Modeling Global Spill-Over of New Product Takeoff

Yvonne M. van Everdingen, Dennis Fok, Stefan Stremersch

Accepted for publication in Journal of Marketing Research

ERIM Report Series *Research in Management*	
ERIM Report Series reference number	ERS-2008-067-MKT
Publication	October 2008
Number of pages	54
Persistent paper URL	http://hdl.handle.net/1765/13616
Email address corresponding author	yeverdingen@rsm.nl
Address	Erasmus Research Institute of Management (ERIM) RSM Erasmus University / Erasmus School of Economics Erasmus Universiteit Rotterdam P.O.Box 1738 3000 DR Rotterdam, The Netherlands Phone: + 31 10 408 1182 Fax: + 31 10 408 9640 Email: info@erim.eur.nl Internet: www.erim.eur.nl

Bibliographic data and classifications of all the ERIM reports are also available on the ERIM website:
www.erim.eur.nl

ERASMUS RESEARCH INSTITUTE OF MANAGEMENT

REPORT SERIES
RESEARCH IN MANAGEMENT

ABSTRACT AND KEYWORDS	
Abstract	This article examines the global spill-over of foreign product introductions and takeoffs on a focal country's time-to-takeoff, using a novel data set of penetration data for 8 high tech products across 55 countries. It shows how foreign clout, the susceptibility to foreign influences, and inter-country distances affect global spill-over patterns. The authors find that foreign takeoffs, but not foreign introductions, accelerate a focal country's time-to-takeoff. The larger the country, the higher its economic wealth, and the more it exports, the more clout it has in the global spill-over process. In contrast, the poorer the country, the more tourists it receives and the higher its population density, the more susceptible it is to global spill-over effects. Cross-country spill-over effects are stronger the closer the countries are to one another, both geographically and economically, but not necessarily in terms of culture. The model the authors develop also quantifies the spill-over between each country-pair, allowing it to be asymmetric.
Free Keywords	new product takeoff, spill-over, cross-country, global, hazard model
Availability	The ERIM Report Series is distributed through the following platforms: Academic Repository at Erasmus University (DEAR), DEAR ERIM Series Portal Social Science Research Network (SSRN), SSRN ERIM Series Webpage Research Papers in Economics (REPEC), REPEC ERIM Series Webpage
Classifications	The electronic versions of the papers in the ERIM report Series contain bibliographic metadata by the following classification systems: Library of Congress Classification, (LCC) LCC Webpage Journal of Economic Literature, (JEL), JEL Webpage ACM Computing Classification System CCS Webpage Inspec Classification scheme (ICS), ICS Webpage

Modeling Global Spill-Over of New Product Takeoff

Yvonne van Everdingen, Dennis Fok, Stefan Stremersch*

Yvonne van Everdingen is Associate Professor of Marketing at Rotterdam School of Management, Erasmus University, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands. Phone: (+31)10-4082054. Fax: (+31)10-4089011. E-mail: yeverdingen@rsm.nl. Dennis Fok is Associate Professor of Econometrics at Erasmus School of Economics, Erasmus University Rotterdam, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands. Phone: (+31)10-4081333. Fax: (+31)10-4089162. E-mail: dfok@few.eur.nl. Stefan Stremersch is Chaired Professor of Marketing and Desiderius Erasmus Distinguished Chair of Economics at Erasmus School of Economics, Erasmus University Rotterdam, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands, phone: (+31)10-4088719, fax: (+31)10-4089169, E-mail: stremersch@few.eur.nl, and Visiting Professor of Marketing, Fuqua School of Business, Duke University, U.S.

*
The authors acknowledge the research support of Lorenz Brongers. They are also grateful for the many valuable suggestions they received from Aurélie Lemmens, Isabel Verniers, audiences at IESE, University of Texas at Austin, Northwestern University, Tilburg University, University of Groningen, University of Nijmegen, the 2007 AMA Sheth Doctoral Consortium, the 2007 Marketing-in-Israel Conference and the 2007 Informs Marketing Science Conference, three anonymous JMR reviewers, the JMR AE and Jan-Benedict Steenkamp, as guest editor.

Modeling Global Spill-Over of New Product Takeoff

ABSTRACT

This article examines the global spill-over of foreign product introductions and takeoffs on a focal country's time-to-takeoff, using a novel data set of penetration data for 8 high tech products across 55 countries. It shows how foreign clout, the susceptibility to foreign influences, and inter-country distances affect global spill-over patterns. The authors find that foreign takeoffs, but not foreign introductions, accelerate a focal country's time-to-takeoff. The larger the country, the higher its economic wealth, and the more it exports, the more clout it has in the global spill-over process. In contrast, the poorer the country, the more tourists it receives and the higher its population density, the more susceptible it is to global spill-over effects. Cross-country spill-over effects are stronger the closer the countries are to one another, both geographically and economically, but not necessarily in terms of culture. The model the authors develop also quantifies the spill-over between each country-pair, allowing it to be asymmetric.

Keywords: new product takeoff, spill-over, cross-country, global, hazard model.

Over the past decade, marketing researchers have shown a strong interest in modeling the takeoff of new products, which refers to the first dramatic increase in sales after an initial period of low sales. After the first efforts to model the takeoff of new consumer durables in the U.S. (Agarwal and Bayus 2002; Golder and Tellis 1997), scholars have recently turned to the study of cross-national differences in time-to-takeoff. Tellis, Stremersch and Yin (2003) have shown that large variance exists in the time-to-takeoff among West European countries, which is explained by differences in national culture, rather than economic differences. Chandrasekaran and Tellis (2008) have extended this earlier study to a sample of 31 countries, and also show large cross-country differences in time-to-takeoff. Tellis, Stremersch and Yin (2003) capture cross-country spill-over by merely controlling for the number of prior takeoffs in other countries, while Chandrasekaran and Tellis (2008) do not control for foreign takeoffs. The present paper extends those earlier studies by explicitly modeling the cross-country spill-over effects of new product introduction and takeoff in foreign countries on the product's time-to-takeoff in a focal country.

Our model explicitly incorporates the distance (economic, cultural and geographic) between countries, from now on referred to as the *inter-country distance*, as moderating the influence of foreign introductions and foreign takeoffs. Also, it allows countries to show different levels of *susceptibility* to foreign introductions and takeoffs and differential *foreign clout* in the international spill-over process. The concepts foreign susceptibility and foreign clout, allow cross-country influences to be asymmetric in our model. For instance, the influence of country A on country B can be stronger than vice versa, because of a stronger clout of A, as compared to B, or a higher susceptibility of B, as compared to A. In contrast, the model by Tellis, Stremersch and Yin (2003) implicitly assumes that all countries are equally distant, all countries have the same susceptibility and that all countries have equal clout. Our new model outperforms this earlier model on fit (both in-sample and out-of-sample) and conceptual insight.

Our study also adds to the international diffusion literature. In this literature, several authors have modeled cross-country spill-over, which they typically relate to inter-country distances (e.g. Albuquerque, Bronnenberg and Corbett 2007; Dekimpe, Parker and Sarvary 1998 and 2000a; Ganesh and Kumar 1996; Ganesh, Kumar and Subramaniam 1997; Kumar and Krishnan 2002; Libai, Muller and Peres 2005; Putsis et al. 1997; Takada and Jain 1991; Van Everdingen, Aghina and Fok 2005). Concepts such as *foreign susceptibility* and *foreign clout* in international spill-over are relatively novel in that literature. A recent study by Albuquerque, Bronnenberg and Corbett (2007) is the only diffusion study that studied the susceptibility and influence of countries in cross-country diffusion, but they did not relate these concepts to country characteristics. Moreover, it investigated adoption at the firm level, while we focus on consumer innovations. Overall, our exploration of these concepts for international takeoff may also stimulate new work on spill-over in international diffusion.

We estimate the parameters of our model on a novel dataset that we composed for this study. It contains sales and penetration data on eight, recently introduced, high tech durables (CD players, video cameras, personal computers, mobile phones, Internet, ISDN, digital cameras, DVD players) in 55 countries around the world. Our dataset is richer than any other dataset so far in the international diffusion and takeoff literatures and includes many developing countries (cfr. Dekimpe, Parker and Sarvary 2000b). In addition, this global dataset allows us to describe global takeoff patterns more extensively than anyone before us (16 countries in Tellis, Stremersch and Yin (2003), 31 countries in Chandrasekaran and Tellis (2007), 55 countries in this study).

Our findings have many implications for international public policy and marketing management. For public policy, a comparison between countries in: (1) average time-to-takeoff, as a demand-side measure for innovativeness (European Commission 2003), (2) foreign susceptibility, (3) foreign clout, and (4) inter-country distance, all can provide valuable input in regulation decisions on the stimulation of innovation adoption and international economic policy. For managers, our results yield useful insights to: (1) inform market entry decisions; (2) manage expectations on global takeoff; and (3) stimulate cross-national spill-over.

In the following section, we explain the concept of takeoff in more detail. Next, we discuss the theoretical concepts underpinning our model. Then, we develop our econometric model, after which we turn to the data we use to estimate the model parameters. Subsequently, we present the results and end with discussing the implications and limitations of this study.

TAKEOFF

Takeoff is defined as the transition from the introductory stage to the growth stage of the product life cycle, which is characterized by the first large increase in sales (Agarwal and Bayus 2002; Golder and Tellis 1997). According to Golder and Tellis (1997) the main reason why new product takeoff occurs, lies in the concept of "affordability". New product sales are initially low due to relatively high prices, but as soon as prices decline, the new product becomes affordable for a larger population and takeoff occurs. According to Agarwal and Bayus (2002), the main reason why new product takeoff occurs, lies in the concept of "industry ecology". New product sales are initially low due to a limited number of suppliers, but as soon as a large number of firms enter, the product and its distribution is improved, consumer awareness of and confidence in the new product is increased, leading to a sharp increase in the demand for the new product.

Takeoff is a critical event in the life of a new product, since the jump in sales has important implications for the resources required for manufacturing, marketing and inventory management. Moreover, takeoff is a signal of mass adoption, and knowing when takeoff is most likely to occur helps managers to decide whether or not to pull the plug on a product (Tellis, Stremersch and Yin 2003). Diffusion studies, alternatively, model the overall new product sales growth pattern, while not explicitly considering takeoff. Moreover, the data used in these studies frequently start from the point of takeoff, rather than introduction (Golder and Tellis 1997).

This study examines country characteristics as drivers of time-to-takeoff (i.e. the time between the commercialization and the moment of takeoff of the new product) – in contrast to Golder and Tellis (1997) and Agarwal and Bayus (2002), who focus on the effect of company decisions on market-level takeoff – and the spill-over effects that occur across countries. To build a comprehensive set of country characteristics, we build upon both the international takeoff and international diffusion literatures (e.g. Chandrasekaran and Tellis 2007; Dekimpe, Parker and Sarvary 2000b; Putsis et al. 1997; Steenkamp, ter Hofstede and Wedel 1999; Stremersch and Tellis 2004; Talukdar, Sudhir and Ainslie 2002; Tellis, Stremersch and Yin 2003; Van den Bulte and Stremersch 2004). From this literature, we may expect that four main country dimensions may affect time-to-takeoff and international spill-over effects. First, a country's *economy* (e.g., see Tellis, Stremersch and Yin 2003) directly relates to the affordability of a new product and time-to-takeoff (e.g. GDP) and economic streams across countries (e.g. international trade or traffic of people) relates to spill-over effects across countries. Second, a country's *culture* (e.g. see Van den Bulte and Stremersch 2004) relates to the degree to which citizens will be, on the one hand, innovative, on the other hand, socially connected. The former may influence time-to-takeoff, while the latter may influence spill-over patterns. Third, a country's *demography* (e.g., see Dekimpe, Parker and Sarvary 2000b) may affect the ease with which countries can be penetrated by new products and the influence they will have in the international realm. Fourth, a country's *geographic location* will affect spill-over patterns, with isolated countries being less important in spill-over patterns than closely connected countries.

GLOBAL SPILL-OVER IN TAKEOFF: CONCEPTUAL FRAMEWORK

To conceptualize on global spill-over patterns in new product takeoff, we first theorize upon the underlying concepts, clout, susceptibility and inter-country distance, in such spill-overs. We then turn to our expectations on the effects of country covariates on each of these concepts, along the higher-level dimensions identified above: economy, culture, demography and geography.

Clout, Susceptibility, and Inter-Country Distance in Global Spill-Over

Figure 1 graphically summarizes our conceptual framework, and shows two main events that may lead to spill-over effects on the time-to-takeoff[1] of product k in country i, namely the prior *introduction* and *takeoff* of product k in country j ($i \neq j$).

--- Insert Figure 1 about here ---

Foreign introductions and takeoffs may positively affect new product takeoff probability in a focal country for a number of reasons. A first reason is that foreign introductions are indicative of a supplier's high expectations of the new product, as well as of the support of foreign distribution channels. Both signal the expectation of commercial success to the marketplace, which, in turn, enables support of retail channels and consumer acceptance in the focal country. Both distribution channels and consumers in the focal country may be even more easily convinced, if takeoff in other countries has already occurred (Tellis, Stremersch and Yin 2003). Under these circumstances, distribution channels may decide to promote the product more heavily. A second reason is that foreign availability of the product, post-launch, will generate cross-country word-of-mouth among consumers (Kalish, Mahajan and Muller 1995). Moreover, it is also conceivable that cross-country word-of-mouth spill-over may intensify after the takeoff in the foreign country, as the product is starting to appeal to the mass market and uncertainty about the ultimate success of the new product is gradually fading (Agarwal and Bayus 2002; Stremersch et al. 2007).

The contribution of the present paper lies in the idea that the extent to which such spill-over effects materialize, depends upon the specific pair of countries one studies. As one can see in Figure 1, we model the influence of foreign susceptibility of country i, foreign clout of country j, and the distance between country i and country j, on such cross-country spill-over effects of introduction and takeoff, all operationalized through country characteristics.

The concepts ‘susceptibility’ and ‘clout’ are very similar to the notion of a brand’s competitive vulnerability and clout, which indicates to what extent a brand is vulnerable to loose market share to competing brands or the ability of a brand to take share away from competitors (Kamakura and Russel 1989). In a similar vein, we argue that some countries will be more receptive to influences from foreign countries (i.e. foreign susceptibility), while other countries are more capable of influencing foreign countries (i.e. foreign clout). We expect that the higher country i’s foreign susceptibility, the stronger the spill-over effect of foreign introductions and takeoffs on new products’ time-to-takeoff in country i. And, the higher country j’s foreign clout, the stronger the spill-over effect of introductions and takeoffs of new products in country j on the time-to-takeoff of those products in other countries. Variation across countries in susceptibility and clout generate asymmetries in the influence countries may have on one another.

We also consider the *distance* between countries. Studies on cross-country learning have shown that the closer countries are, the stronger the learning effect from the lead to the lag country, which in turn positively affects adoption timing (Ganesh, Kumar and Subramaniam 1997; Kumar and Krishnan 2002). Along similar lines, we expect strong cross-country spill-over effects to occur between countries that are close to each other in economic, cultural, or geographic terms, while we expect *distant* countries to have little effect on each other.

As shown in Figure 1, we expect country characteristics to affect time-to-takeoff, inter-country distance, foreign susceptibility and foreign clout.

Country Characteristics: Economy, Culture, Demography and Geography

This section presents our theoretical expectations on the role of economic, cultural, demographic and geographic characteristics of countries in the global spill-over pattern in new product takeoff (our expectations are included in Table 5, which also contains our empirical findings).

Economy. The economic wealth of a country may have a strong positive effect on the probability for takeoff to occur, as takeoff is driven to a large extent by affordability concerns (Golder and Tellis 1997 and 2004). In addition to wealth, we also take into account the distribution of wealth. If income inequality is high, only a few people in a country may afford a new product, while the vast majority still lacks the ability to buy the new product

(Chandarasekaran and Tellis 2008; Tellis, Stremersch and Yin 2003). In line with these arguments, we expect income inequality to be negatively related to the takeoff probability.

Moreover, a poor country is likely to be more susceptible to foreign events, such as introduction and takeoff. Citizens of poor countries have a stricter budget constraint than citizens of a wealthy country, which will make them more hesitant in adopting new products early on, without strong signals of ultimate success in other countries (Dekimpe, Parker and Sarvary, 2000c). In contrast, a rich country is more likely to influence other countries than relatively poor countries, because the reputation and sophistication of users of an innovation in wealthy countries can signal the quality of an innovation to foreign consumers (Beise 2004).

The economic openness of a country is another important variable in explaining the penetration potential of a new product (Talukdar, Sudhir and Ainslie 2002). An economy can be open in terms of its international trade (e.g. imports or exports of goods and services) or in terms of its international traffic of people (e.g. tourism). Citizens in open economies will be more able to share information with foreigners, because they have developed more relationship-heuristics (Wuyts et al. 2004), such as understanding the way in which to do business with a country (Beise 2004), or a higher ability in foreign languages, as compared to more closed economies. Therefore, foreign clout will be especially high for export-oriented countries or countries of which citizens show higher tourism expenditures abroad, while countries showing higher import figures or countries that receive many tourists will be more susceptible to the influence of foreign countries.

We also expect that economically distant countries will show weaker spill-over effects than economically close countries. This expectation is grounded in theories that connect economic similarity, mainly in terms of GDP, to cross-country learning (Dekimpe, Parker and

Sarvary 2000c; Ganesh, Kumar and Subramanian 1997; Kumar and Krishnan 2002). Similar economic conditions between countries may be associated with similarities in consumer demand as well as in the communications infrastructure (Mitra and Golder 2002). Consequently, it is more likely that consumers from economically similar countries communicate with each other about new products than consumers from economically dissimilar countries.

Culture. A very popular framework to study national culture is the four-dimensional framework, posited by Geert Hofstede (Hofstede 2001). The four "classic" dimensions he originally posited – later he would add a fifth (long term orientation) – are uncertainty avoidance, individualism, masculinity and power distance. In this paper, we focus solely on the dimension of uncertainty avoidance, which indicates to what extent a society tolerates uncertainty and ambiguity, and moreover to what extent a culture programs its members to feel either uncomfortable or comfortable in unstructured situations. The reasons for this choice are that: (1) uncertainty avoidance is found to be the most relevant to innovative behavior (Steenkamp, ter Hofstede and Wedel 1999; Tellis, Stremersch and Yin 2003); (2) inclusion of all cultural dimensions generates harmful collinearity and inefficiency in the estimation, due to overparametrization with likely insignificant effects; and (3) in our empirical tests (see below), we found uncertainty avoidance to be the only cultural dimension among the four with significant explanatory power.

A country's high uncertainty avoidance hinders consumer innovativeness (Steenkamp, Ter Hofstede and Wedel 1999), which will negatively affect a new product's takeoff probability (Tellis, Stremersch and Yin 2003). Uncertainty avoidance may also affect foreign susceptibility. Citizens of countries low in uncertainty avoidance show less alienation from what happens in the world, have greater tolerance of foreigners' opinions, accept people from other races as neighbors more easily, tolerate immigrants better, and show a more open-minded mentality in search for information, as compared to citizens of countries high in uncertainty avoidance (Hofstede 2001). Therefore, the former type of countries will show greater foreign susceptibility than the latter type. The relation between uncertainty avoidance and foreign clout is less clear, although we could argue that if the new product has taken off in uncertainty avoidant countries, this is a stronger quality signal, given that they are more conservative, as compared to countries low in uncertainty avoidance.

The degree to which citizens in two countries have similar or different attitudes towards uncertainty, will affect the degree to which spill-overs exist between these two countries. The reason is that people communicate more easily when they share a common cultural background (Ganesh, Kumar and Subramanian 1997; Kumar and Krishnan 2002; Rogers 1995; Takada and Jain 1991).

Demography. Population size and population density both may affect the takeoff probability of a new product positively, as they both enhance the speed at which an innovation diffuses through a population (Dekimpe, Parker and Sarvary 2000b).

Both population size and population density may also be important demographic influences on foreign susceptibility and clout. Small countries are typically less self-centered than large countries (Alesina and Wacziarg 1998; Spolaore 2004), which may make them more susceptible to foreign influence. In contrast, large countries are likely to have a more diverse population than small countries (Alesina and Spolaore 1997), which may generate more diverse foreign contacts. Putsis et al. (1997) have indeed shown that large E.U. countries have relatively more external contacts than small E.U. countries. Therefore, we may expect large countries to have more foreign clout.

Countries with a dense population may be more susceptible to foreign influences, than countries with a low population density, because foreign information can more easily penetrate the social system (Lemmens, Croux and Dekimpe 2007; Mitra and Golder 2002). Individuals in dense countries are close to one another physically, which may enhance the likelihood of communicating with each other, and consequently there seem to be more ways in which citizens learn about new products' adoption in foreign countries. High density may also increase word-of-mouth with foreign countries and thus increase clout.

Geography. We consider geography only in relation to distance between countries. We expect that the more geographically distant countries are, the weaker the international spill-over between them. This expectation is grounded in prior work by Mahajan and Peterson (1979) – who referred to it as "the neighborhood effect" – and Garber et al. (2004) – who found spatial clusters in adoption phenomena – among others.

Other variables. We also control for other factors that prior literature has found to be of importance. First, we control for time, since it is well known that there is duration dependence in the time-to-takeoff (Golder and Tellis 1997). We include both the time *since* introduction and the time *of* introduction (i.e. the launch year). Note that the first variable is time-varying, while the second is time-invariant. Second, we control for the product category.

MODELING GLOBAL SPILL-OVER IN NEW PRODUCT TAKEOFF

The econometric model we develop to capture global spill-over in new product takeoff builds upon the conceptual framework in Figure 1. Denote the number of countries by I and the number of products by K. Time of introduction of product k in country i is given by T^0_{ik} and the time of takeoff of product k in country i is denoted by T_{ik}. Our goal is to explain the time-to-takeoff, given the time of the product's introduction, that is, $(T_{ik} - T^0_{ik})$ for I = 1,…., I and k = 1,…, K. As data is usually only available on an annual basis, we opt for a discrete-time duration model, that is, we model the probability of a new product taking off given that takeoff has not yet occurred and given that the product has been introduced. This also allows us to capture the duration dependence of takeoff.

More formally, we model the conditional probability $\Pr [T_{ik} = t \mid T_{ik} > t\text{-}1, T^0_{ik} \leq t]$, for $t = T^0_{ik}, T^0_{ik} + 1, \ldots$ This conditional probability of takeoff at time t depends on whether introduction and/or takeoff already have taken place at time t-1 in other countries. The magnitude of the influence of country j on country i depends on the distance between the two countries, the susceptibility of country i to foreign introductions and takeoffs, as well as the clout of country j.

Let D^0_{ikt} denote a dummy variable, which we set to one if product k has already been introduced in country i at time t and zero otherwise, that is,

$$D^0{}_{ikt} = I[T^0{}_{ik} \leq t], \tag{1}$$

where I[A] is an indicator function that equals one if condition A is true and zero otherwise. Similarly, denote by D_{ikt} a dummy variable defined by

$$D_{ikt} = I[T_{ik} \leq t]. \tag{2}$$

This dummy indicates whether the product k took off in country i at or before time t. We now specify the conditional probability of takeoff of product k in country i, conditional on the introduction of this product, as

$$\Pr[T_{ik} = t \mid T_{ik} > t-1, T^0{}_{ik} \leq t] = \frac{\exp(V_{ikt})}{1+\exp(V_{ikt})}, \tag{3}$$

We specify V_{ikt} as

$$V_{ikt} = \mu_k + \beta' Z_i + f(t - T^0{}_{ik}; \varphi) + \lambda T^0{}_{ik} + \alpha_0 \sum_{j=1}^{I} \psi_{ij} D^0_{jk,t-1} + \alpha_1 \sum_{j=1}^{I} \psi_{ij} D_{jk,t-1}, \tag{4}$$

where μ_k denotes a product-specific intercept, Z_i denotes a vector of country characteristics, and β is the associated effect of these characteristics. The term $\lambda T^0{}_{ik}$ denotes the influence of the launch year, while the baseline hazard is given by $f(t\text{-}T^0{}_{ik};\phi)$; the latter term captures the influence of time since the introduction. We choose to use a flexible function of time to allow for a wide range of different patterns, that is, we specify

$$f(t;\varphi) = \varphi_1 t + \varphi_2 t^2 + \varphi_3 \log(t+1), \qquad t \geq 0. \tag{5}$$

The influence of foreign introductions and foreign takeoffs is captured by the terms α_l ($l = 0, 1$) and ψ_{ij}. The first term, α_l ($l = 0, 1$), specifies the main effect of an introduction, respectively takeoff, in one country on another. Both parameters (α_0 and α_1) are expected to be positive (i.e. increase the takeoff probability), as an introduction or takeoff in another country is a positive signal. The second term, ψ_{ij} measures the influence of country j on country i. We decompose ψ_{ij} as

$$\psi_{ij} = \pi_{ij} \rho_j \theta_i, \tag{6}$$

where π_{ij} measures the *distance* between i and j, ρ_j captures the *clout* of j ($\rho_j > 0$), and θ_i equals the *foreign susceptibility* of country i ($\theta_i > 0$)[2]. We opt for a multiplicative specification in Equation 6, because susceptibility, clout, and distance interact with each other. If the susceptibility of a country i is low, we expect ψ_{ij} to be small for all j, even for a nearby country j with a high clout. An additive specification would not capture such effects.

Foreign susceptibility of a country relates to economics, national culture, and demographics, which we capture in a vector of country-specific variables W_i. To ensure that θ_i is positive, we specify θ_i as

$$\theta_i = \exp(\delta' W_i), \tag{7}$$

where the parameter vector δ measures the importance of economic, cultural and demographic characteristics to the country's foreign susceptibility.

For clout, we consider a similar specification:

$$\rho_i = \exp(\kappa' U_i). \tag{8}$$

Note that to be able to identify α_0, α_1, δ, and κ we cannot include a constant in W_i or U_i.

We relate the weights π_{ij} to economic, cultural, and geographic distance measures, denoted by X_{ij}, as follows:

$$\pi_{ij} = \begin{cases} 0 & i = j \\ \dfrac{\exp(\gamma' X_{ij})}{\sum_{l=1, l\neq i}^{I} \exp(\gamma' X_{il})} & i \neq j. \end{cases} \tag{9}$$

We expect that $\gamma < 0$, i.e. a larger distance results in a smaller weight. Some variables may be reverse-scaled, for example a dummy variable that indicates whether two countries are neighbors. For such variables, we expect $\gamma > 0$. Note that if $\gamma = 0$, all π_{ij} ($i \neq j$) will be equal to $1/(I-1)$.

Note that through the normalization in Equation 9 we restrict that $\pi_{i1} + \pi_{i2} + \ldots + \pi_{iJ} = 1$. Thus, we ensure that the total spill-over effect is measured by α_0 and α_1 and that π_{ij} will not be equal to π_{ji}. The latter is not a limitation of our model, but a logical consequence of the normalization of the weights. The relative weight π_i indicates how the total foreign influence on country i is *distributed* across all countries. This weight is not necessarily symmetric. To explain this point further, let us consider the following hypothetical situation. Suppose there is a continent of four countries and one island far off the coast of the continent. Furthermore, suppose that only the geographic distance is important. The weight of the island for any of the four countries on the continent is likely to be small. However, for the island country other countries are all far away and the weight of each of these countries will be substantial. This small example shows that the normalization is essential to be able to isolate the effect of the presence of many close-by countries from the susceptibility of a country.[3]

In principle, the same variables may enter W (susceptibility), U (clout), X (distance), and Z (direct country effect). For example, the log of GDP will enter all four concepts. Such specification will not cause multicollinearity or identification problems, as they all affect the takeoff probability differently. Regarding identification, consider the influence of country A on country B, and suppose we use log GDP as the only country characteristic, for the sake of exposition. The GDP of country A may affect the clout of A, while the GDP of B may affect the susceptibility of B. The *absolute* difference between the GDPs – economic distance – may affect the weight of the influence between A and B. The influence of A on B is therefore related to log GDP_A (clout), log GDP_B (susceptibility), and $|\log GDP_A - \log GDP_B|$ (distance). The fact that our distance measure $|\log GDP_A - \log GDP_B|$ is an absolute value, and therefore not linearly dependent on log GDP_A (clout) and log GDP_B (susceptibility), provides identification. Our approach can be compared to a hierarchical model where the same variable is used to capture differences in a number of parameters. Examples of such models are widespread in the marketing literature (see e.g. Fok et al. 2006; Montgomery 1997).

Of course, the typical problem of multicollinearity among the country characteristics themselves may still remain. In the empirical section, we will use the statistic by Belsley, Kuh, and Welsch (1980), also known as the condition index method, to test for this and find that our estimation is not plagued by harmful multicollinearity.

We estimate the model parameters using maximum likelihood. Denote $y_{ikt} = 0$ if takeoff has not occurred for product k in country i at time t, and $y_{ikt} = 1$ if takeoff has occurred. Furthermore, let $L_{ik} = \min(T_{ik}, T)$, that is, L_{ik} is the year of takeoff in case this is observed, and the end of the dataset in case takeoff is not observed. The likelihood can now be written as

$$L = \prod_{i=1}^{I}\prod_{k=1}^{K}\prod_{t=T^0_{ik}}^{L_{ik}}(1-\Pr[T_{ik}=t \mid T_{ik}>t-1, T^0_{ik}\le t])^{1-y_{ikt}}\Pr[T_{ik}=t \mid T_{ik}>t-1, T^0_{ik}\le t]^{y_{ikt}}. \quad (10)$$

Note that possible right-censoring is incorporated in this model specification. The log of the likelihood in Equation 10 can straightforwardly be maximized over the parameter space. To avoid ending up with a local optimum we perform the maximization a large number of times, each time with different, random, starting values. We have used Ox 4.04 (Doornik 2002) to this end. Standard errors can easily be obtained using the Hessian of the log likelihood.

DATA

Data Collection Procedures

We gathered penetration data for eight products (CD players, PCs, video cameras, digital cameras, mobile phones, internet access, ISDN, and DVD players) across 55 countries worldwide. For Internet access and mobile phones, we use population penetration, because multiple persons in one household typically have access to the Internet, and possess a mobile phone. For all other products, we use penetration data at the household level, as they typically are considered to be household products, especially early in the life cycle.

Our database covers annual data from the period 1977-2004. Since the eight products are launched at different times during this period, the start of the data set differs across these products (CD players: 1982, PCs: 1981, video cameras: 1977, digital cameras: 1998, mobile phones: 1980, Internet access: 1990, ISDN: 1989, and DVD players: 1998).

We collected the penetration data from a number of sources, including Euromonitor, International Telecommunications Union, the World Bank, and the OECD. We used Euromonitor as the main source for our data. However, for some product-country combinations (e.g. Internet in Finland), data for earlier years were available in one of the other mentioned sources. Since we needed data starting from the launch year, for those cases where earlier years were available, we decided to merge the Euromonitor data with the data from one of the other sources. We only merged those data series when the remainder of the time series was highly correlated or even identical.

To ensure that we have data from the year of introduction, we also collected data on launch years from external, secondary sources, such as books, company reports, and articles in newspapers and scientific journals. Consistent with Tellis, Stremersch and Yin (2003), we included all product-country combinations for which: (i) the precise launch year is known and we have data available from that launch year, or (ii) the precise launch year is unknown, but the penetration in the first year of our data is less than 0.5%. We dropped all other series to avoid left-truncation bias. In total, the sample we use contains 308 product-country combinations.

Data on the independent variables were gathered from multiple, publicly available, sources, such as the United Nations Statistical Yearbook, the CIA World Factbook, World Development Indicators, U.S. Census Bureau, Euromonitor online, Hofstede (2001), and various websites (e.g. for capital distances: http://www.wcrl.ars.usda.gov/cec/java/capitals.htm).

Measures

We first discuss the measures we employ for the dependent variable, after which we turn to our measures for the independent variables. Note that in principle one could use complete time series for the independent variables. However, complete time series data is lacking for many developing countries. Therefore, for these variables we will only use the average over time, not to introduce any bias stemming from a different treatment of developed and developing countries.

Dependent variable. The dependent variable in our model is the occurrence of takeoff for a new product at a particular point in time. We identify takeoff using the same methodology as Tellis, Stremersch and Yin (2003). This methodology specifies a threshold function that plots the growth rate of sales versus market penetration, and identifies takeoff as the first year a product's growth in sales crosses this threshold. This threshold for takeoff varies by the base level of penetration. When the base level of penetration is small, a relatively large percentage increase in sales may occur without signaling takeoff, while in case of a large base level of penetration, takeoff may occur at a relatively small percentage increase in sales.

Tellis, Stremersch and Yin (2003) specified the threshold function used for takeoff identification heuristically. They iterated between identifying takeoff years, based on a threshold function, and visual identification. The threshold rule they retained in the end was the one that provided the best fit with visual identification of takeoff times. While its metric properties have not been inventoried, it performs well empirically. Since we have penetration data instead of sales data, we evaluate the growth in penetration (rather than the growth in sales), accounting for the base level of penetration. Since takeoff occurs early in the life cycle, when few replacements take place, this adaptation should not have major consequences. By definition, takeoff can only occur once in a product's life.

Figure 2 provides an example of the application of the threshold rule using data on the penetration of digital cameras in Italy. The upper part of the figure shows the cumulative penetration of digital cameras in Italy, while the lower part shows the threshold rule and the sales growth percentage. In this case, 2001 is the first year that the growth crosses the threshold, and is therefore determined as the year of takeoff. The threshold rule we use is simple, has predictive validity, and is interpersonally certifiable (Tellis, Stremersch and Yin 2003). Below we will also consider other measures as a robustness check.

--- Insert Figure 2 about here ---

Independent variables. Recall that in our model the cross-country influence of introduction and takeoff is affected by (i) *foreign susceptibility*, (ii) *foreign clout*, and (iii) *inter-country distances.* For each, we use a number of indicators, which we explain next. We normalize all measures (mean = 0; standard deviation = 1), to allow effect comparison.

The economic indicators we use are operationalized as follows. Economic wealth is measured by the log of GDP per capita in U.S. dollars. Economic trade is measured by the log of import divided by GDP as an indicator of susceptibility and the log of export divided by GDP as an indicator of clout. We use the GINI index at the household level and based on net income, to capture income inequality (Tellis, Stremersch and Yin 2003). We operationalize the effect of tourism on foreign susceptibility by the number of tourist arrivals, divided by the number of inhabitants of the visited country (Gatignon, Eliashberg and Robertson 1989; Helsen, Jedidi and DeSarbo 1993). We operationalize the effect of tourism on foreign clout by the log of tourist expenditures (in U.S. dollars) in foreign countries. The measure for uncertainty avoidance is taken from Hofstede (2001). The demographic variables are population density, operationalized as the number of people per square kilometer, and population size, operationalized as the log of the number of inhabitants.

We measure geographic distance by the log of the distance (in kilometers) between the capital cities of countries (Ganesh, Kumar and Subramanian 1997) and by a dummy variable which indicates if two countries are neighbors. We measure economic distance by the absolute value of the difference in the log of GDP per capita between countries (cfr. Mitra and Golder 2002). We use the absolute difference between the uncertainty avoidance index of countries as a measure for the *cultural distance* between countries.[4]

We have checked the independent variables for potential multicollinearity using the Belsley, Kuh, and Welsch (1980) statistic. The BKW statistic equals 8.31, which is below the commonly used threshold value of 30. Thus, collinearity among regressors in our model does not threaten our conclusions.

EMPIRICAL RESULTS

Descriptives of Time-to-Takeoff

In Tables 1, 2 and 3, we present summary statistics on time-to-takeoff for all products, countries and regions in our sample. Each table presents: the number of cases (column 2), the number of right-censored cases for which we did not observe any takeoff yet (column 3), the average time-to-takeoff based on the raw data for the cases where takeoff has already occurred (column 4) and the expected time-to-takeoff (column 5). The latter is calculated using a discrete-time, duration model with the same baseline hazard as specified in (5) and product-, country- or region-fixed effects. Given the model parameters, the expected time-to-takeoff can easily be obtained from the implied takeoff probabilities. Note that in this metric right-censoring is automatically accounted for. We see that, in case of zero right-censored cases, the expected time-to-takeoff according to the simple model is very close to the average time-to-takeoff in column 4. In all other cases, we find a longer time-to-takeoff.

On average, the time-to-takeoff across all product/country combinations for which takeoff has already occurred is 4.46 years. However, large differences exist in the time-to-takeoff across product categories, countries and regions. Columns 4 and 5 of Table 1 show that the average time-to-takeoff is shortest for DVD players and longest for video cameras.

--- Insert Table 1 about here ---

If we look at the cross-country variation in time-to-takeoff in Table 2, we see large differences, with the time-to-takeoff varying from on average 1.50 years for Switzerland to on average 9.33 years for Indonesia (see column 4 of Table 2). Other countries where the products in our sample take off fast are: Switzerland, the Nordic countries, New Zealand, the U.K., Hong Kong and the U.S. We come to similar conclusions if we account for right-censoring (see column 5 of Table 2).

--- Insert Table 2 about here ---

Table 3 presents the descriptive statistics across regions. The West European and the North American countries show the shortest time-to-takeoff, while the countries in South America, Africa, the Middle East and Australasia are lagging behind with respect to time-to-takeoff.

--- Insert Table 3 about here ---

Model Fit

We next estimate the parameters of the model we specified above. First, we evaluate the fit of the model. Table 4 compares our model to various restricted models, based on the log likelihood and likelihood ratio tests. The simplest model we consider here only contains the baseline hazard (model 0). Further, we compare our model with a baseline hazard model including product fixed effects (model 1), a baseline hazard model including both product fixed effects and country characteristics (model 2a), a baseline hazard model including product fixed effects and introduction and takeoff effects (model 2b), a baseline hazard model including product fixed effects, introduction and takeoff effects and country characteristics (model 3). The latter model does not account for variation in spill-over effects according to between-country distance, clout and susceptibility as our model does (model 5). The models 4a to 4f extend model 3 by including either one (model 4a, 4b and 4c) or two of these concepts (model 4d, 4e and 4f). Based on these fit comparisons in Table 4, we can conclude that our model with the combined effects of susceptibility, clout and the weights (model 5), is preferred over any other model we estimated.

--- Insert Table 4 about here ---

Using the results in Table 4 we can also calculate some absolute measures for the fit of our final model. As we have a duration model, standard measures such as the R^2 are not well defined. In the literature, one commonly judges the fit of the model relative to the fit of a very basic model. The performance relative to such a simple model can be measured using the likelihood ratio index ($1 - \log L_{\text{final}} / \log L_{\text{simple}}$) or a pseudo R^2 (Cox and Snell 1989; Magee

1990). If we take the model with only a baseline hazard (model 0) as the basis for comparison, we obtain a likelihood ratio index of 0.22 and a pseudo R^2 of 0.64.

As a further model validity check, we also compare the fit of our model with a model similar to that developed by Tellis, Stremersch, and Yin (2003). In this model, we account for the number of prior takeoffs in foreign countries, include work/fun product dummies and the introduction year of the product. Furthermore, we include all country characteristics used in our model as explanatory variables. As this model is not nested in our model we compare both models based on information criteria. The information criteria (AIC, HQ, BIC, and CAIC) all indicate that our model (log L = -556.69, 35 parameters) outperforms the model of Tellis, Stremersch and Yin (2003) (log L = -624.79, 16 parameters). This further substantiates our claim that clout, susceptibility and country distances are important factors in global spill-over.

Parameter Estimates

We present the parameter estimates in Table 5, which shows the influence of foreign introductions and takeoffs, as well as the role of foreign susceptibility, foreign clout, inter-country distance, the direct effect of country characteristics, the effect of the launch year, the product fixed effects and the effect of time. The significant effects are also shown in Figure 1, marked with an asterisk. The results show that the takeoff probability of a new product in a country increases due to foreign takeoffs ($\hat{\alpha}_1 = 4.099$; $p < .01$), but not due to foreign introductions ($\hat{\alpha}_0 = .136$; $p > .10$)[5]. The latter finding may be due to the fact that before takeoff, sales are at a very low level by which they do not generate noticeable spill-over effects, nor in word-of-mouth between adopters and potential adopters, nor between channels, across countries.

--- Insert Table 5 about here ---

Foreign susceptibility is affected by economics, both by wealth ($\hat{\delta}_1$ = -.419; $p < .10$) and by tourist arrivals ($\hat{\delta}_3$ = .145; $p < .05$), but not by economic trade ($\hat{\delta}_2$ = -.026; $p > .10$), demography – although only by population density ($\hat{\delta}_6$ = .169; $p < .01$) and not by population size ($\hat{\delta}_5$ = .016; $p > .10$). The signs of these effects are as expected. It is not affected by the cultural trait of uncertainty avoidance ($\hat{\delta}_4$ = .048; $p > .10$).

The foreign clout of countries is determined by economic variables, i.e. a country's economic wealth ($\hat{\kappa}_1$ = 1.070; $p < .01$) and a country's economic trade ($\hat{\kappa}_2$ = .954; $p < .01$), as well as the size of the country ($\hat{\kappa}_5$ = 1.035; $p < .01$). Again, the signs of these effects are as expected. Foreign clout is not affected by the cultural trait of uncertainty avoidance ($\hat{\kappa}_4$ = .217; $p > .10$). It is also not affected by population density ($\hat{\kappa}_6$ = -.009; $p > .10$) and tourist expenditures ($\hat{\kappa}_3$ = -.199; $p > .10$).

The inter-country distance dimensions, geography ($\hat{\gamma}_3$ = -.492; $p < .01$) and economics ($\hat{\gamma}_1$ = -.792; $p < .05$), have the negative signs we expected. Neighboring countries do not necessarily exert more influence on one another ($\hat{\gamma}_4$ = -.197; $p > .10$), holding everything else in the model (such as distance between capitals) constant. Distance in the cultural value of uncertainty avoidance does not appear to be a significant component of inter-country distance ($\hat{\gamma}_2$ = -.135; $p > .10$).

As to the direct effects of country characteristics, we find that higher economic wealth ($\hat{\beta}_1$ = 1.708; $p < .01$) and higher income inequality ($\hat{\beta}_2$ = .332; $p < .01$) may lead to faster takeoff. While economic wealth shows the effect we predicted – new products takeoff faster in wealthy countries, as affordability is less of an issue – we find that the effect for income inequality (Gini) is opposite to what we had expected. Possibly, the concentration of wealth in the hands of the most innovative consumers affects takeoff probability more positively, than spreading this wealth more thinly across the entire population. Uncertainty avoidance ($\hat{\beta}_3$ = -.418; $p < .05$) and population density ($\hat{\beta}_5$ = -1.321; $p < .01$) are found to negatively affect takeoff probability, while population size ($\hat{\beta}_4$ = .015; $p > .10$) has no significant effect on takeoff probability.

These findings are consistent with prior literature, except for the strong significance of the economic characteristics of countries (e.g. Tellis, Stremersch and Yin (2003) found economic differences across countries not to affect time-to-takeoff). The reason may be that our sample includes many developing countries, while previous studies have not, and that consequently there is more variance in our data on economics than in data sets employed by prior research. Moreover, Burgess and Steenkamp (2006) argue that economic factors may be especially important in emerging markets, because these countries are more resource constrained. Resource constraints may be a prime driver of international takeoff, as takeoff itself hinges on affordability (Golder and Tellis 1997).

Table 5 also presents the effect of the launch year, the product fixed effects and the effect of time. We summarize the latter by depicting the baseline hazard in Figure 3. All else being equal, the (conditional) probability of takeoff first increases until about 3 years after introduction, after which it gradually decreases. This pattern is similar to the pattern found by Tellis, Stremersch and Yin (2003), who also found the probability of takeoff to peak at 3 years.

--- Insert Figure 3 about here ---

Influence of Other Dimensions of National Culture

In our model, we only included one dimension of national culture, i.e. uncertainty avoidance, as was explained in the theoretical section of this paper. To test whether the other dimensions of Hofstede's national culture framework affect our conclusions, we estimate our model using each one of the cultural variables separately. We take the model in Table 5 as the basis. Furthermore, we consider a model without any cultural variable (LL = -565.27, 31 parameters). This allows us to test for the significance of each of the cultural variables. For efficiency reasons and the fact that the cultural variables are highly correlated, we do not start with a model that includes all cultural variables. Comparing the models including only one of the cultural dimensions with the model without any cultural variable shows that Uncertainty Avoidance is the only significant factor at the conventional $p < .05$ significance level (LL = -556.69, 35 parameters, $p = .002$). Individualism (LL = -562.61, 35 parameters, $p = .256$), Masculinity (LL = -562.88, 35 parameters, $p = .311$) and Power Distance (LL = -561.26, 35 parameters, $p = .091$) do not add to the explanatory power of the model. As power distance is marginally significant, we also estimate a model including both uncertainty avoidance and power distance, but this model does not explain more of the variation in the data than our model with only uncertainty avoidance ($p = .300$). The same applies to the other dimensions of national culture, such as individualism and masculinity. Therefore, our specification with uncertainty avoidance as the only dimension of national culture is found to be empirically valid.

Robustness

We checked the robustness of our results and the model's performance in many ways. First, we considered other early growth metrics, such as time to 3% (approximately, the mean penetration level at takeoff, as shown by Golder and Tellis (1997)) and 10% penetration (as used by Van den Bulte and Stremersch (2006) as an early growth metric). Second, we estimated our model parameters after randomly deleting countries from the data set. Third, we removed the product DVD, estimated the parameters for both models and next calculated the predictive likelihood of both models on the DVD category. In the latter comparison we obtain a log likelihood of -49.09 for our model, and for the model by Tellis, Stremersch and Yin we obtain -52.99.

Foreign Susceptibility and Foreign Clout

From the estimated parameters, we can calculate the *foreign susceptibility* as well as the *foreign clout* for every country (see Table 6). Table 6 includes: the country (column 1), its foreign susceptibility (column 2), its rank on foreign susceptibility (column 3), its foreign clout (column 4), and its rank with respect to foreign clout (column 5). Countries that are most susceptible to foreign influences are mainly Asian countries, such as Singapore, Vietnam, India, Pakistan and China, while the Nordic countries and the U.S. show the lowest levels of foreign susceptibility. Three West-European countries are in the top 5 with respect to clout, i.e. Belgium, Germany, and The Netherlands. Hong Kong is ranked second and Taiwan is ranked fourth, while the U.S. ranks only 13th. The fact that Belgium and the Netherlands have a strong clout may appear surprising at first, but both countries have among the highest import and export ratios in the world, and are generally also influential because of their centrality, both politically (founding countries of E.U.) and economically (trade and logistic nodes and large harbors). In general, Table 6 shows that countries ranked high on clout are ranked low on susceptibility and vice versa (correlation = -.50, $p < .001$), indicating strong asymmetry in influences.

--- Insert Table 6 about here ---

Although a clear pattern of clout and susceptibility emerges, one needs to be cautious in interpreting our results, given the uncertainty that surrounds our estimates. First of all, the measure for clout relates to the *potential* clout, not the *actual* clout. Thus, it depends upon when takeoff occurs in a country as well, whether a country can have an impact. E.g. for Belgium we find a high *potential* clout (ranked 1). The *actual* impact of Belgium will, however, be limited, since the average time-to-takeoff for Belgium is only 5.67 years. Consequently, the takeoffs in Belgium will only show cross-country spill-over effects for countries where the takeoff occurs late. Second, susceptibility and clout are defined locally, i.e. a country with a large clout will still only influence local countries, due to the significant moderating effect of distance. This implies that cross-country spill-over effects occur mainly between countries close to one another in both geographic and economic distance. Third, our estimation of clout and susceptibility is mostly affected by countries with 'average' values on the predictors and not so much by countries with 'extreme' values. Therefore, our estimation approach will more accurately represent a country that has "average" values on predictors, than countries with "extreme" values on predictors. For instance, Belgium and The Netherlands may be such countries, because they have extremely high import and export numbers, relative to their size.

Bivariate Cross-Country Influences Visualized

Our model allows us to visualize bivariate cross-country influences. Figure 4 shows graphical representations of the cross-country effects for three country pairs, that is, the influence of the U.S. on Canada, the influence of the U.S. on the U.K., and the influence of France on Belgium. The first bivariate pair is a typical neighbor pattern in North America, while the third one is such a pair in Europe. The second represents a cross-continent spill-over, i.e. the influence of a takeoff in the U.S. on the takeoff in the U.K. Figure 4 only includes the cross-country effects of foreign takeoffs, since the introduction effect is insignificant, and thus shows how the conditional takeoff probability of a new product in the focal country would change given that takeoff takes place in a foreign country. On the horizontal axis of the graph, we give the takeoff probability for a focal country given that no foreign takeoff occurred. On the vertical axis, we give the takeoff probability for that country given that foreign takeoff did occur. The solid line indicates the baseline case of no cross-country spill-over.

--- Insert Figure 4 about here ---

Of the three examples in Figure 4, the effect size appears to be largest for the European pair of countries. A takeoff in France triggers an increase of almost 50% in the takeoff probability in Belgium, as compared to when there was no such takeoff in France (evaluated at 45% probability of takeoff without a French takeoff). Belgium is an interesting case, as it shares borders with France, Germany and the Netherlands, with which it also shares languages at these borders (French in the South of Belgium, Dutch in the North and German in the East). Our findings hint that Belgium is mostly influenced by France, rather than the Netherlands or Germany, in new product takeoff (full results available from the authors upon request).

Figure 4 further shows the substantial influence that a takeoff in the U.S. has on the takeoff probability in Canada. If the takeoff probability in Canada without takeoff in the U.S. is

45%, then the probability when the U.S. has shown takeoff increases to 56%. Thus, a takeoff in the U.S. gives an increase in the takeoff probability in Canada of 24%, which is economically significant. In comparison, Figure 4 shows that a takeoff in the U.S. only increases the probability of takeoff in the U.K. to 47%, when that probability without a U.S. takeoff is at 45%. Thus, a U.S. takeoff only increases the probability of takeoff in the U.K. with 5%, which is a much smaller increase as compared to its influence on a Canadian takeoff.

DISCUSSION

Implications

This study has important implications for public policy administrators and managers. These implications should, however, be interpreted with caution, because our model is descriptive (correlations) rather than normative (causation). And, moreover, the empirical results are conditional on the countries in our sample.

For public policy administrators, the comparison between countries in: (1) average time-to-takeoff, as a demand-side measure for innovativeness, (2) foreign susceptibility, and (3) foreign clout, can provide valuable input in regulation decisions on the stimulation of innovation adoption and international economic policy. For instance, our takeoff statistics can be used as demand side innovativeness measures, in the same manner the European Commission (2003) has done with the earlier results of Tellis, Stremersch and Yin (2003). For instance, in the context of its innovation stimulation policy, the E.U. may compare the European region with the U.S. or Asia, as well as compare European member states with one another.

Knowledge on the role of susceptibility, clout, and inter-country distance at the country level, is valuable for national public policy administrators. If susceptibility is weak and public policy administrators wish to stimulate takeoff of a new product – which is often the case in digital technologies (such as broadband) – they should acknowledge that foreign takeoffs will not aid that much. They need to promote the new product more aggressively, without depending upon foreign influence. If foreign susceptibility is strong, showcasing foreign acceptance – preferably from a country strong on clout and close in terms of inter-country distance – of the new product may be highly effective to increase acceptance.

For managers, our results also yield many useful insights. First, our results show dramatic differences in time-to-takeoff across regions and even across countries within these regions. The most innovative regions are West Europe and North America, followed by Central and East Europe. Within these regions, however, we also found large differences in time-to-takeoff. In West Europe, for example, time-to-takeoff ranges on average from 1.5 years for Switzerland to 5.67 years in Belgium. If one wants to follow the advice of Tellis, Stremersch and Yin (2003) to first launch in the most innovative country, and then trickle down to other countries with longer times to takeoff, our study aids in identifying "fast" and "slow" countries. The descriptives we generated on global takeoff may also inform managers on withdrawal or repositioning decisions, for instance, when a product takes longer to take off than expected (given the patterns we found).

Second, we have shown the importance of taking into account cross-country spill-over in estimating takeoff probability. Consequently, when launching a new product, international marketing managers cannot consider the new product launch in individual countries as separate managerial decisions, but they should treat them as interdependent processes, in line with the arguments by Putsis et al. (1997) and Van Everdingen, Aghina and Fok (2005). It also means that the ideal introduction country would not only be fast in time-to-takeoff, but also have a strong influence (clout) on other (susceptible) countries. Worldwide, Hong Kong and the U.S. are interesting candidate countries to start launching a new product, both showing a fast time-to-takeoff, and at the same time ranking high on foreign clout (the 2nd and 13th place respectively). Taking into account the market potential of these countries, which can be determined by the market size and the expected penetration ceiling (Van Everdingen, Aghina and Fok 2005), the U.S., given their large population size, seems to be the most promising country to enter first. Interesting to note is that New Zealand and Australia both show a fast time-to-takeoff, 2.0 and 2.8 years respectively. These countries rank, however, very low in both foreign susceptibility and clout. New Zealand is also one of the smallest countries in our sample, implying a limited market potential.

More in particular, in Europe, interesting countries to start the launch of a new product may be Germany, France, the United Kingdom and Switzerland. On the one hand, Switzerland and the United Kingdom show a fast time-to-takeoff (1.5 and 2.0 years respectively), but a modest influence on other countries, ranked at the 18th and the 14th position. On the other hand, Germany and France show somewhat longer times-to-takeoff, being 3.3 and 3.8 years, but appear to be very influential on other countries, ranked at the 3rd and the 6th position in our sample of countries. Except for Switzerland, which is one of the smallest countries in the dataset, these countries also have large population sizes, and are thus very attractive as countries to start launching a new product in. Although the Scandinavian countries Norway, Finland and Sweden, countries that were heavily emphasized by Tellis, Stremersch and Yin (2003) for first launch decisions, show a fast takeoff, they show only modest foreign clout, implying a limited role in cross-country spill-over. Thus, only looking at time-to-takeoff without taking into account the distance between countries and their susceptibility and clout in cross-country spill-over, as Tellis, Stremersch and Yin (2003) did, leads to less detailed insights.

Countries characterized by a relatively long time-to-takeoff and limited foreign clout, but high foreign susceptibility are good candidate countries for a late product launch. Examples are Singapore, Vietnam, India, Indonesia, Pakistan, and China. Once these countries are penetrated, however, the market potential is huge, given their large population sizes, especially in the cases of India, Pakistan and China.

Limitations

Given the complexity of the process and the parsimony we wish to achieve in our model development, this study has some limitations that may trigger future research.

First, we do not have data on marketing variables, such as advertising and pricing. Heavy advertising or lower prices in particular countries may have a positive influence on the time-to-takeoff in these countries. However, due to a lack of data, we were unable to assess the role of these variables in triggering takeoff, which also means that our model cannot distinguish between supply and demand factors. Thus the cross-country spill-over effects in takeoff we identify, may be driven by both supply (e.g. suppliers in country 1 mimicking suppliers in country 2) and demand (e.g. adopters of one country influencing adopters in another country) factors, without us being able to discern the two. As a consequence, our model is a purely descriptive model.

Second, we only investigate successful products – i.e. products that have taken off in a large enough number of countries. This may lead to a success bias in our estimates. While it would be fruitful for future research to address this issue, it is a priori not clear how it would bias our findings and data on failed products are extremely difficult to obtain on a global scale.

Third, as we control for introduction timing in the model – through the influence of foreign introductions – there is a danger of endogeneity. For instance, companies may choose their international entry timing based on expectations on the time-to-takeoff of the countries they consider entering. We believe this danger is in theory important, but perhaps of limited practical relevance in our case. Prior research has shown that introduction patterns in practice are not (yet) driven by time-to-takeoff expectations (Tellis, Stremersch and Yin 2003) nor, in our experience, by cross-country spill-over.

Fourth, like all studies on international new product growth, our study cannot include all factors that may characterize a country. Thus, spurious correlation is always around the corner in this type of studies. However, we believe the danger of spurious correlation in the spill-over effects is limited. We include the direct effect of many country characteristics that may determine takeoff. Thus, for instance infrastructural differences or variation in regulatory regimes (Stremersch and Lemmens 2008) would be picked up by this direct effect vector and not by the cross-country effects. Obviously, the number of variables we can pick up in the direct effects of country characteristics is limited (e.g. infrastructure in our model would be very much picked up by GDP) and thus, a small risk exists that we have omitted variables in the country characteristics, which should lead to caution in interpretation.

Most importantly, we illustrated how to specify a model that accounts for global spill-over effects of introduction and takeoff on new product takeoff. We also found patterns and effects that are credible. Thus, this paper provides a good first step towards the further exploration of this phenomenon.

REFERENCES

Albuquerque, Paulo, Bart J. Bronnenberg, and Charles J. Corbett (2007), "A Spatiotemporal Analysis of the Global Diffusion of ISO 9000 and ISO 14000 Certification," *Management Science*, 53 (3), 451-68.

Alesina, Alberto and Romain Wacziarg (1998), "Openness, Country size and Government," *Journal of Public Economics*, 69 (3), 305-21.

---, and Enrico Spolaore (1997), "On the Number and Size of Nations," *The Quarterly Journal of Economics,* 112 (4), 1027-56.

Agarwal, Rajshree and Barry L. Bayus (2002), "The Market Evolution and Sales Takeoff of Product Innovations," *Management Science,* 48 (8), 1024-41.

Beise, Marian (2004), "Lead Markets: Country-specific Drivers of the Global Diffusion of Innovations," *Research Policy,* 33 (6-7), 997-1018.

Belsley, David A., Edwin Kuh, and Roy E. Welsch (1980), *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*. New York: John Wiley and Sons.

Burgess, Steven M. and Jan-Benedict E.M. Steenkamp (2006), "Marketing Renaissance: How Research in Emerging Markets Advances Marketing Science and Practice," *International Journal of Research in Marketing*, 23 (4), 337-56.

Chandrasekaran, Deepa and Gerard J. Tellis (2008), "The Global Takeoff of New Products: Culture, Wealth, or Vanishing Differences?" *Marketing Science,* forthcoming.

Cox, David and E. Joyce Snell (1989), *The Analysis of Binary Data*. 2nd ed. London: Chapman & Hall.

Dekimpe, Marnik G., Philip M. Parker, and Miklos Sarvary (1998), “Staged Estimation of International Diffusion Models: An Application to Global Cellular Telephone Adoption,” *Technological Forecasting and Social Change*, 57 (1-2), 105-32.

---, ---, and --- (2000a), ““Globalization”: Modeling Technology Adoption Timing across Countries,” *Technological Forecasting and Social Change,* 63 (1), 25-42.

---, ---, and --- (2000b), “Multimarket and Global Diffusion,” In: V. Mahajan, E. Muller and Y. Wind (eds.), *New-Product Diffusion Models*, 49-73.

---, ---, and --- (2000c), “Global Diffusion of Technological Innovations: A Coupled-Hazard Approach,” *Journal of Marketing Research*, 37 (1), 47-59.

Doornik, Jurgen A. (2002), *Object-Oriented Matrix Programming Using Ox*. 3rd ed. London: Timberlake Consultants Press and Oxford: www.doornik.com.

Douglas, Susan P. and Yoram Wind (1987), “The Myth of Globalization,” *Columbia Journal of World Business,* 22 (4), 19-30.

European Commission (2003), *2003 European Innovation Scoreboard: Technical Paper No 5, National Innovation System Indicators.*

Fok, Dennis, Csilla Horváth, Richard Paap, and Philip Hans Franses (2006), “A Hierarchical Bayes Error Correction Model to Explain Dynamic Effects of Price Changes,” *Journal of Marketing Research*, 43 (3), 443-61.

Ganesh, Jaishankar and V. Kumar (1996), “Capturing the Cross-National Learning Effect: an Analysis of an Industrial Technology Diffusion,” *Journal of the Academy of Marketing Science,* 24 (4), 328-37.

---, --- and Velavan Subramanian (1997), “Learning Effect in Multinational Diffusion of Consumer Durables: An Exploratory Investigation,” *Journal of the Academy of Marketing Science*, 25 (3), 214-28.

Garber, Tal, Jacob Goldenberg, Barak Libai, and Eitan Muller (2004), “From Density to Destiny: Using Spatial Dimension of Sales Data for Early Prediction of New Product Success,” *Marketing Science*, 23 (3), 419-28.

Gatignon, Hubert, Jehoshua Eliashberg, and Thomas S. Robertson (1989), “Modeling Multinational Diffusion Patterns: An Efficient Methodology,” *Marketing Science,* 8 (3), 231-47.

Golder, Peter N. and Gerard J. Tellis (1997), “Will It Ever Fly? Modeling the Takeoff of Really New Consumer Durables,” *Marketing Science,* 16 (3), 256-70.

--- and --- (2004), “Growing, Growing, Gone: Cascades, Diffusion and Turning Points in the Product Life Cycle,” *Marketing Science*, 23 (2), 207-18.

Helsen, Kristiaan, Kamel Jedidi, and Wayne S. DeSarbo (1993), “A New Approach to Country Segmentation Utilizing Multinational Diffusion Patterns,” *Journal of Marketing,* 57 (October), 60-71.

Hofstede, Geert (2001), *Culture’s Consequences: Comparing Values, Behaviors, Institutions, and Organizations Across Nations.* 2nd edition. Beverly Hills: Sage.

---, and Gert-Jan Hofstede (2004), *Cultures and Organizations: Software of the Mind.* New York: McGraw-Hill

Kalish, Shlomo, Vijay Mahajan, and Eitan Muller (1995), “Waterfall and Sprinkler New-Product Strategies in Competitive Global Markets,” *International Journal of Research in Marketing*, 12 (2), 105-19.

Kamakura, Wagner A. and Gary J. Russell (1989), "A Probabilistic Choice Model for Market Segmentation and Elasticity Structure," *Journal of Marketing Research,* 26 (November), 379-90.

Kumar, V. and Trichy V. Krishnan (2002), "Multinational Diffusion Models: An Alternative Framework," *Marketing Science*, 21 (3), 318-30.

Libai, Barak, Eitan Muller, and Renana Peres (2005), "The Role of Seeding in Multi-Market Entry," *International Journal of Research in Marketing*, 22 (4), 375-93.

Lemmens, Aurelie, Christophe Croux, and Marnik Dekimpe (2007), "Consumer Confidence in Europe : United in Diversity?" *International Journal of Research in Marketing*, 24 (2), 113-27.

Magee, Lonnie (1990), "R^2 Measures Based on Wald and Likelihood Ratio Joint Significance Tests," *The American Statistician*, 44 (3), 250-3.

Mahajan, Vijay and Robert A. Peterson (1979), "Integrating Time and Space in Technological Substitution Models," *Technological Forecasting and Social Change,* 14 (3), 231-41.

Mitra, Debanjan and Peter Golder (2002), "Whose Culture Matters? Near-Market Knowledge and Its Impact on Foreign Market Entry Timing," *Journal of Marketing Research*, 39 (3), 350-65.

Montgomery, Alan L. (1997), "Creating Micro-Marketing Pricing Strategies Using Supermarket Scanner Data", *Marketing Science*, 16 (4), 315-37.

Putsis, William P. Jr., Sridhar Balasubramanian, Edward H. Kaplan, and Subrata K. Sen (1997), "Mixing Behavior in Cross-Country Diffusion," *Marketing Science*, 16 (4), 354-69.

Rogers, Everett M. (1995), *Diffusion of Innovations.* 4th edition. New York: The Free Press.

Spolaore, Enrico (2004), "Is Small Really So Ugly?" *World Trade Review*, 3 (3), 447-52.

Steenkamp, Jan-Benedict E.M., Frenkel ter Hofstede, and Michel Wedel (1999), "A Cross-National Investigation into the Individual and National Cultural Antecedents of Consumer Innovativeness," *Journal of Marketing*, 63 (2), 55-69.

Stremersch, Stefan and Aurélie Lemmens (2008), "Sales Growth of New Pharmaceuticals Across the Globe: The Role of Regulatory Regimes," *Marketing Science*, forthcoming.

--- and Gerard J. Tellis (2004),"Understanding and Managing International Growth of New Products," *International Journal of Research in Marketing*, 21 (4), 421-38.

---, ---, Philip Hans Franses, and Jeroen L.G. Binken (2007), "Indirect Network Effects in New Product Growth," *Journal of Marketing*, 71 (3), 52-74.

Takada, Hirokazu and Dipak Jain (1991), "Cross-National Analysis of Diffusion of Consumer Durable Goods in Pacific Rim Countries," *Journal of Marketing,* 55 (April), 48-54.

Talukdar, Debabrata, K. Sudhir, and Andrew Ainslie (2002), "Investigating New Product Diffusion Across Products and Countries," *Marketing Science*, 21 (1), 97-114.

Tellis, Gerard J., Stefan Stremersch, and Eden Yin (2003), "The International Takeoff of New Products: The Role of Economics, Culture and Country Innovativeness," *Marketing Science*, *22* (2), 188-208.

Van den Bulte, Christophe and Stefan Stremersch (2004), "Social Contagion and Income Heterogeneity in New Product Diffusion: A Meta-Analytic Test," *Marketing Science*, 23 (4), 530-44.

Van den Bulte, Christophe and Stefan Stremersch (2006), "Contrasting Early and Late New Product Diffusion: Speed across Time, Products and Countries," *working paper.*

Van Everdingen, Yvonne M., Wouter B. Aghina, and Dennis Fok (2005), “Forecasting Cross-Population Innovation Diffusion: a Bayesian Approach,” *International Journal of Research in Marketing*, 22 (3), 293-308.

Wuyts, Stefan, Stefan Stremersch, Christophe van den Bulte, and Philip Hans Franses (2004), “Vertical Marketing Systems for Complex Products: A Triadic Perspective,” *Journal of Marketing Research,* 41 (November), 479-87.

FOOTNOTES

[1] Although time-to-takeoff is the fundamental dependent variable in our study, in the discussion of the theory and in the econometric modeling it is easier to talk about the occurrence of the takeoff event. More formally, we will talk about the probability that takeoff takes place at a particular point in time given that takeoff did not occur yet. For readability, we will abbreviate this probability by "the probability of takeoff". Note that a variable that is said to have a positive effect on this probability will shorten the time-to-takeoff and will therefore have a negative effect on the time to takeoff.

[2] θ_i, ρ_j, and π_{ij} all relate to the influence of introduction and takeoff. This choice has a benefit (i.e. saving on the number of parameters), but also a drawback (i.e. one assumes foreign susceptibility, clout and inter-country distance to be the same for introduction and takeoff). Here, we opt for model parsimony. If one has rich data, with much variance, one may be able to relieve this constraint, but we were not able to do so in our database. Note that through α_0 and α_1 we do allow the net effect of foreign introduction and foreign takeoff to be different.

[3] In the data we use for the empirical section below, we do not observe all country/product pairs. For each product we observe a different set of countries. However, we have to define π_{ij} for all country pairs irrespective of the focal product. The sum in (9) is therefore always over the complete set of all countries.

[4] Some authors also use a composite index for cultural distance, which combines multiple Hofstede dimensions. We chose to only include uncertainty avoidance to remain consistent with the other components of the model and to make this effect easy to interpret.

[5] We have experimented with a model without the foreign introduction events ($\alpha_0 = 0$) and a model without foreign takeoffs ($\alpha_1 = 0$). The results for the former model are the same as the results in Table 5. In the model without foreign takeoffs, we still do not find any effect of foreign introductions. These findings show that our results are not affected by any multicollinearity between foreign takeoffs and foreign introductions.

Table 1

TIME-TO-TAKEOFF PER PRODUCT CATEGORY

Product	**Number of cases**	**Number of right-censored cases**	**Average time-to-takeoff**	**Expected time-to-takeoff***
CD player	40	0	3.93	3.95
Digital camera	29	13	2.81	5.26
DVD player	32	5	2.15	3.06
Internet	49	0	4.39	4.37
ISDN	36	10	4.38	7.13
Mobile phones	55	0	6.05	6.04
PC	29	1	2.89	3.33
Video camera	38	2	6.47	7.44
Total / weighted average	**308**	**31**	**4.46**	**5.16**

* The expected time-to-takeoff is calculated using a simplified version of our model. We estimate a discrete-time duration model with product specific intercepts and where the baseline hazard is specified as in (5).

Table 2

TIME-TO-TAKEOFF PER COUNTRY, INCREASING IN AVERAGE TIME-TO-TAKEOFF

Country	**Nr of cases**	**Nr of right censored cases**	**Average time-to-takeoff**	**Expected time-to-takeoff***
Switzerland	4	0	1.50	1.44
Norway	3	0	1.67	1.64
New Zealand	4	0	2.00	1.89
United Kingdom	5	0	2.00	2.01
Hong Kong, China	3	0	2.33	2.45
U.S.	6	0	2.50	2.49
Finland	7	0	2.57	2.54
Sweden	5	0	2.60	2.57
Australia	5	0	2.60	2.71
Portugal	7	0	2.71	2.64
Israel	7	0	2.71	2.70
Canada	5	0	2.80	2.81
South Africa	6	1	2.80	4.70
Austria	3	0	3.00	2.94
Taiwan	3	0	3.00	2.94
Greece	8	0	3.25	3.20
Germany	6	0	3.33	3.43
Malaysia	6	1	3.40	5.32
Denmark	4	0	3.50	3.47
South Korea	6	0	3.50	3.51
Slovenia	5	0	3.60	3.62
Estonia	6	0	3.83	3.73
France	6	0	3.83	3.99
Venezuela	6	0	4.00	4.01
Ireland	3	0	4.00	4.10
Czech Republic	6	1	4.00	4.46
Ecuador	5	1	4.00	5.93
Poland	6	0	4.17	4.12
Hungary	7	1	4.17	4.54
Italy	5	0	4.20	4.09
Russia	7	2	4.20	5.55
Netherlands	4	0	4.25	4.41
Bulgaria	6	2	4.25	5.76
Spain	6	0	4.67	4.72
Slovakia	7	1	4.67	4.91
Peru	4	1	4.67	8.08
Argentina	5	0	5.00	5.05
Japan	5	0	5.00	5.17
Mexico	6	0	5.17	5.10
Brazil	6	1	5.20	5.72
Belgium	4	1	5.67	6.51
Thailand	8	2	5.67	7.65
Vietnam	7	2	5.80	10.01
Croatia	5	0	6.00	5.83
Philippines	7	2	6.00	7.23
Romania	6	2	6.00	8.74
Turkey	6	1	6.20	7.11
Colombia	7	0	6.29	7.11
Singapore	4	0	6.50	6.51
Chile	5	0	7.60	7.68
China	8	1	7.86	8.19
Pakistan	5	1	8.00	9.00
Morocco	8	3	8.00	9.59
India	7	3	8.50	10.21
Indonesia	7	1	9.33	9.50
Total / weighted average	**308**	**31**	**4.46**	**5.24**

* The expected time-to-takeoff is calculated using a simplified version of our model. We estimate a discrete-time duration model with country specific intercepts, and where the baseline hazard is specified as in (5).

Table 3

TIME-TO-TAKEOFF PER REGION

	Number of cases	**Number of right-censored cases**	**Average time-to-takeoff**	**Expected time-to-takeoff[*]**
West Europe	86	2	3.44	3.58
North America	17	0	3.53	3.54
Central and East Europe	61	9	4.44	5.25
Africa and Middle East	21	4	4.29	5.60
South America	38	3	5.34	6.10
Australasia	85	13	5.50	6.66
Total / weighted average	**308**	**31**	**4.46**	**5.21**

[*] The expected time-to-takeoff is calculated using a simplified version of our model. We estimate a discrete duration model with region specific intercepts, and where the baseline hazard is specified as in (5).

Table 4

COMPARISON OF MODEL FIT WITH VARIOUS RESTRICTED MODELS

				Likelihood ratio test								
Model	**Description**	**Log L**	**No. pars**	**vs. 0**	**vs. 1**	**vs. 3**	**vs. 4a**	**vs. 4b**	**vs. 4c**	**vs. 4d**	**vs. 4e**	**vs. 4f**
0	Baseline hazard	-712.27	4	-	-	-	-	-	-	-	-	-
1	Baseline hazard + Product effects	-691.66	11	.000	-	-	-	-	-	-	-	-
2a	Model 1 + Country characteristics	-622.52	17	.000	.000	-	-	-	-	-	-	-
2b	Model 1 + Introduction + Takeoff	-691.59	13	.000	.932	-	-	-	-	-	-	-
3	Model 1 + Introduction + Takeoff + Country characteristics	-589.55	19	.000	.000	-	-	-	-	-	-	-
4a	Model 3 + Distance	-585.27	23	.000	.000	.073	-	-	-	-	-	-
4b	Model 3 + Susceptibility	-584.06	25	.000	.000	.089	-	-	-	-	-	-
4c	Model 3 + Clout	-574.52	25	.000	.000	.000	-	-	-	-	-	-
4d	Model 3 + Susceptibility + Clout	-567.46	31	.000	.000	.000	-	.000	.028	-	-	-
4e	Model 3 + Distance + Susceptibility	-575.97	29	.000	.000	.002	.005	.003	-	-	-	-
4f	Model 3 + Distance + Clout	-567.32	29	.000	.000	.000	.000	-	.006	-	-	-
5	**Our model**	**-556.69**	**35**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**	**.002**

Table 5

PARAMETER ESTIMATES FOR THE FULL GLOBAL SPILL-OVER MODEL

	Expected sign	**Parameter estimate**	**Standard Error**	**p-value**
Main effects				
Foreign introduction (α_0)	+	.136	.503	.786
Foreign takeoff (α_1)	+	4.099 ***	1.031	.000
Foreign susceptibility				
Log GDP (δ_1)	-	.419 *	.222	.059
Log import/GDP (δ_2)	+	-.026	.053	.624
Tourist arrivals/ inhabitants (δ_3)	+	.145 **	.071	.041
Uncertainty avoidance (δ_4)	-	.048	.077	.531
Log inhabitants (δ_5)	-	.016	.078	.840
Population density (δ_6)	+	.169 ***	.060	.005
Foreign clout				
Log GDP (κ_1)	+	1.070 ***	.404	.008
Log export/GDP(κ_2)	+	.954 ***	.203	.000
Log tourist expenditures(κ_3)	+	-.199	.177	.261
Uncertainty avoidance (κ_4)	+	.217	.174	.214
Log inhabitants (κ_5)	+	1.035 ***	.329	.002
Population density (κ_6)	+	-.009	.181	.959
Inter-country distance				
Log GDP/capita distance (γ_1)	-	-.792 **	.316	.012
Uncertainty avoidance distance (γ_2)	-	-.135	.097	.164
Log capital distance (γ_3)	-	-.492 ***	.137	.000
Neighbors (yes/no) (γ_4)	-	-.197	.386	.609

	Expected sign	**Parameter estimate**	**Standard error**	**p-value**
Direct effect of country characteristics				
Log(GDP) (β_1)	+	1.708 ***	.222	.000
Gini (β_2)	-	.332 ***	.112	.003
Uncertainty avoidance (β_3)	-	-.418 **	.164	.011
Log inhabitants (β_4)	+	.015	.159	.925
Population density (β_5)	+	-1.321 ***	.448	.003
Launch year				
Start year		-.072	.060	.225
Product fixed effects				
CD player		-4.186 ***	.562	.000
Mobile phone		-5.968 ***	.761	.000
DVD player		-2.780 **	1.266	.028
Digital camera		-3.360 ***	1.291	.009
Internet		-5.216 ***	.874	.000
ISDN		-5.739 ***	1.030	.000
PC		-3.319 ***	.664	.000
Video camera		-4.607 ***	.601	.000
Effect of time				
Time		-1.116 ***	.211	.000
Time^2		.028 ***	.007	.000
Log(1+time)		4.043 ***	.663	.000

*: $p<0.10$; ** $p<0.05$; *** $p<0.01$ (two-sided tests)

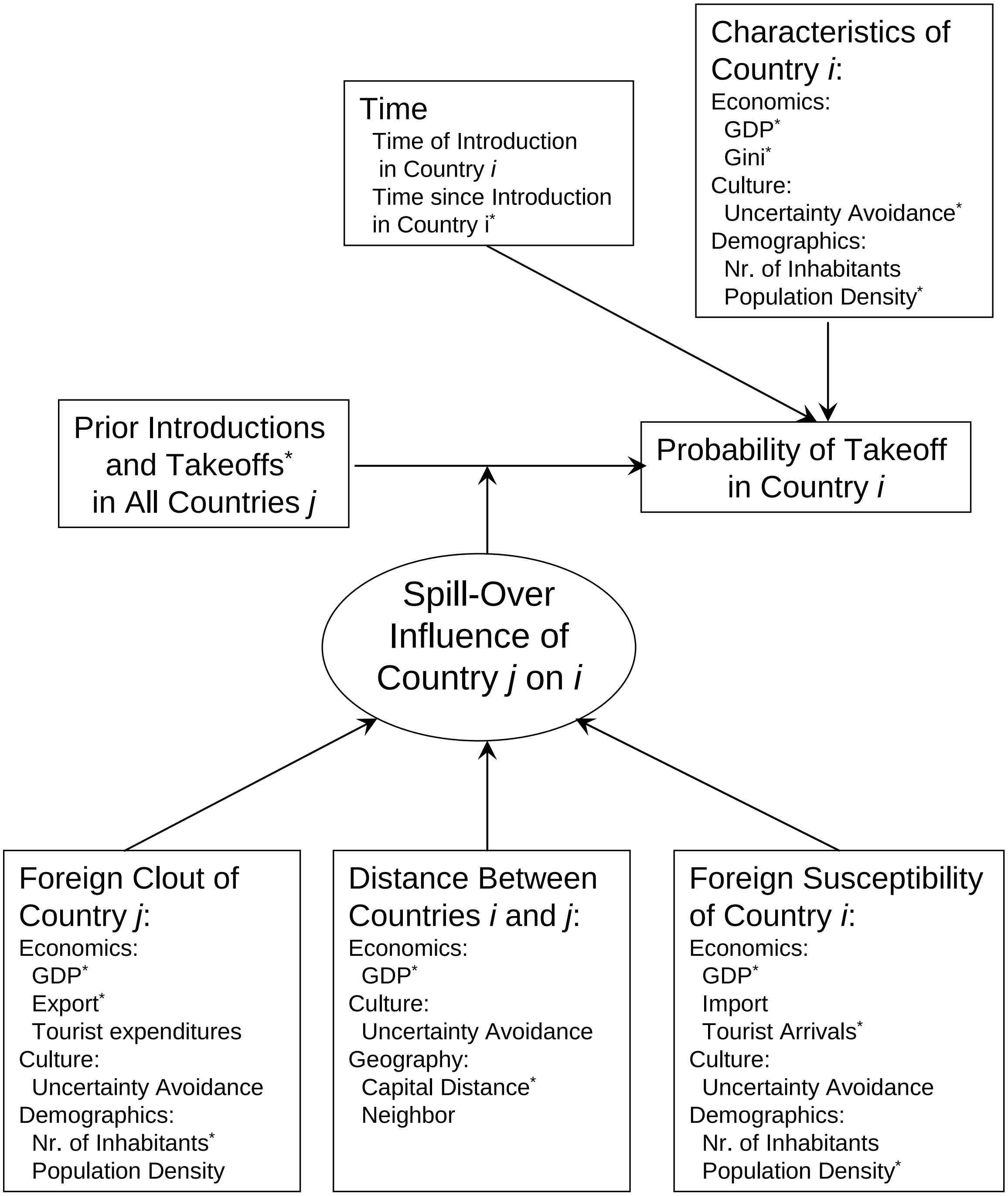
Table 6

ESTIMATED FOREIGN SUSCEPTIBILITY AND CLOUT FOR ALL COUNTRIES

Country	Foreign susceptibility	Rank on susceptibility	Foreign Clout	Rank on clout
Argentina	.94	32	.34	47
Australia	.59	51	.73	34
Austria	1.07	22	1.33	21
Belgium	.71	43	12.14	1
Brazil	1.15	20	.57	41
Bulgaria	1.24	16	.67	36
Canada	.64	47	2.71	10
Chile	1.05	24	.56	42
China	1.87	5	1.07	27
Colombia	1.32	12	.23	50
Croatia	1.18	19	.30	49
Czech Republic	1.07	23	2.00	12
Denmark	.54	54	.88	30
Ecuador	1.30	14	.20	54
Estonia	1.02	29	.38	46
Finland	.59	50	1.08	26
France	.79	37	3.61	6
Germany	.63	48	4.86	3
Greece	1.05	25	.33	48
Hong Kong China	.76	39	8.83	2
Hungary	1.49	9	1.10	25
India	2.28	3	.21	52
Indonesia	1.72	6	.75	33
Ireland	.75	41	1.78	17
Israel	.73	42	.64	39
Italy	.75	40	2.73	9
Japan	.63	49	3.07	8
Malaysia	1.03	28	1.81	15
Mexico	1.07	21	1.43	20
Morocco	1.53	8	.20	53
Netherlands	.66	45	3.91	5
New Zealand	.67	44	.40	45
Norway	.55	53	1.15	23
Pakistan	2.11	4	.17	55
Peru	1.35	11	.21	51
Philippines	1.59	7	.45	44
Poland	1.24	17	.78	32
Portugal	1.04	27	.80	31
Romania	1.39	10	.65	37
Russia	1.20	18	2.08	11
Singapore	2.87	1	3.45	7
Slovakia	.96	31	.97	28
Slovenia	.80	35	.92	29
South Africa	1.04	26	.64	38
South Korea	.78	38	1.78	16
Spain	.94	33	1.50	19
Sweden	.52	55	1.27	22
Switzerland	.80	36	1.62	18
Taiwan	.83	34	4.15	4
Thailand	1.32	13	1.13	24
Turkey	1.25	15	.46	43
United Kingdom	.65	46	1.90	14
U.S.	.55	52	2.00	13
Venezuela	.99	30	.69	35
Vietnam	2.29	2	.63	40

Figure 1

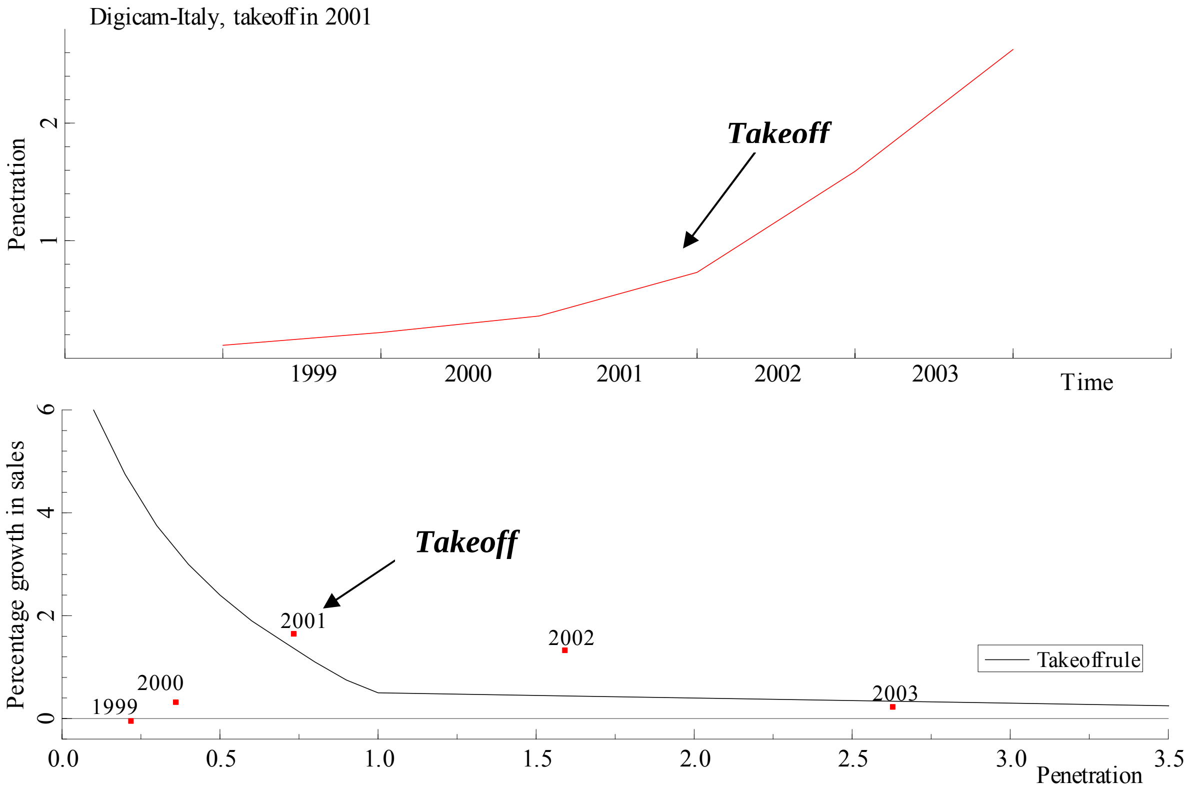
THE ROLE OF CLOUT, SUSCEPTIBILITY AND DISTANCE IN GLOBAL SPILL-OVERS OF TAKEOFF



Note: The effects marked with an asterisk are significant in our empirical testing.

Figure 2

EXAMPLE OF THRESHOLD RULE TO IDENTIFY TAKEOFF



Note: Takeoff is defined to occur in the period in which the percentage growth in sales, given the product's penetration, *for the first time*, exceeds the threshold curve, in panel B of Figure 2. Panel B of Figure 2 shows this percentage growth for each penetration level that occurred over time for Digicams in Italy, based on the penetration data in panel A of Figure 2. Takeoff, by definition, only occurs once in a product's life cycle.

Figure 3

BASELINE HAZARD FOR FULL GLOBAL SPILL-OVER MODEL

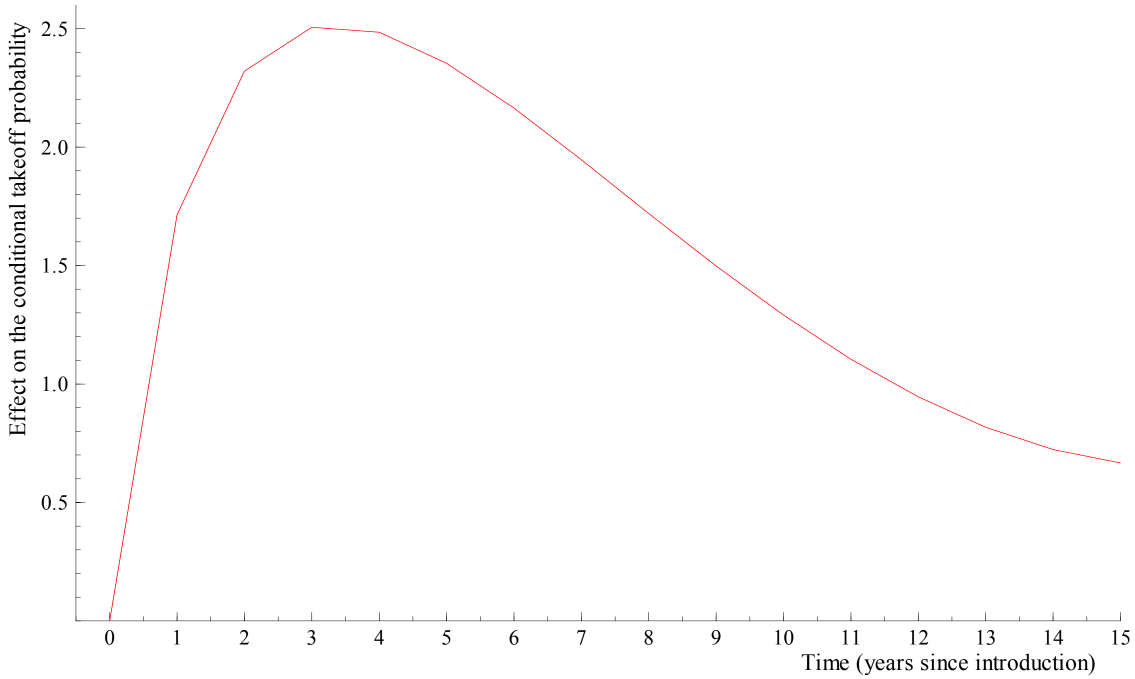
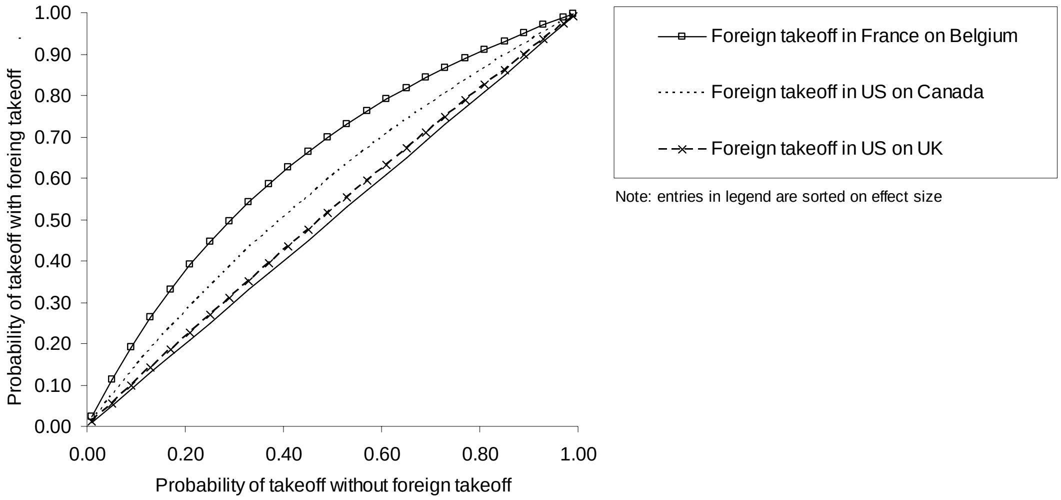


Figure 4

VISUALIZATION OF THE EFFECT OF FOREIGN TAKEOFFS IN THREE DIFFERENT CASES



Note: entries in legend are sorted on effect size

Publications in the Report Series Research* in Management

ERIM Research Program: “Marketing”

2008

Experts' Stated Behavior
Youssef Boulaksil and Philip Hans Franses
ERS-2008-001-MKT
http://hdl.handle.net/1765/10900

The Value of Analogical Reasoning for the Design of Creative Sales Promotion Campaigns: A Case-Based Reasoning Approach
Niek A.P. Althuizen and Berend Wierenga
ERS-2008-006-MKT
http://hdl.handle.net/1765/11289

Shopping Context and Consumers' Mental Representation of Complex Shopping Trip Decision Problems
Benedict G.C. Dellaert, Theo A. Arentze and Harry J.P. Timmermans
ERS-2008-016-MKT
http://hdl.handle.net/1765/11812

Modeling the Effectiveness of Hourly Direct-Response Radio Commercials
Meltem Kiygi Calli, Marcel Weverbergh and Philip Hans Franses
ERS-2008-019-MKT
http://hdl.handle.net/1765/12242

Choosing Attribute Weights for Item Dissimilarity using Clikstream Data with an Application to a Product Catalog Map
Martijn Kagie, Michiel van Wezel and Patrick J.F. Groenen
ERS-2008-024-MKT
http://hdl.handle.net/1765/12243

The Effect of Superstar Software on Hardware Sales in System Markets
Jeroen L.G. Binken and Stefan Stremersch
ERS-2008-025-MKT
http://hdl.handle.net/1765/12339

Sales Growth of New Pharmaceuticals Across the Globe: The Role of Regulatory Regimes
Stefan Stremersch and Aurélie Lemmens
ERS-2008-026-MKT
http://hdl.handle.net/1765/12340

When Intelligence is (Dys)Functional for Achieving Sales Performance
Willem J. Verbeke, Frank D. Belschak, Arnold B. Bakker, and Bart Dietz
ERS-2008-034-MKT
http://hdl.handle.net/1765/12633

Path Dependencies and the Long-term Effects of Routinized Marketing Decisions
Paul Farris, Willem J. Verbeke, Peter Dickson and Erjen van Nierop
ERS-2008-035-MKT
http://hdl.handle.net/1765/12634

Does Irritation Induced by Charitable Direct Mailings Reduce Donations?
Merel van Diepen, Bas Donkers and Philip Hans Franses
ERS-2008-036-MKT
http://hdl.handle.net/1765/12704

Brain Mechanisms of Persuasion: How "Expert Power" Modulates Memory and Attitudes
Vasily Klucharev, Ale Smidts and Guillén Fernández
ERS-2008-038-MKT
http://hdl.handle.net/1765/12784

Moderating Factors of Immediate, Dynamic, and Long-run Cross-Price Effects
Csilla Horváth and Dennis Fok
ERS-2008-042-MKT
http://hdl.handle.net/1765/12901

Why, How and When Do Prices Land? Evidence from the Videogame Industry
Carlos Hernandez-Mireles, Dennis Fok and Philip Hans Franses
ERS-2008-044-MKT
http://hdl.handle.net/1765/12900

Situation-Based Shifts in Consumer Web Site Benefit Salience: The Joint Role of Affect and Cognition
Sonja Wendel and Benedict G.C. Dellaert
ERS-2008-050-MKT
http://hdl.handle.net/1765/13179

Including Item Characteristics in the Probabilistic Latent Semantic Analysis Model for Collaborative Filtering
Martijn Kagie, Matthijs van der Loos and Michiel van Wezel
ERS-2008-053-MKT
http://hdl.handle.net/1765/13180

Cross-National Logo Evaluation Analysis: An Individual Level Approach
Ralf van der Lans, Joseph A. Cote, Catherine A. Cole, Siew Meng Leong, Ale Smidts, Pamela W. Henderson, Christian Bluemelhuber, Paul A. Bottomley, John R. Doyle, Alexander Fedorikhin, M. Janakiraman, B. Ramaseshan, and Bernd H. Schmitt
ERS-2008-055-MKT
http://hdl.handle.net/1765/13181

Sales and Sincerity: The Role of Relational Framing in Word-of-Mouth Marketing
Mirjam A. Tuk, Peeter W.J. Verlegh, Ale Smidts and Daniel H.J. Wigboldus
ERS-2008-056-MKT
http://hdl.handle.net/1765/13183

Interpersonal Relationships Moderate the Effect of Faces on Person Judgments
Mirjam A. Tuk, Peeter W.J. Verlegh, Ale Smidts and Daniel H.J. Wigboldus
ERS-2008-057-MKT
http://hdl.handle.net/1765/13185

Evaluative Conditioning 2.0: Referential versus Intrinsic Learning of Affective Value
Steven Sweldens, Stijn M.J. van Osselaer, and Chris Janiszewski
ERS-2008-062-MKT
http://hdl.handle.net/1765/13612

Gender Identity Salience and Perceived Vulnerability to Breast Cancer
Steven Sweldens, Stefano Puntoni, and Nader Tavassoli
ERS-2008-063-MKT
http://hdl.handle.net/1765/13613

The Emotional Information Processing System is Risk Averse: Ego-Depletion and Investment Behavior
Bart De Langhe, Steven Sweldens, Stijn M.J. van Osselaer, and Mirjam Tuk
ERS-2008-064-MKT
http://hdl.handle.net/1765/13614

The Moderating Roles of Relationship Quality and Dependency in Retailers' New Product Adoption Decisions
Yvonne M. van Everdingen, Laurens M. Sloot, and Peter C. Verhoef
ERS-2008-065-MKT
http://hdl.handle.net/1765/13615

Modeling Global Spill-Over of New Product Takeoff
Yvonne M. van Everdingen, Dennis Fok, Stefan Stremersch
ERS-2008-067-MKT
http://hdl.handle.net/1765/13616

---

[*] A complete overview of the ERIM Report Series Research in Management:
https://ep.eur.nl/handle/1765/1

ERIM Research Programs:

LIS	Business Processes, Logistics and Information Systems
ORG	Organizing for Performance
MKT	Marketing
F&A	Finance and Accounting
STR	Strategy and Entrepreneurship