stricter rule than the 0.5% rule recommended by Tellis, Stremersch and Yin (2003).

Year of Takeoff

The literature contains many measures of takeoff. Agarwal and Bayus (2002) define takeoff as the central partition between a pre-takeoff and post-takeoff period, determined by a percentage change in sales. Garber et al (2004) and Goldenberg, Libai and Muller (2001) define takeoff at the point when market penetration is 16%. Golder and Tellis (1997) define takeoff as the first year in which a new product's sales growth rate relative to the prior year's sales crosses a threshold based on sales levels. Tellis, Stremersch and Yin (2003) define takeoff as the first year a new product's sales growth rate relative to the prior year's sales crosses a threshold based on a penetration levels.

For a cross-country study such as ours, the measure of takeoff proposed by Tellis, Stremersch and Yin (2003) while appropriate, is also very demanding, as it requires both sales and market penetration data. We have early sales data only for a sub-set of categories for which we have market penetration data. Rather than sacrifice the breadth of products and countries for which we have market penetration data (430 combinations), we use a measure of takeoff that is similar in form to one of Garber et al (2004) and Goldenberg, Libai and Muller (2001) but in substance to that of Tellis, Stremersch, and Yin (2003). Golder and Tellis (2004, 1997) find that

the average penetration at takeoff is 1.7%. Interestingly, this latter finding is similar to Roger's (1995) estimate that innovators make up 2.5% of the population and Mahajan, Muller and Srivatsava's (1990) upper bound of 2.8% for innovators. So we use the heuristic that the year of takeoff is the first year the market penetration reaches 2%. The key issue for subsequent analysis is that we use the same rule consistently across countries. In essence, our measure of takeoff reduces our definition of takeoff to an instrumental one. Thus, an alternate interpretation of all our results is how quickly and why do new products reach a 2% market penetration in various countries of the world.

We define time-to-takeoff as the difference between the year of takeoff and the year of commercialization in a country.

Independent Variables

One measure for Economic Development is the Real GDP per capita (Laspeyres) measured in $ terms from the Penn World Tables (Heston, Summers and Aten 2002). This is obtained by adding up consumption, investment, government and exports, and subtracting imports in any given year. It is a fixed base index where the reference year is 1996. Since this data is available only up to 2000, we calculate GDP per capita for the years 2001 to 2004 using average growth rate figures from the UNDP Human Development report. We use a related measure for Economic Development, which is the electric power consumption in kwh per capita (production of power plants and combined heat and power plants, less distribution losses, and own use by heat and power plant). Our measures for Information Access include radio receivers in use for broadcasts to the general public per 1000 people, television sets per 1000 people, telephone mainlines (lines connecting a customer's equipment to the public switched telephone

network) per 1000 people, and vehicles (including cars, buses, and freight vehicles but not two-wheelers) per 1000 people.

We have multiple items to measure the extent of Trade Openness- trade (the sum of exports and imports of goods and services) as % of GDP, trade in goods (the sum of merchandise exports and imports) as % of GDP, gross foreign direct investment (the sum of the absolute values of inflows and outflows of foreign direct investment recorded in the balance of payments financial account) recorded as a % of GDP and gross private capital flows (sum of the absolute values of direct, portfolio, and other investment inflows and outflows recorded in the balance of payments financial account) recorded as a % of GDP. We derive all these measures from World Development Indicators Online, a database provided on subscription basis by the World Bank.

We use the Gini Index as a measure of Economic Disparity that exists in the population. We derive this from the Deninger and Squire (1996) database. This database gives multiple Gini coefficients, and hence we consider only those coefficients that are considered 'acceptable', and are measured at the national level. For some countries (Austria, Egypt and Morocco), where acceptable estimates are not obtainable from the database, we use measures derived from the CIA World Factbook (2003). We use People per Square Kilometer as a measure for Population Density, from the World Population Prospects: The 2000 Revision, United Nations Population Division/Department of Economic and Social Affairs.

We measure dimensions of culture (Collectivism, Power Distance, Performance Orientation and Uncertainty Avoidance) using the *societal practices* scores reported in the Global Leadership and Organizational Behavior Effectiveness (hereby referred to as GLOBE) research program (House et al 2004). This is a long-term program designed to conceptualize, operationalize, test, and validate a cross-level integrated theory of the relationship between

culture and societal, organizational, and leadership effectiveness. The cultural dimensions proposed in this project are similar in spirit but vary operationally from the traditional indices used in cross-cultural research such as Hofstede's indices (Hofstede 2001). The GLOBE dimensions are better defined and suffer less from confounds in meaning and interpretation than the Hofstede measures (House and Javidan 2004). The GLOBE dimensions are constructed based on responses to questionnaires by 17000 managers in 62 cultures to two types of questions- managerial reports of actual practices in their societies or their organizations and managerial reports of what should be the practices and/or values in their societies or organizations. The values are expressed in response to questionnaire items in the form of judgments of '*What Should Be'*. We however use actual practices as measured by indicators assessing '*What Is*, or *What Are'*, common behaviors, institutional practices, proscriptions and prescriptions. House et al (2004) note that the practices approach to the assessment of culture grows out of a psychological/behavioral tradition, in which it is assumed that shared values are enacted in behaviors, policies, and practices. Hence, we believe that actual practices reflect the behavior of the people and are more useful in explaining time-to-takeoff than the values measures.

Religiosity or religiousness has been measured in prior literature through the use of variables such as church attendance, frequency of prayer, belief in God, belief in the authority of the Bible, and self-appraised level of religiousness (Hossain and Onyango 2004; Lindridge 2005; Wilkes, Burnett and Howell 1986). Since we require a measure that is suitable across countries, some of whom have many different religions, we construct a unified measure of Religiosity using two items which we obtain from the World Values Survey from the site http://www.worldvaluessurvey.org/. This survey is a large investigation of socio-cultural and

political change carried out by an international network of social scientists in several waves since 1981. For the first measure, we use the responses to the question 'How often do you attend religious service?' in the World Values Survey. The responses can range from '> 1 week' to 'Never'. In some religions, such as Hinduism, worship can be done within the home and attendance in religious services may not be necessary (Lindridge 2005). Hence, we also consider a second item from the World Values Survey involving a response to the question, 'How important is God to your life'. The responses can range from 'Not at all' to 'Very'. We take the average of One, the percentage of respondents in the sample answering either '> 1 week' or 'Weekly' to the first question on the attendance of religious service and Two, the percentage of respondents in the sample answering either 'Very' or '9' to the second question on the importance of God to construct a unified measure of Religiosity[4].

Control Variables

We use the year of first ever commercialization of the product category in any country as a measure of Product Vintage. We measure Prior Takeoffs as the number of takeoffs in the prior or same year in countries in the same region as a target country.

Model

We model takeoff as a time dependent binary event. We face two issues with our data. One, there are a number of censored observations. Two, the probability of takeoff may increase with the length of time a product has not taken off. Hence, we use a hazard function to model takeoff. The time to takeoff from commercialization of a product in a country T is a random

[4] For Thailand, the World Values Survey does not give measures that can be used to construct Religiosity. We have taken the corresponding measures for Vietnam as a surrogate for Thailand, as it has geographical and religious proximity.

variable with a probability density f(t) and a cumulative density F(t). The likelihood that a product takes off, given that it has not taken off in the interval [0, T] is

$$h(t) = f(t)/(1-F(t)) \quad (1)$$

We can use either a non parametric method to model the effects of covariates on the hazard or use parametric methods, like the accelerated failure time approach, to model the effects of independent variables on time to event i.e., takeoff. In the accelerated failure time approach, the hazard of takeoff is of the form

$$h_i(t, X_i) = \exp^{aX_i} h_0(\exp^{aX_i} t) \quad (2)$$

i.e., the impact of independent variables on the hazard for the i^{th} observation is to accelerate or decelerate time-to-takeoff as compared to the baseline hazard (see Srinivasan, Lilien and Rangaswamy (2004) for a detailed description of this approach). An easier way of estimating this model is to write it as follows

$$Y = X\beta + \sigma\varepsilon \quad (3)$$

Where Y is the vector of the log of time-to-takeoff, X is the matrix of covariates, β is a vector of unknown regression parameters, σ is an unknown scale parameter and ε is a vector of errors, assumed to come from a known distribution such as normal, log-gamma, or logistic or extreme value forms, leading to the log-normal, gamma, log-logistic, or the Weibull/exponential distributions for T respectively. We use PROC LIFEREG in SAS to estimate this model (Allison 1995). The estimation is done via maximum likelihood.

Results

First, we factor analyze some of the independent measures to achieve parsimony in the data. Second, we present descriptive statistics for initial insights into the phenomenon of takeoff. Third, we test for the hypothesized variation in time-to-takeoff using the hazard model. Fourth,

we examine differences in time-to-takeoff across economic and cultural clusters. Fifth, we examine whether there is convergence in takeoff. Sixth, we test for the robustness of the results.

Factor Analysis of Economic Variables

The economic variables are highly correlated, suggesting the presence of underlying factors. In particular, Dekimpe, Parker and Sarvary (2000) note in their review of global diffusion that constructs like information access, are often considered distinct from wealth but are actually highly related to wealth and are also used in some studies as describing the wealth of a country (Ganesh, Kumar and Subramaniam 1997; Helsen, Jedidi and DeSarbo 1993). Our preview of the data leads us to agree with this view. Nevertheless, we test this point of view with a factor analysis of for the measures relating to Economic Development, Information Access and Trade Openness. We run an exploratory factor analysis of the measures using data from 1950 to 2004. We use the principal components approach and Varimax rotation of these dimensions. We obtain a two factor solution from the exploratory factor analysis (See Table 1). Based on the loading of items, we call these factors: Wealth and Openness. We use these two factors in the hazard model instead of the individual measures of Economics.

We do not run a separate factor analysis for cultural variables, because the cultural variables already represent unique and distinct dimensions of culture (Hofstede 2001; House et al 2004; Van den Bulte and Stremersch 2004).

Descriptive Statistics on Takeoff

We first examine our data for outliers by simultaneously examining the plots of time-to-takeoff across products and countries. We find one observation (Dishwasher in US) to be an extreme outlier and delete it from our analysis.

Takeoff occurs in 80% of the 430 country x category combinations. Takeoff has occurred in all countries for very old and/or very useful categories (e.g. Washing machine, Internet, Cellular phone). Lack of takeoff may be due to the effect of the hypothesized explanatory variables or insufficient observation time for younger categories in particular countries. The latter problem is referred to in the literature on hazard models as censored data. The advantage of the hazard model is that it can estimate the effects of the independent variables on censored data.

Table 2 shows the mean time-to-takeoff across categories for each country. Countries vary widely in terms of the mean time-to-takeoff. What are the reasons for these differences? The next section seeks to answer this question.

Tests of Hypotheses via Hazard Model

We estimate the hazard model in Equation 3, assuming a Weibull baseline distribution (A subsequent subsection tests the robustness of this assumption). The dependent variable is the log of the time-to-takeoff. Note, except for the cultural variables, Product Vintage and Product Class, all independent variables are time specific. A positive sign for the estimate coefficient indicates that an increase in the independent variable is associated with a lengthening of the time-to-takeoff. We estimate the hazard model for 27 out of 31 countries in Table 2 (373 observations). We drop Belgium, Chile, Norway and Vietnam because they were not included in the GLOBE study from which we obtain the measure for the cultural variables.

We first run the model for each of the independent factors or variables separately (see Univariate Analysis in Table 3). As expected, Product Vintage has a coefficient which is both negative and significantly different from zero. i.e., products that are commercialized later in time seem to takeoff faster than those earlier in time. For instance, we find that successive generation of communication products (Cellular phone, Internet and Broadband) have shorter times-to-

takeoff. Figure 1 supports the result for Product Vintage. It shows that time-to-takeoff has typically been declining over calendar time.

As expected, Prior Takeoffs also have an effect that is negative and significantly different from zero. This implies the existence of learning or diffusion effects between neighboring countries that shorten time-to-takeoff.

As expected, work products are associated with a longer time-to-takeoff than fun products. Descriptive analysis suggests that the mean time-to-takeoff of fun products is 7 years while that for work products is almost double at 12 years (see Table 4), with much of the difference being attributed to developing countries.

An increase in Wealth is associated with a shorter time-to-takeoff (Table 3) while an increase in Economic Disparity is associated with a longer time-to-takeoff, as hypothesized. Contrary to hypotheses, the effect of Openness and Population Density are not significantly different from zero. The effect of Performance Orientation is not in the expected direction. An increase in Uncertainty Avoidance is associated with a shorter time-to-takeoff. High levels of Collectivism, Power Distance and Religiosity are each associated with a longer time-to-takeoff as hypothesized.

We next explore the relative strength of all the significant independent variables by a multivariate hazard model. All variables retain their significance and expected direction, except for the Economic Disparity and the three cultural variables of Religiosity, Power Distance, and Uncertainty Avoidance. These results indicate that the effects of most of the cultural models are not robust to specification. On the other hand, the effects of Product Class, Prior Takeoffs, Product Vintage, Wealth, Collectivism are strong, robust, and in the expected direction. This

model explains 27% of the variance. These results indicate that *both* Economics and Culture determine differences in time-to-takeoff.

To complement and enrich the above analysis, we consider how takeoff varies across cultural clusters of countries.

Differences in Time-to-takeoff across Cultural Clusters

Much research suggests the existence of distinct cultural clusters of countries (Gupta and Hanges 2004; Ronen and Shenkar 1985). Based on prior research, we identify eight cultural clusters (Ashkanasy, Trveor-Roberts and Earnshaw 2002; Gupta and Hanges 2004; Gupta et al 2002; Jesuino 2002; Kabasakal and Bodur 2002; Szabo et al 2002; Ronen and Shenkar 1985). Table 5 describes the cultural clusters and the logic for their classifications. Countries within these clusters exhibit similar culture because of geographic proximity, common language, common ethnicity, or shared history. Table 5 also compares the clusters on the five cultural variables used in the Hazard model. For each variable, we present the mean and the standard deviation within a cluster. Note that except in the case of Religiosity for Confucian Asia, the means are more than twice the values of the standard deviation within the cluster, justifying the grouping of these countries within a cluster. Also, in most cases, the means are often significantly different from the mean for the rest of the countries, supporting inter-cluster classification of countries.[5]

[5] Is the United Kingdom a member of the Anglo cluster or the Germanic cluster? As the founder of the British Empire and the motherland of the English language, it would seem to belong to the former. However, due to its proximity to Europe, its Germanic roots, and its ties to the "old economies" of Europe we consider it part of the latter group. Japan also differs significantly in terms of time-to-takeoff from other Confucian Asian countries. However, Confucianism while possessing a core set of values is believed to be practiced in different Confucian societies in different ways (Hartfield 1989).The selective adaptation of Confucianism to the requirements of modernization is believed to lead to the divergent development of Japan, S. Korea and China. We give results of Confucian Asia both with and without Japan

Table 6 shows the differences in time-to-takeoff across the eight distinct cultural clusters. Here again, the results show distinct differences in mean time-to-takeoff between clusters with low standard deviations within clusters, overall as well as separately for both work and fun products. We consider the overall average, the average of work and the average of fun products for each country in each cultural cluster and run both univariate ANOVA as well as MANOVA. The tests indicate significant differences across the cultural clusters (For Wilks Lambda and Pillai's Trace, Prob > F =0.003). As further evidence of the strength of culture, note how Latin countries across both Europe and America have very similar mean times-to-takeoff, despite being geographically separate.

Table 7 examines the impact of cultural clusters on time-to-takeoff via the hazard model. We include Product Vintage, Prior Takeoffs, and Product Class, which are not collinear with cultural clusters. We do not include the cultural and economic variables because they are highly collinear with cultural clusters. We find that countries in the Confucian Asia, Latin Europe, Latin America, North Africa, and Southern Asia clusters see significantly slower times-to-takeoff of products than those in the excluded Nordic cluster, which serves as a comparison group. The differences for Confucian Asia are stronger with Japan outside the cluster.

Table 6 also shows that fun products seem to takeoff faster than work products within every cultural cluster. Moreover, the differences across cultural clusters for work products are higher than the differences across the cultural clusters for work products. This result suggests work products are more culture-bound than fun products probably because the former relate to food and clothing habits, which are immersed in cultural traditions. Such cultural products may take off rapidly in some countries where they match the culture (e.g. rice cooker in Japan or

coffee maker in the US) and slowly in other countries where they do not match the culture (e.g. coffee maker in China or rice cooker in Germany). On the other hand, fun products (e.g. Cellular phones, cameras) are used in a similar manner all over the world. Hence, time-to-takeoff of fun products is likely to vary less dramatically across countries than work products.

Table 8 explores the effects of the Hazard model separately by Product Class. For fun products, the effects of Product Vintage, Prior Takeoffs, Wealth and In-group Collectivism are significantly different from zero and in the expected direction. Results for Openness are also in the expected direction. These results indicate that not only Wealth but also economic linkages across countries, Vintage and Culture are important in influencing time-to-takeoff of fun products. For work products however, only the effects of Culture are significantly different from zero and in the expected direction. We find that not only high levels of In-group Collectivism but also Religiosity impact time-to-takeoff of work products. These results are consistent with those in Table 6 suggesting that work products are more culturally bound.

Convergence in Time-to-Takeoff

Though our results indicate substantial differences in time-to-takeoff across countries, a key issue is whether takeoff patterns across countries are converging or diverging? We use the word Convergence to refer to the decrease over time in the range of dates of takeoff across the same set of countries. Convergence in product takeoff may occur due to several reasons. First, economists have documented convergence in wealth across countries over time, especially in countries that were previously poor (Sala-i-Martin 1996). Second, most countries are enjoying better access to the media, which facilitates the diffusion of new products, but here again , the improvement is greatest in countries that were furthest behind. Third, most countries are also experiencing a greater similarity in culture due to increasing inter-country communication and

travel, common education curriculum, use of English, exposure to western practices, adoption of common cultural activities such as movies and music, and diffusion of Eastern religions and philosophies (such as yoga and Buddhism). Thus, cultural differences that caused divergence could be dissolving, albeit slowly (Dorfman and House 2004). Indeed, a fear of such a trend and the need to maintain cultural uniqueness may be seen in Europe (Dorfman and House 2004). For instance, the French government has taken several measures to prevent the contamination of French culture by American culture.

To measure convergence, we take the time spread between the two countries, where takeoff occurs first and last, in any single product category. We then plot the time spread of the product category across any one of two scales: the year of first takeoff or the year of first commercialization for the respective product category. If convergence is occurring, then the curve should slope downwards over time. If divergence is occurring, then the curve should slope upwards over time. If neither is occurring, then the curve should be flat.

Since our measures require takeoff to have occurred, we do not include countries where takeoff has not occurred. In the interest of consistency, we also need to include the same set of countries in each category. As a result, for this analysis, we can consider only 14 product categories in 18 countries. The countries are Japan, US, Canada and 15 countries of Western Europe. We include all the products in our sample except MP3 players and hand-held computer (we have data only till 2003 for the former and not for all the countries for the latter). This sample covers 246 observations.

The results are in Figures 2a and 2b with year of first takeoff and first commercialization respectively as the X-axis. Figure 2a shows a dramatic, downward, almost linear plunge over time indicating a strong convergence in time-to-takeoff. The time spread between the first and

last takeoff drops from over 50 years in 1950 to 5 years in 2000. A simple regression of time spread on year of first takeoff yields a coefficient that is negative and significantly different from zero (T stats of -6.6, $R^2 = 0.78$). Figure 2b shows a similar pattern. A regression of time spread on year of first commercialization also yields a coefficient that is negative and significantly different from zero (T stats of -5.1, $R^2 = 0.68$). The sharp increase in the first few periods of both graphs could be due to the negative effects of the World Wars and the Depression, though we cannot draw any firm conclusions because of the small sample size.

Tests of Robustness

Apart from examining different distributional assumptions, we carry out two tests of robustness on the baseline hazard and alternate measure of takeoff.

Baseline Distribution

We considered several alternate baseline distributions such as the Log-Normal, Log-logistic, Exponential, Weibull, and Gamma of the Hazard model. In order to determine the best distribution function, we compare non-nested models using the SBC (Schwarz's Bayesian Criterion), as suggested by Allison (1995), Srinivasan, Lilien and Rangaswamy (2004), and Pliner (2005). SBC is calculated using the formula: -2*log-likelihood + k*(# of parameters), where k = log (n), with n representing the number of observations. Lower values of SBC indicate better fit. We find that the Weibull model generally outperforms the other models using the SBC criteria, with a SBC value of 638.7 for the final model in Table 3.

Measure of Takeoff

Recall that we used an operational measure (achieving 2% penetration) to measure the year of takeoff because we did not have sales data for all categories. We evaluate the robustness of our results by two approaches.

First, for 190 product-country combinations in our original data set, we were able to collect both sales and penetration data. These include established categories such as work products, CD player and PC for developed countries (92 observations) and new categories such as DVD player, digital camera, MP3 player and hand-held computer where we have data for both developed and developing countries (98 observations). For all of these product-country combinations, we compare the year of takeoff as measured by our 2% penetration rule to the year of takeoff as measured by the rule proposed by Tellis, Stremersch and Yin (2003) which uses sales and penetration data. We find that overall, in 87% of the cases, the absolute differences in the year of takeoff between the two rules are less than or equal to two years, while they match exactly in 35% of the cases (Table 9).

Second, for 160 product-country combinations among European countries, US and Japan, we use the Tellis, Stremersch and Yin (2003) rule to examine the mean penetration at takeoff. We find that the mean penetration at takeoff is 1.8%, which adds further validity to using the 2% rule.

Thus, our rule has the advantages of being simple, consistently applied across all categories and countries, and relatively similar to that proposed by Tellis, Stremersch and Yin (2003). In the absence of adequate data, following this rule seems a good alternative to the option of dropping those categories for which we do not have adequate data.

Discussion

This section summarizes the key findings, discusses questions and implications of findings, and lists limitations of the study.

Summary

Our study leads to several new findings:

- Time-to-takeoff is getting shorter over calendar time. In addition, there is strong convergence in takeoff over calendar time among developed countries.
- Despite these two effects, differences across countries are quite strong.
    - Products takeoff fastest in Japan and Norway, followed by other Nordic countries, US and some countries of Mid-western Europe.
    - Newly developed countries of Asia (e.g., South Korea) see faster times-to-takeoff of products than established, major European countries (e.g., France, Italy) with centuries of industrialization.
    - Latin countries across Europe and South America have similar times to takeoff.
    - Despite the recent and rapid increases in the GDP of emerging markets such as China, India, Philippines, these countries still substantially lag other countries in time-to-takeoff of new products.
- Takeoff is *not* a purely cultural phenomenon. Differences in both Economics (Wealth) and Culture (In-group collectivism) account for differences in time-to-takeoff across countries and regions.
- The mean time-to-takeoff varies considerably between developing countries (11 years) and developed countries (7 years). The mean time-to-takeoff varies between 6 and 12 years across cultural clusters.
- Time-to-takeoff varies considerably between fun products (7 years) and work products (12 years).
    - Fun products takeoff substantially faster than work products within each cultural cluster.
    - Time-to-Takeoff of fun products also show smaller differences across cultural clusters than work products do.
    - Time-to-Takeoff of fun products is driven by dynamic economic variables and takeoff for fun products is converging faster over time than work products.

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Questions

These findings raise three important questions.

First, can time-to-takeoff serve as an indicator of the innovativeness of a country?

Researchers across disciplines and global policy makers have long debated which countries rank high on innovativeness (The Task Force on the Future of American Innovation Report 2006). Prior research has measured this innovativeness either by input measures such as R&D and scientific talent (e.g. Furman, Porter and Stern 2002) or by surveys of consumers (e.g. Steenkamp, Hofstede and Wedel 1999). However, an alternate viewpoint holds that innovativeness is better defined by the willingness and ability of consumers to acquire and use new products and technologies (Bhide 2006; Tellis, Stremersch and Yin 2003). Based on hard

data, such a measure of innovativeness is also less prone to self-report and cultural biases as is survey data. We find significant differences across countries in terms of the times-to-takeoff. These differences persist within classes of products and across time. Thus, they could serve as a metric of the innovativeness of the nation itself. However, when doing so, we need to keep in mind that the differences in time-to-takeoff, and hence innovativeness are due to both wealth and national culture.

Second, why does Japan not fit in with the cultural cluster of Confucian Asia? Cultural clusters explain differences in times-to-takeoff across countries, with one notable exception, Japan. It has the shortest time-to-takeoff even though it is sometimes grouped in the Confucian cluster, which shows slow times to takeoff. We propose one explanation for this anomaly, consumerism. Consumerism has been defined by Stearns (2001) as a societal trait in which many people formulate their goals in life partly through acquiring goods that they clearly do not need for subsistence or for routine appearance. They derive some of their identity through this process of acquisition. Authors claim that consumerism has flourished in Japan due to a combination of factors: a major thrust by the government to promote product development and consumption, a strong native desire of the Japanese to produce and own the best products, investment in new products rather than land (which is scarce) as symbols of economic progress, and a broader admiration of Western (materialistic) values (Stearns 2001). In Japan, modern consumerism may have overwhelmed older Confucian values, leading to one of the most aggressive and dynamic markets for consumer goods[6]. Unfortunately, scales for this construct are unavailable across all countries, so we could not test this explanation.

[6] In the 1950s and 1960s, Japanese consumers referred to the three Ss: senpuki, sentakuki and suihanki (fan, washing machine, and electric rice cooker) or three Jingi (TV, refrigerators and washing machines) as major life goals. This was followed by the three Cs, in the late 1960: ska, kura, kara terebi (car, air conditioner, and color TV), and by the Js in the late 1970s - jueru, jetto, jutaku– jewels, jetting and a house" (Stearns 2001).

Third, manufacturers have not introduced major new work products (except microwave oven) recently, whereas they have introduced a large number of fun products. So, are the distinctions between work and fun products indistinguishable from that between older and newer vintage products? An examination of Table 4 can address this issue. Note, more fun products than work products have taken off in developing countries, *even though* they have been introduced more recently. Thus, the distinction between fun and work products seems intrinsic to these product classes.

Implications

The study's findings have the following strategic and research implications.

First, researchers have debated the merits of a waterfall strategy (staggering the commercialization of new products across countries) versus a sprinkler strategy (simultaneously introducing the new product across countries). For instance, Chryssochoidis and Wong (1998) and Gielens and Dekimpe (2001) argue for a simultaneous launch to minimize product failure risk due to delayed roll outs and competitive environments. However, Kalish, Mahajan and Muller (1995) argue that conditions such as long product life cycles, small size or slow growth of a foreign market make a waterfall strategy more preferable. Mitra and Golder (2002) suggest that firms enter countries where they have greater economic and cultural knowledge based on operating in similar other countries. Tellis, Stremersch and Yin (2003) argue that a waterfall strategy greatly reduces the scale of operation and exposure to risk of product failure, and increases senior management support when takeoff occurs quickly in the most innovative countries.

Second, market strategy should depend considerably on the type of products. Because times-to-takeoff of fun products are more similar across countries and converging faster over

time than that for work products, they probably have a universal appeal across cultures. Hence, a sprinkler strategy might be feasible for fun products. However, work products are culturally bound and adopted in some cultures more readily than in others. In such categories, a waterfall strategy might be more profitable. By introducing first in countries or cultural clusters where the products are more conducive to the culture, product managers can lower risk, increase odds of success, win support of senior management, and use the confidence, revenues, and lessons gained from those countries and regions to market the product in less accepting countries. In this respect, even small differences in times-to-takeoff of 1 to 3 years may represent enough real time differences to execute a waterfall strategy.

Third, should one choose a waterfall strategy, authors have debated about which countries are the best to introduce a new product first. We recommend one of two sets of strategies. If a manager wishes to launch a new product in an innovative and large market, then the best countries to launch in would be the Japan or the US. However, if a manager wishes to test-market in a small but highly innovative country, then the best countries to launch in would be in the Nordic cluster, Switzerland or Netherlands. In addition to these countries, South Korea also shows promise as a relatively small country with a relatively short time-to-takeoff of new products. For example, it leads the world in penetration of Broadband and 3G technologies.

Fourth, in addition to country innovativeness, managers need to consider the economics of scale, especially between marketing to giants such as China and India and to small countries such as Norway. For example, Cellular phone subscribers are growing by 6 million a month in India in 2006 (*The Economist*). The annualized sales of Cellular firms in countries like India and China would dwarf the entire population of most European countries. The issue of scale becomes especially critical in conjunction with population concentration. If one country's adopters are

concentrated in a small easily accessed portion of the country and yet another country's adopters are dispersed more widely, then the former may be a superior option to the latter.

Limitations and Further Research

Five limitations of the current study suggest areas for future research. First, due to data limitations, we use a heuristic of 2% to measure the point of takeoff. Second, we do not account for the role of variables such as price declines, quality improvements, or competition within product markets (Agarwal and Bayus 2002; Golder and Tellis 1997; Jain, Mahajan and Muller 1991; Mahajan, Muller and Bass 1995; Van den Bulte 2000). Third, we do not consider differences in time-to-takeoff within a country. Fourth, there is multi-collinearity among some variables. However, we partly mitigate this problem by considering Wealth as a factor of related dimensions and partly by examining univariate hazard results. Fifth, an extension of this study to products other than consumer durables and high-tech services will lead to a better intuition about the phenomenon of takeoff.

TABLE 1
Factor Analysis of Economic Variables

	Wealth	Openness
Television sets per 1000 people	**0.93**	0.26
GDP per capita	**0.91**	0.31
Vehicles per 1000 people	**0.90**	0.00
Telephone mainlines per 1000 people	**0.88**	0.33
Electricity consumption per capita	**0.86**	0.23
Radios per 1000 people	**0.85**	0.22
Trade (% of GDP)	0.11	**0.91**
Trade in goods (% of GDP)	0.09	**0.90**
Gross private capital flows (% of GDP)	0.34	**0.74**
Gross foreign domestic investment (% of GDP)	0.30	**0.70**

TABLE 2
Mean Time-to-Takeoff across Categories within Countries

	Mean	Std	Total
Japan	5.4	3.3	14
Norway	5.7	2.4	15
Sweden	6.1	2.9	15
Netherlands	6.1	3.7	16
Denmark	6.1	2.6	15
US	6.2	3.4	14
Switzerland	6.3	3.4	15
Austria	6.4	3.3	15
Belgium	6.5	2.5	16
Canada	6.9	5.2	12
Finland	7.0	2.6	15
Germany	7.1	4.3	15
South Korea	7.2	3.3	12
Venezuela	7.3	4.5	12
UK	8.0	4.5	14
France	8.2	3.5	15
Italy	8.3	4.0	15
Spain	8.5	4.0	14
Chile	8.5	5.7	11
Mexico	8.7	3.7	11
Portugal	8.8	4.5	15
Greece	9.0	4.4	14
Brazil	9.3	4.9	11
Thailand	10.2	6.3	12
Egypt	12.1	5.3	13
Morocco	12.3	6.3	12
India	12.4	5.0	14
Philippines	12.6	7.1	13
Indonesia	13.6	6.2	15
Vietnam	13.9	5.6	14
China	13.9	6.1	16

TABLE 3
Estimates of Hazard Model

	Univariate Analysis			Multivariate Analysis
Construct	**Beta (T-stats)**	**Log likelihood**	**R square-like**	**Beta (T-stats)**
Product Vintage	-0.01 (-7.29)	-365.72	0.07	-0.005 (-2.14)
Prior Takeoffs	-0.09 (-10.15)	-354.82	0.10	-0.02 (-2.05)
Product class (Work =1)	0.51 (7.29)	-366.75	0.07	0.20 (2.01)
Population Density	0.00 (1)	-393.17	0.00	
Wealth	-0.32 (-12.79)	-327.42	0.17	-0.08 (-1.90)
Openness	0.01 (0.40)	-393.41	0.00	
Economic Disparity	0.02 (3.94)	-385.02	0.02	0.00 (-0.80)
Performance Orientation	0.17 (1.83)	-391.87	0.00	
Uncertainty Avoidance	-0.29 (-4.81)	-382.2	0.03	0.20 (2.95)
In-group Collectivism	0.41 (11.52)	-332.28	0.16	0.33 (4.01)
Power Distance	0.47 (6.45)	-375.78	0.04	0.01 (0.04)
Religiosity	0.01 (6.62)	-370.68	0.06	0.0 (1.20)
Log-Likelihood				-286.79
R square-like				0.27

TABLE 4
Mean Time-to-Takeoff by Product Class and Economic Development

	All Countries			Developed Countries			Developing Countries		
Product Class	**Mean (Std Dev)**	**Total**	**% Taken Off**	**Mean (Std Dev)**	**Total**	**% Taken Off**	**Mean (Std Dev)**	**Total**	**% Taken Off**
Fun products	7.3 (3.9)	305	81	6.2 (3.2)	184	95	8.9 (4.5)	121	60
Work products	11.8 (6)	125	78	8.9 (4.4)	80	99	17.0 (5.1)	45	42

TABLE 5
Comparisons of Cultural Clusters

Cultural clusters	**Nordic Europe**	**Anglo**	**Germanic Europe**	**Latin America**	**Latin Europe**	**Confucian Asia**	**Northern Africa**	**Southern Asia**
Countries	Sweden Denmark Finland	Canada USA	Austria Germany Switzerland Netherlands UK	Brazil Mexico Venezuela	France Italy Portugal Spain Greece	China Japan South Korea	Egypt Morocco	India Indonesia Philippines Thailand
Logic for Cluster	• Geographic proximity • Common Nordic history, religion and languages	• Ethnic and linguistic similarities • Secular, with strong legal infrastructures	• Linguistic and religious similarities • Tradition of orderliness, standards, and rules	• Roman law heritage, common Spanish or Portuguese languages • Similar Emphasis on family living, food, clothing, and lifestyle	• Shared history of Roman empire • Roman Catholic tradition and languages based on Latin • Paternalistic role of State • Similar emphasis on family living, food, clothing, and lifestyle	• Historical influence of China • Confucianism • Emphasis on hierarchy, diligence, self-sacrifice and delayed gratification	• Influence of Arab invasion, Islamic legal and moral code and the Arabic language • Geographical proximity to Northern Rim	• Peaceful coexistence of diverse religions, languages, customs and cuisines • Similarity in values, such as morality, respect for elders and conservation of resources
In-group Collectivism	3.8* (0.3)	4.2* (0)	4.2* (0.4)	5.5** (0.3)	5.1(0.5)	5.3 (0.6)	5.8** (0.2)	5.9**(0.3)
Power Distance	4.5 (0.6)	4.85* (0)	4.9 (0.5)	5.3** (0.1)	5.4** (0.1)	5.2 (0.3)	5.4 (0.6)	5.4** (0.2)
Religiosity	8.4* (3.2)	47.8 (14)	18.1* (6.6)	64.7** (4.8)	29.1(13.6)	11.3 * (12.9)	69.5**(4.1)	57.8 (29.8)
Performance Orientation	3.9(0.3)	4.5** (0)	4.3** (0.2)	3.8 (0.4)	3.7* (0.3)	4.4 **(0.2)	4.1 (0.2)	4.3 (0.2)
Uncertainty Avoidance	5.2** (0.2)	4.4 (0.3)	4.9** (0.3)	3.7* (0.4)	3.9* (0.4)	4.2 (0.7)	3.9 (0.3)	4.0* (0.1)

**Significantly higher than mean of rest of countries
*Significantly lower than mean of rest of countries ($p<0.10$ or $p<0.05$)
Standard deviations in parentheses

TABLE 6
Mean Time-to-Takeoff across Cultural Clusters (Standard Deviation in Brackets)

	Nordic Europe	Anglo America	Germanic Europe	Latin America	Latin Europe	Confucian Asia	Confucian Asia w/o Japan	North Africa	Southern Asia
Average All Products	6.44 (2.7)	6.54 (4.2)	6.8 (3.9)	8.4 (3.3)	8.6 (4.1)	9.0 (4.4)	11.0 (6.1)	12.2 (5.8)	12.3 (6.2)
Average Fun Products	6.0 (2.4)	5.3 (2.2)	5.8 (3.2)	7.4 (2.7)	7.6 (3.3)	7.8 (4.0)	9.1 (4.1)	9.2 (3.7)	9.7 (4.5)
Average Work Products	7.33 (3.3)	11.6 (2.4)	9.2 (3.8)	13 (3.3)	10.6 (5.0)	13.2 (2.7)	18.00 (3.8)	17.4 (5.0)	18.4 (4.9)

TABLE 7
Hazard Model Including Cultural Clusters

	Hazard Model with Japan in Confucian Asia		Hazard Model without Japan in Confucian Asia	
Log likelihood	-292.32		-266.44	
R square-like	0.26		0.29	
Observations	373		358	
	Beta	T-stats	Beta	T-stats
Product Vintage	-0.01	-2.75	-0.01	-2.57
Prior Takeoffs	-0.02	-1.79	-0.02	-1.92
Product Class (Work=1)	0.19	1.92	0.20	1.97
Anglo America	-0.03	-0.21	-0.03	-0.23
Germanic Europe	0.07	0.82	0.07	0.87
Latin Europe	0.27	3.12	0.27	3.21
Latin America	0.40	3.23	0.39	3.28
North Africa	0.77	5.00	0.75	5.09
Confucian Asia	0.50	4.29	0.68	5.20
Southern Asia	0.87	6.98	0.85	7.12
Nordic Europe				

TABLE 8
Comparison of Hazard Model for Fun versus Work Products

	Fun Products		Work Products	
Variables	Beta	T-stats	Beta	T-stats
Product Vintage	-0.02	-4.7		
Prior Takeoffs	-0.02	-2.7	-0.03	-0.89
Wealth	-0.09	-1.7	-0.02	-0.20
Openness	-0.05	-1.6		
Economic Disparity	0.00	-0.5	-0.01	-0.67
In-group Collectivism	0.27	2.9	0.48	2.96
Power Distance	0.00	0.0	-0.02	-0.11
Religiosity	0.00	-0.1	0.01	1.90
Uncertainty Avoidance	0.19	2.8	0.25	1.60
Observation	267			106
Log likelihood	-177.41			--85.00
R Square-like	0.29			0.27

TABLE 9
Absolute Difference Between 2% Penetration Rule and Penetration Threshold Rule

	Abs Diff=0	Abs diff=1	Abs diff=2	Abs diff>2	No. of countries
Total	65	67	34	24	190
%	34	35	18	13	
Cumulative %	34	69	87	100	

FIGURE 1
Mean Time-to-Takeoff over Calendar Time

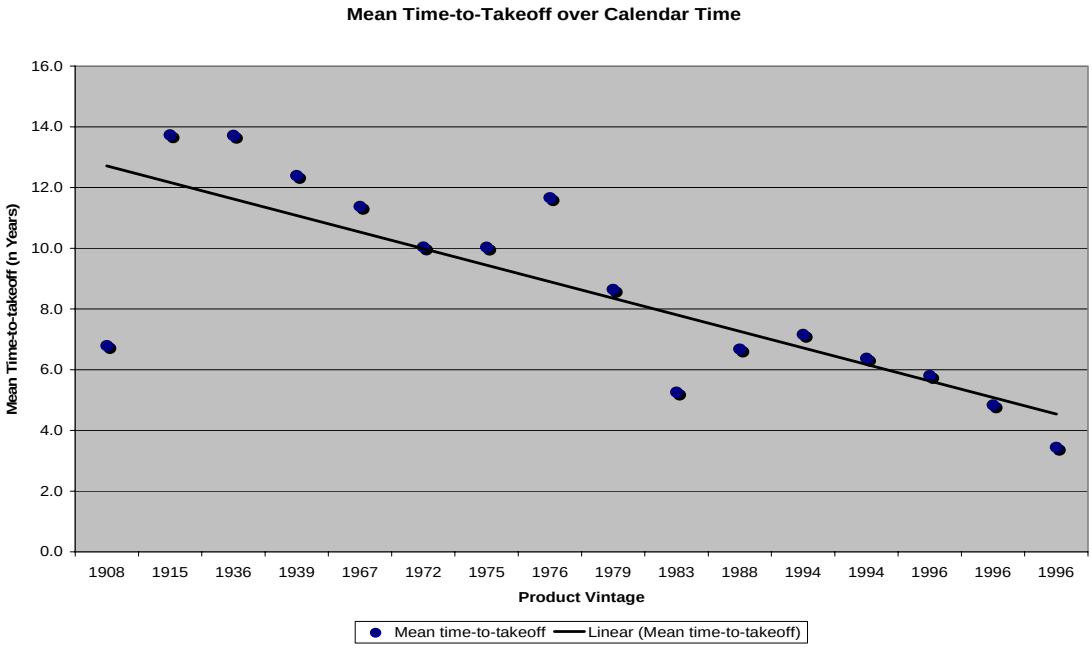


FIGURE 2a
Time Spread in years between First and Last Takeoff by Year of First Takeoff

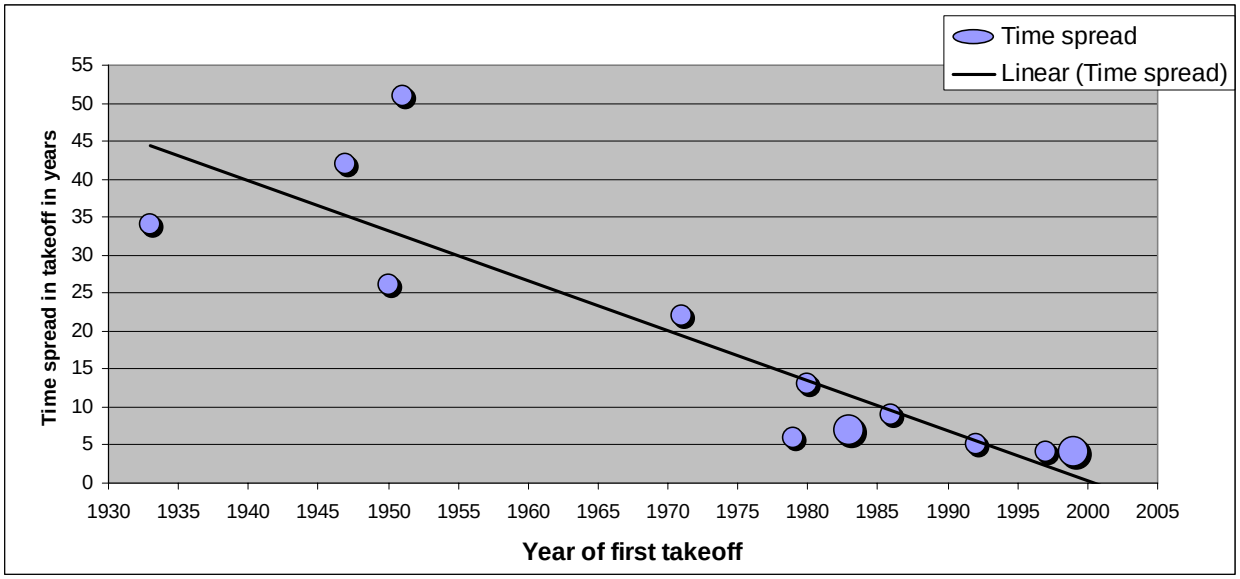
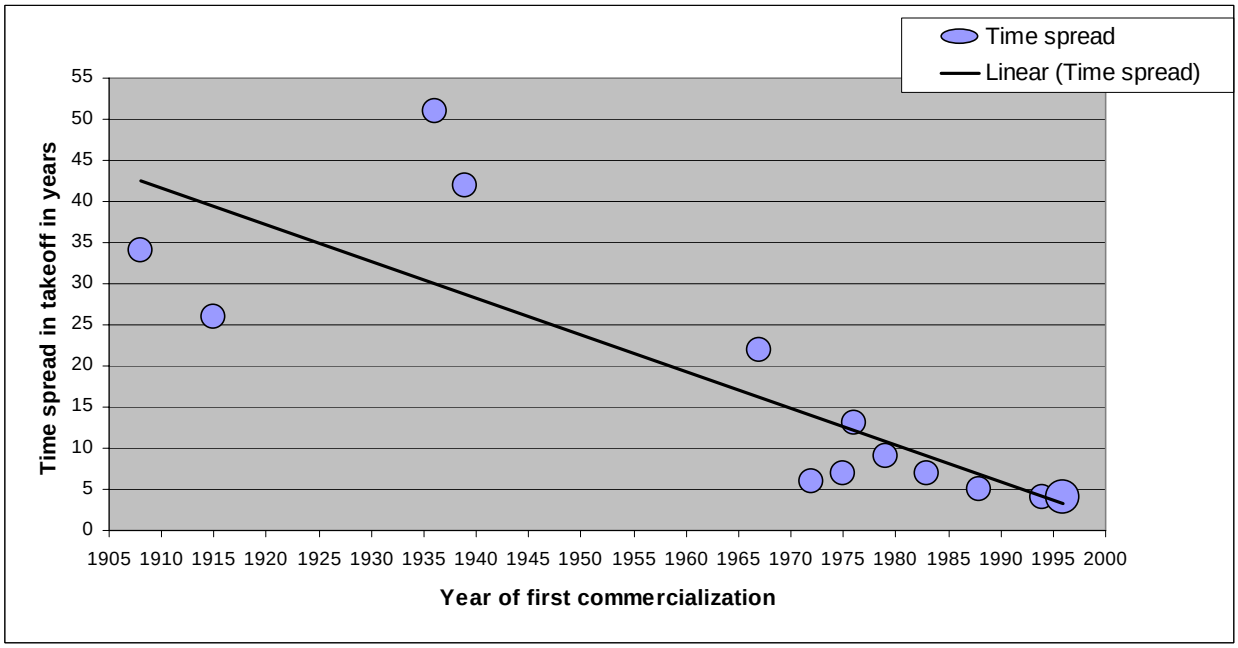


FIGURE 2b
Time Spread in years between First and Last Takeoff by Year of First Commercialization



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