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A New Approach to Country Segmentation Utilizing Multinational Diffusion Patterns

Country segmentation has been proposed to assist in marketing strategy decisions for international marketing managers. Such schemes typically consist of grouping or clustering a set of specified countries on the basis of a wide array of macroeconomic variables. The authors focus on the merits of such country classification schemes in gaining an understanding about multinational diffusion patterns. More specifically, they analyze the extent to which countries belonging to the same (different) grouping reveal similar (dissimilar) diffusion patterns. To that end, they compare the results of traditional segmentation approaches with diffusion-based country segments derived for three different consumer durable goods. For the latter, they rely on a recently developed latent-structure methodology, here modified to accommodate the Bass diffusion model, which simultaneously determines the segments and segment-level estimates of the diffusion parameters. They find that the market segments derived from these two approaches differ dramatically and that macro-level variables do not fully explain differences in diffusion patterns across countries. In addition, country segments formed on the basis of diffusion patterns often differ by product. Finally, they discuss some managerial implications and directions for future research.

FACED with intensifying competition and saturated markets in their home market, many U.S. durable good manufacturers have attempted to revitalize their business by looking overseas. These efforts have not been limited to merely bolstering operations in existing markets. Driven by the consolidation of the European market and the emergence of new marketplaces, such as the former Eastern Bloc countries, companies are constantly adding new countries to their list of markets. A typical example is Whirlpool's recent acquisition of the Philips white goods division to establish a beachhead in the Pan-European appliance business (*Business Week* 1991). The expansion of a firm's country portfolio inevitably creates daunting challenges such as, Which product should the firm introduce, in which markets, and when? Should the firm tailor its marketing program for each country separately (Davidson and Harrigan 1977)?

To facilitate decisions in these areas, several international marketing researchers have proposed to rely on country segmentation. For example, Sethi (1971, p. 348) states:

> Developing a successful strategy for global marketing depends to a large extent upon a firm's ability to segment its world markets so that uniform sets of marketing decisions can be applied to a group of countries.

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Proponents of country classification efforts point out a wide range of benefits. For instance, in the domain of target market selection, global marketers might consider entering countries or "segments" where the product has already been successfully commercialized (Johansson and Moinpour 1977). Such market entries could then be fortified by appropriate marketing mix programs. When penetrating new markets, a firm could borrow from experience collected in similar countries that were entered earlier (Jain 1993). This notion of "cross-fertilization" is often touted as a key ingredient for a successful global marketing program. Jain also mentions the importance of niche strategies in global markets and the role of country segmentation in locating niche markets. In the area of international marketing research, Downham (1986, p. 644) recommends grouping the relevant set of countries under consideration and concentrating research efforts on a *prototypical* member from each group. Presumably, research results for the selected key member(s) can then be projected to other member countries.

The importance of country segmentation has been recognized in most academic circles. Most international marketing textbooks devote a fair amount of space to country segmentation related topics (e.g., Jain 1993; Toyne and Walters 1993; Samli, Still, and Hill 1993). Typically, international segmentation approaches either classify countries on a single dimension (e.g., per capita Gross National Product) or on multiple socioeconomic, political, and cultural criteria such as those available from the World Bank. Figure 1 presents a list of various criteria for segmenting countries vis-à-vis such macro-level variables taken from Jain (1993) and Jaffe (1974). These segmentation approaches typically involve the use of numerical taxonomy methods (e.g., cluster analysis) to classify the countries into homogeneous groups. This approach is exemplified in the study per-

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FIGURE 1
Criteria for Grouping Countries

Construct	Variables
Aggregate production and transportation	Number of air passengers/km Air cargo (ton/km) Electricity production Number of newspapers Number of cities with a population of over 100,000 Population
Personal consumption	Income per capita GNP per capita Cars per capita TV sets per capita Energy consumption per capita Hospital beds Newspaper circulation Electricity production per capita Telephones per capita Radios per capita School enrollment per capita in population 15–19 years old College, university, and professional school education per capita in population 15–64 years old
Trade	Imports/GNP Exports/GNP Consumer price index
Health and education	Illiteracy among adults 15 years and older Percent of population in agriculture Life expectancy Physicians per capita Number of cities with a population of under 100,000 School enrollment per capita in population 5–14 years old Political stability

Source: Eugene D. Jaffe, *Grouping: A Strategy for International Marketing* (New York: AMACOM, 1974), p. 17, adapted from S. Prakash Sethi, "Comparative Cluster Analysis for World Markets," *Journal of Marketing Research*, August 1971, pp. 350–351, and listed in Jain (1993).

formed by Sethi (1971). He first collapsed 29 macro-level variables into four dimensions using factor analysis. A total set of 91 countries was then cluster analyzed yielding seven country clusters or segments along the four dimensions identified in the first stage. An alternative approach is cross-country segmentation which derives groups of customers who are alike (Hassan and Katsani 1991; Kale and Sudharshan 1987). Therefore, each country may contain several clusters that cross the borders, such as "global elites" or "global teenagers" (Hassan and Katsani 1991). Conceptually, it makes sense that certain segments may cross borders, especially for luxury items, industrial goods, and products targeted toward teenagers. Examples of country segmentation studies are summarized in Jain (1993). Though these country clustering studies may offer some valuable insights, some researchers have disputed their appeal for international marketing practitioners. Cavusgil and Nevin (1981) pinpoint several potentially serious limitations, such as the absence of comparable data, reliance on aggregate data, and lack of validity of partitionings over time. In addition, the use of such macro-level variables for international segmentation schemes may indeed be questionable when one examines the rather heterogeneous nature of the products and services typically involved in multinational business activities. Accurate strategic decisions may not be possible with such general or macro-level segmentation schemes whose underlying taxonomy may have little effect in explaining or describing differences in specific new product/service diffusion rates.

We propose a new approach to country segmentation using a different perspective. In a recent survey article of research contributions in international marketing, Douglas and Craig (1992, p. 312) lament the lack of recent research on international market segmentation:

> Closely related to this issue is that of international market segmentation. Segmentation is a central issue in domestic marketing strategy. Yet, in international markets it has received little attention.

The present research segments markets using a multinational diffusion perspective. Our focus is limited to durable good markets. Rather than using macro-level variables to classify countries, a firm might consider segmenting markets on the basis of aggregate new-product diffusion patterns given the recent importance placed on international diffusion (cf. Douglas and Craig 1992). We describe a recently developed methodology employing latent structure regression to analyze multinational diffusion patterns. In this endeavor, we also address several issues concerning the implementation of such country segmentation studies. In particular, we are interested in exploring the extent to which macro-level country segmentation will enable us to gain a better understanding of multinational diffusion processes. That is, we will investigate whether countries falling in the same macro-level country segment show a parallel diffusion process. Wills, Samli, and Jacobs (1992) recently identified this topic area as one of the most important in developing global products and associated marketing strategies. Likewise, we examine the degree to which countries belonging to different macro-level country segments manifest dissimilar diffusion processes. Such insights will be valuable to international marketing practitioners. For instance, if two markets that belong to the same segment are entered according to a "waterfall" strategy[1] (Mahajan, Muller, and Kalish 1990), the manager could make inferences about the penetration pattern (including elements such as market size, magnitude, and timing of sales peak) for the "lag" market by looking to the diffusion process observed for the "lead" market (Takada and Jain 1991). To that end, we compare a traditional, macro-level segmentation/clustering scheme with the groupings of countries derived from a latent structure analysis of observed diffusion processes for a number of recently introduced consumer durables. That is, rather than *a priori* selecting a battery of aggregate variables along which a given set of countries are classified, we propose to actually segment the countries on the basis of how the diffusion process evolves within these countries for various consumer durables. The diffusion-based clustering is accomplished using an adaptation of a new latent structuring methodology that, in the present context, will simultaneously segment the countries and calibrate the diffusion parameter estimates for the respective segments/clusters (DeSarbo et al. 1992). The key merits from this proposed approach are twofold. First, it allows the global marketer to segment countries on the basis of actual purchase patterns (namely, the new product diffusion process) rather than macroeconomic aggregates. Thus, the approach is a response-based segmentation procedure. Such insights will prove helpful in making, for instance, global pricing or market research decisions. Second, it permits countries to belong to multiple clusters at the same time. This feature is in the spirit of cross-country segmentation. As Jain (1993) points out, cross-country segmentation is more realistic than the standard approach, which views each country as belonging to a single cluster. Given the country groupings derived by a traditional clustering approach and the latent structure analysis of the multinational diffusion patterns, we will explore the extent to which there is an agreement between the two resulting taxonomies. Therefore, our first research question can be stated as follows:

1. To what extent do country segments derived from traditional analyses of macro-level data correspond to segments derived from multinational, product-class specific diffusion patterns?

Several authors have made the argument that countries belonging to the same macro-level segment should reveal *comparable product life cycles* (Johansson and Moinpour 1977, p. 67). If this is indeed the case, a country classification scheme on the basis of macro-level country characteristics should closely correspond to a diffusion-based classification. Prima facie, one might hypothesize the existence of such a link because, according to the diffusion literature (e.g., Rogers 1983), diffusion patterns are typically influenced by certain macroeconomic variables (e.g., standard of living) that typically are used to classify countries. For example, Lee (1991) classified various countries in terms of innovativeness by relating several macro-level variables to the respective penetration rate of black and white television sets. Countries were then categorized by Rogers' (1983) rate of adoption schema. Even if such links prove to be untenable, one might hope that some of the variables that are typically used in the traditional, macro-level, country segmentation analysis may assist the researcher in profiling diffusion-based country segments. Information on these variables could then be used to speculate about diffusion patterns for future innovations. This leads to our second research question:

2. How well do variables that are typically used in macro-level country segmentation studies perform when used to profile diffusion-based country groups?

This question addresses the extent to which country macro-level characteristics can discriminate among diffusion-based segments. Findings in the multinational diffusion literature provide some support for the existence of such a relationship. In their cross-country diffusion study of six consumer durables, Gatignon, Eliashberg, and Robertson (1989) found cosmopolitanism, mobility, and sex roles to have significant influences on diffusion patterns. Similarly, Takada and Jain (1991) found faster rates of adoption in countries characterized by high context culture and homophilous communication in their study analyzing the adoption of four consumer durables in Pacific Rim countries.

As an alternative to traditional macro-level, clustering-based country classifications, the international marketing analyst might consider diffusion patterns for past new product introductions. In a domestic setting, Lenk and Rao (1990) demonstrated how information on previously introduced products can be gainfully employed to make inferences about the adoption process for a new product. In our context, the underlying notion would be that countries grouped together for past innovations can reveal similar diffusion processes for subsequently launched innovations. Evidently, this may depend on the nature of the innovations. This reasoning brings us to the third research question:

3. How stable are diffusion-based country segmentation schemes estimated across different innovations?

We first survey earlier marketing studies on multinational diffusion processes. We then briefly describe and motivate the latent structure methodology that will be used to derive our diffusion-based country groupings. Next, we discuss the data and our key findings. Finally, we discuss the implications of the results and suggest areas for further research.

Multinational Diffusion Research

Marketing research on multinational diffusion processes has been relatively sparse to date. Most of the modeling efforts are variants of the classical Bass (1969) diffusion

[1] In a "waterfall" strategy new products trickle down in a cascade fashion from one country to another. Typically this strategy first launches the innovation in the home market, then in other advanced countries, and finally in developing countries.

model that specifies the diffusion process for new durables with the following formulation:

$$(1) \quad d\,X/dt = p\,[m-X(t)] + q\,X(t)\,[m-X(t)],$$

where X(t) is the cumulative number of adopters at time t, m is the total market potential, and the p and q parameters are interpreted as capturing the effect of internal and external (by word-of-mouth interplay) influences, respectively, on the diffusion process (see Mahajan, Muller, and Bass 1990 for an excellent review of new product diffusion models). Heeler and Hustad (1980) were among the first set of scholars who assessed the Bass model in an international setting. They evaluated the performance of the Bass model in terms of predicting the timing and magnitude of the sales peak. The overall results were rather disappointing—parameter estimates were often unstable, the fit to the data was poor for many cases, and the level of the sales peak was seldom predicted in an accurate manner. We speculate that environmental differences and the lack of sufficient time series data explain the poor fits. However, we should add that the data sets they used were production, not sales data. Therefore, the failure of the Bass model to produce reasonable forecasts in their study may also be because of the poor quality of their data base.

Another diffusion modeling application in a multinational setting was provided by Eliashberg and Helsen (1987). These authors expanded the Bass model in equation (1) to reflect the lead-lag phenomena. More specifically, to calibrate the diffusion process in the lag market, they incorporate a term that captures the impact of the adoption process in the lead market on the diffusion pattern in the lag market. Mahajan, Muller, and Kalish (1990) use a similar version of this model to analyze whether firms should launch their product in all their target markets simultaneously ("sprinkle" diffusion strategy) or sequentially ("waterfall" strategy). More recently, Takada and Jain (1991) applied the Bass model to analyze the diffusion process of durables in four Pacific Rim countries. They find that, in general, the imitation coefficient, q, tends to have larger values for lag countries, indicating that the diffusion process is accelerated for these market places. Finally, Gatignon, Eliashberg, and Robertson (1989) provide another application of the diffusion paradigm in a global market setting. These authors investigated the existence of systematic patterns in cross-country diffusion processes. Their results illustrate the importance of a country's cosmopolitanism, mobility level, and gender roles to account for cultural differences in the diffusion of new consumer durables in an international context.

At this stage, it is useful to position our research vis-à-vis these earlier studies. First, the primary focus of the current study is to evaluate and compare country segmentation schemes on the basis of traditional macro-level approaches with schemes on the basis of observed new product diffusion processes. With this, we hope to shed some light on the merits of comparative cluster analysis to international marketing practitioners. Second, to overcome the shortness of time series problem, we rely on a newly devised latent class pooling methodology that simultaneously yields segment level parameter estimates (p and q) as well as the composition of the segments. Third, we explore whether variable alternatives to comparative cluster analysis exist. For example, we examine the relationship between the diffusion patterns of subsequently introduced durables.

The studies by both Gatignon, Eliashberg, and Robertson (1989) and Takada and Jain (1991) attempt to systematically explain diffusion parameters in an international setting. In that sense, these studies are closely related to our second research question: Is it possible to use macro-level information on country characteristics to explain diffusion patterns? However, Takada and Jain only focus on the external influence coefficient, q. Except for the lead-lag effect, no systematic efforts are made to assess observed differences in the p and q values. Neither of these studies were really concerned with the country segmentation issue. Both studies are also somewhat limited with regard to their geographic scope: The study by Gatignon, Eliashberg, and Robertson (1989) only comprises European countries, and Takada and Jain concentrate on four Pacific Rim countries. In contrast, our study includes countries from both regions.

A Latent Structure Methodology

The technique we use to segment the set of countries on the basis of observed diffusion patterns is a latent class structure methodology for regression models. Latent class analysis has been traditionally used to extract market structure from brand switching data (Grover and Srinivasan 1987; Jain, Bass, and Chen 1990). However, these applications do not involve regression analysis. The methodology that we will modify for this study was developed by DeSarbo et al. (1992) who demonstrate its potential for conjoint analysis. The methodology entails several advantages that make it preferable to simply clustering, say, OLS-based parameter estimates of the diffusion coefficients for each country (see also Ramaswamy, et al. 1993). First, it allows us to escape from the short time series problem (Heeler and Hustad 1980) by pooling sales penetration data across countries. Second, the country segments are derived without imposing any *a priori* segmentation scheme. A third benefit is that the country segments and parameter estimates are determined simultaneously. Also, the technique relies on statistical criteria to evaluate the appropriate number of country segments. Finally, the method allows each country to belong to fractionally more than one grouping. Conceptually, the latter benefit is appealing in our context. For many products, each country's market encompasses different segments that cross country boundaries (Jain 1993; Toyne and Walters 1993). That is, a particular segment in one country may well exist in some of the other foreign markets. However, the proportionate sizes of these segments will usually differ between countries. The latent structure framework used here will capture such phenomena. The appendix describes the technical aspects of this methodology.

Data Description

Annual unit sales data for three consumer durables (color TV sets, VCRs, and CD players) were made available by a multinational consumer electronics firm. The countries include all member states of the European Community and the European Free Trade Association, Japan, and the U.S.[2]

[2]The supplier of our data set requested anonymity.

TABLE 1
Macro-Level Country Characteristics

Construct	Items
1. Aggregate Production and Transportation (Mobility)	Number of Air Passengers/km Air Cargo (ton/km) Number of Newspapers Population Cars per Capita Motor Gasoline Consumption per Capita Electricity Production
2. Health	Life Expectancy Physicians per Capita Political Stability (Euromoney)
3. Trade	Imports/GNP Exports/GNP
4. Lifestyle	GDP per Capita Phones per Capita Electricity Consumption per Capita
5. Cosmopolitanism	Foreign Visitors per Capita Tourist Expenditures per Capita Tourist Receipts per Capita
6. Miscellaneous*	Consumer Price Index Newspaper Circulation Hospital Beds Education Expenditures/Government Budget Graduate Education in Population per Capita

*Items that did not load high on any of the factors.

The sales data ($\underset{\sim}{Y}$) span a period ranging from the year of introduction in each country to 1990. For each country, we selected 14 years of observations.[3] To make our results comparable across products, we only retained those countries for which we had a sufficient number of observations for all three products and no missing values. As a result, we included 12 countries in the final analysis: Austria, Belgium, Denmark, France, Finland, Japan, the Netherlands, Norway, Sweden, Switzerland, the U.K., and the U.S.

The three products that are included in our data base are somewhat similar in the sense that all three are entertainment consumer durable goods. The color TV is a "continuous" innovation (Robertson 1971); the other two are "discontinuous" innovations because they involve new consumption patterns and entail new side-products (VCR tapes and compact discs, respectively). Given the parallel nature of the products, one would anticipate largely similar diffusion patterns for these consumer goods. However, differences in matters such as regulatory regimes, market entry timing, etc., could lead to distinct diffusion developments.

Background information on these 12 countries (macro-level variables) was gathered from two Euromonitor publications—*European Marketing Data and Statistics, International Marketing Data and Statistics*—and *Euromoney* (for the political risk indicator). The selected country characteristics are listed in Table 1. Variables in Table 1 were chosen on the basis of the items under the four constructs in Figure 1, previous research in the diffusion literature investigating the impact of country characteristics on innovation adoption patterns (Gatignon, Eliashberg, and Robertson 1989), and previous country segmentation studies (Jain 1993; Johansson and Moinpour 1978; Martinez, Quelch, and Ganitsky 1992; Sethi 1971). Most of the items correspond to the country segmentation characteristics listed in Jain (1993). The first set of eight items in Table 1 closely resembles the "Aggregate Production and Transportation" measure in Figure 1. The second construct captures health-related indicators; the third set refers to the level of international trade that countries engage in; and the fourth relates to the country's standard of living. Diffusion research has indicated that a high standard of living is usually coupled to fast rates of adoption (Rogers 1983). Cosmopolitanism has been recognized as another important factor in diffusion research. This construct is captured by tourist-related indicators (see Gatignon, Eliashberg, and Robertson 1989). Most of these indicators (or their equivalents) have been used previously in country segmentation studies. Preferably, one would have wanted to include constructs that capture cultural (dis)similarities. Since the health situation and education system is part of a society's culture, we tap some facets of culture. However, to cover the entire cultural spectrum, one needs to include many more aspects, such as language, religion, customs, and values (Terpstra and David 1991). Many of these cultural elements are hard to measure using secondary data. As Wind and Douglas (1972) point out, culture is difficult to conceptualize and operationalize in international market segmentation. For example, Tansuhaj and colleagues (1991) found in a cross-cultural study that fatalism was strongly related to people's willingness to try new

[3]The 14 years does not necessarily cover the entire life cycle of the product in these countries. However, most previous diffusion studies in marketing cover only part of the diffusion time horizon. A horizon of 14 years is close to the number of years selected in other diffusion studies (e.g., Takada and Jain 1991).

TABLE 2
Factor Loadings of Macro-Level Country Characteristics (After Varimax Rotation)

Item	Factor 1 (MOBIL)	Factor 2 (HEALTH)	Factor 3 (TRADE)	Factor 4 (LIFE)	Factor 5 (COSMO)	Factor 6
Passengers	.969	.050	-.139	.060	-.104	.115
Air Cargo	.943	.133	-.192	-.062	-.167	.121
Newspapers	.975	.025	-.104	.113	-.071	.036
Population	.880	.225	-.330	-.099	-.214	.041
GDP	.187	.149	-.142	.841	.180	-.050
Cars	.784	-.172	.196	.355	.150	.360
Gas	.904	-.029	-.048	.337	.035	.193
Circulation	-.121	.510	-.593	-.118	-.240	.059
Phones	.175	.071	-.036	.839	-.009	.275
Imports	-.349	-.014	.902	-.160	.087	-.031
Exports	-.379	-.033	.897	-.127	-.045	-.106
CPI	-.166	-.655	-.236	.258	-.433	.424
Life Exp.	-.268	.716	-.247	.287	-.070	-.207
Visitors	-.110	.046	-.013	-.028	.982	.087
Tourist Exp.	-.401	-.072	.330	.470	.607	-.142
Tourist Rec.	-.161	-.032	.050	.011	.969	.018
Pol. Stab.	.261	.888	.070	-.066	-.001	.193
High Educ.	.910	-.325	.058	.114	-.060	-.197
Hospitals	.623	-.128	-.147	-.314	-.032	.598
Physicians	-.133	.677	-.566	-.025	-.028	.169
Elec. Cons.	.048	-.347	-.057	.761	-.181	-.250
Elec. Prod.	.957	.091	-.209	.048	-.143	.054
Educ. Gvt.	-.399	-.415	.341	-.164	-.197	-.666
%Variance Explained	39.9	16.4	13.3	11.1	7.0	4.6
Cronbach α	.979	.752	.993	.783	.899	

products. However, these authors admit that such a construct is difficult to operationalize using non-survey-related data. Certain items (e.g., literacy rate) commonly used were not included in our study given that these measures vary little across our particular set of countries. One obvious limitation of these traditional macro-level country segmentation approaches is that the derived segments will typically differ depending on the variables specified in the analysis. Note that the segmentation studies we reviewed typically use such data for a given year. This may be a problem when the characteristics change over time. Therefore, we use the mean of each of the items over time in these analyses.

Results

The first approach we employed was to perform a traditional, macro-level, country segmentation analysis, similar to the analysis used by Sethi (1971) and others. Following common practice (e.g., Sethi 1971; Sethi and Curry 1973; Jain 1993), we first factor analyzed the 23 country traits to collapse the variables into a smaller number of dimensions. The factor loadings derived from applying principal components analysis to our data set (followed by a Varimax rotation) are shown in Table 2 (the loadings were similar to those obtained using a Promax rotation). Both the scree test and minimum eigenvalue rule indicated a six-factor solution, which explains 94% of the total variance.[4] Except for the final factor, the factors show a fair amount of face validity and largely agree with the results reported in past studies. The items loading heavily on the first construct (number of air passengers per kilometer, air cargo, number of cars per inhabitant, and per capita motor gasoline consumption) correspond to Sethi's (1971) "aggregate production and transportation" factor and Gatignon, Eliashberg, and Robertson's (1989) "mobility" construct. We refer to this construct as the overall mobility (MOBIL) factor. The second factor (HEALTH) primarily includes items that relate to the country's health situation. The third factor (TRADE) refers to the foreign trade activities (exports and imports) of a country. The fourth factor (LIFE) encompasses three items: per capita gross domestic product, electricity consumption, and per capita phones. Each of these have been used to reflect a country's standard of living. This measure parallels the "Personal Consumption" variable listed in Figure 1. The fifth factor includes three country traits: foreign visitors received, per capita tourism expenditures, and receipts. This variable could be termed cosmopolitanism (COSMO) because it roughly corresponds to a similar measure reported in Gatignon, Eliashberg, and Robertson (1989). The sixth factor does not have a clear interpretation. None of the items loads highly on this factor. We therefore dropped this factor in the remainder of our analysis. All the constructs appear to be fairly reliable measures having Cronbach-alpha coefficients ranging from .75 to .99 (see bottom row of Table 2).

Again using guidelines by Sethi (1971), we computed factor scores for each of the twelve countries corresponding

[4]Maximum likelihood factor analysis was also attempted as suggested by one reviewer. However, because of singularity problems in the correlation matrix, solutions could not be derived.

TABLE 3
Macro-Level Country Segments Based on Factor Scores

A. Two-Segment Solution

Segment 1	**Segment 2**
Austria	Japan
Belgium	Sweden
Denmark	U.S.
France	
Finland	
Holland	
Norway	
Switzerland	
U.K.	

Centroids:	**MOBIL**	**HEALTH**	**TRADE**	**LIFE**	**COSMO**
Segment 1	-.263	-.208	.137	-.157	.199
Segment 2	.788	.623	-.410	.470	-.597

B. 3-Segment Solution

Segment 1	**Segment 2**	**Segment 3**
Holland	Austria	U.S.
Japan	Belgium	
Sweden	Denmark	
U.K.	Finland	
	France	
	Norway	
	Switzerland	

Centroids:	**MOBIL**	**HEALTH**	**TRADE**	**LIFE**	**COSMO**
Segment 1	-.272	.815	-.016	-.141	-.613
Segment 2	-.288	-.438	.058	.027	.379
Segment 3	3.103	-.195	-.346	.373	-.203

to the five factors. These factor scores were then submitted to a standard K-means clustering algorithm (PROC FASTCLUS in SAS). Table 3 presents an overview of the two- and three-cluster solutions suggested as appropriate by an examination of the resulting error sums-of-squares statistics. Not surprisingly, as indicated by the size of the largest cluster in both solutions, most of the countries are fairly homogeneous. The three-cluster solution indicates that the U.S. forms a singleton group of its own. This is consistent with previous comparative cluster analyses (e.g., Sethi 1971; Johansson and Moinpour 1978). We also observe in this three-cluster solution that Japan is grouped with some of the European countries. Johansson and Moinpour (1978) also found that cluster formations of Pacific Rim and non-Rim countries do not correspond to geographic groupings. Both cluster solutions are primarily driven by the first factor (MOBIL). The factors reflecting the country's health status (HEALTH) and cosmopolitanism (COSMO) also play a role, though to a somewhat lesser extent.[5]

Table 4 presents the results (for the minimum AIC solution) for the latent class estimation of the Bass model for each of the three product introductions. The first two columns of Table 4 present the parameter estimates for the propensity to innovate (p) and imitate (q) parameters. The final column displays the time to peak sales,[6] τ^*, which is a measure of the speed of diffusion (Bass 1969; Bayus 1992). To calibrate these models, we first obtained estimates of the respective market potentials, m_c, for each of the countries by applying non-linear least-squares to the solution of the differential equation in (1) (Srinivasan and Mason 1986). These estimates were used as inputs to normalize the sales penetration data. The parameter values for the innovation and imitation coefficients are all within a plausible range. In all cases, the q-parameter values are substantially higher than the p-parameter values. Table 5 shows the segment as-

TABLE 4
Latent Structure Diffusion Parameter Estimates

Segment	"p"	"q"	"τ^*"
A. Color TV Sets			
1	.004	.391	11.6
2	.006	.256	14.3
3	.007	.357	10.8
B.VCR Players			
1	.002	.479	11.4
2	.009	.435	8.7
3	.006	.365	11.1
C. CD-Players			
1	.020	.523	6.0
2	.019	.728	4.9

[5]We should also add that the clustering solution was sensitive to the variables that were selected. For example, a country segmentation scheme based on the macroeconomic variables only was different from the partitioning on the basis of all the variables.

[6]Time to peak sales, τ^*, is computed (Bass 1969) as $\tau^* = \ln(q/p)/(p + q)$, and has measure according to the same time interval as the input data (years in the present application).

TABLE 5
Segment Assignments Based on Posterior Probabilities

	Segment			Posterior Probability		
Country	Color TV	VCR	CD	Color TV	VCR	CD
Austria	1	1	1	1.000	1.000	1.000
Belgium	3	3	1	1.000	1.000	1.000
Denmark	3	3	1	1.000	.999	1.000
Finland	2	3	1	.940	.887	1.000
France	2	1	1	.996	.949	1.000
Japan	3	1	1	1.000	1.000	1.000
Netherlands	2	1	1	.994	.961	.998
Norway	3	2	2	.922	1.000	.999
Sweden	2	3	2	1.000	.990	.991
Switzerland	2	1	2	.998	.963	1.000
U.K.	2	2	1	.993	1.000	.997
U.S.	2	2	2	.992	1.000	1.000

signments ($\underset{\sim}{P}$) for each of the three products on the basis of the posterior membership probabilities mentioned in equation (A-3). We note that in all cases, the posterior membership probabilities are fairly extreme (i.e., close to 0 or 1) indicating excellent centroid separation for the estimated conditional multivariate distributions. The segments pertaining to the diffusion of color TV sets shows one singleton segment (Austria) and two equally sized clusters. The single-member segment has the highest imitation coefficient, but the lowest innovation coefficient. The two remaining segments only differ with respect to the imitation coefficients (.26 and .36, respectively). Note that for countries belonging to the second segment, the diffusion process was considerably slower ($\tau^* = 14.3$ years) than for the other two segments. The latent structure methodology also reveals a three-segment solution for the multinational diffusion process of VCR players. The first segment, containing Central European countries and Japan, has the lowest innovation coefficient, but the highest imitation coefficient. The second segment shows the highest innovation coefficient and an intermediate value for the imitation propensity. This segment also reveals the most accelerated diffusion pattern ($\tau^* = 8.7$ years) of the three derived segments. The third VCR segment, containing mostly Scandinavian countries, has the lowest imitation coefficient. Finally, the diffusion-based segmentation for the most recent innovation, CD players, produced two evenly balanced segments. The two segments differ primarily on the imitation propensity coefficients (.52 versus .73). We also observe that both coefficients are considerably higher than any of the corresponding values found for the other two consumer durables. Evidently, the diffusion rates for CD players are considerably higher across all countries as compared with the VCR and color TV durables. This would provide some support to the claim that products are diffusing at an accelerating pace (Qualls, Olshavsky, and Michaels 1981).

Discussion

We organize our discussion around the three research questions we posed at the outset:

1. Do cluster-based macro-level country segmentation schemes relate to diffusion-based country groupings?

We first focus on the relationship between the macro-level country segmentation and diffusion-based segmentation. If diffusion patterns are comparable for countries that fall in the same macro-level country characteristics-based segment, international marketing managers could use such traditional country segmentation schemes to assess target markets. A rough comparison of the segment assignments in Tables 3 and 5 demonstrates that there is little correspondence between the respective partitionings. For example, though the U.S. consistently shows up as a stand-alone entity in the K-means cluster solution, its diffusion patterns are similar to many European countries. Most of the clusters are also more evenly sized for the diffusion-based segmentations. To measure the level of agreement between macro-level and diffusion-based segments, we computed (adjusted) Rand indices (Hubert and Arabie 1985) for each of the cluster comparisons. This adjusted R^2-like quantity measures the degree of correspondence between a pair of cluster solutions. A value close to 1 (corresponding to a perfect match) of the Rand index indicates a good consensus between a pair of partitionings. The values of the Rand index for the macro-level two-segment (three-segment) solution comparisons with each of the diffusion-based groupings using color TV, VCR, and CD player are -.056 (.123), .156 (.015), and .177 (-.055), respectively. These low values corroborate the observation concerning the lack of congruence between the two segmentation schemes.

We also can compare the diffusion-based country groupings to the high-low context cultural classification developed by Hall (1976). The terms "high" and "low" refer to the weight attached to spoken messages vis-à-vis the context in which the message is conveyed. Low context societies attach more meaning to the message itself. What is said is what is meant. High context cultures pay more attention to the context of the message (e.g., social standing of messenger, identity of messenger). Of the countries covered in our studies, Hall classified the U.S., Swiss, and Scandinavian cultures as low context. Japanese society is viewed as a high-context society. The remaining countries (France, U.K., Belgium, Netherlands) are medium context societies. Using this classification scheme as a benchmark, we note that the diffusion-based clusters derived for color TVs and VCRs contain a mixture of low/high context societies. For instance, the third color TV cluster (see Table 5) contains

TABLE 6
OLS Regression of Pairwise Country Differenced Diffusion Parameters on Country Factor Scores

Variable	Color TV		VCR		CD-player	
	"p" (x1000)	"q"	"p" (x1000)	"q"	"p" (x1000)	"q"
CONSTANT	.330**	.011	.703	-.009	-.050*	.015*
	(2.5)	(1.3)	(1.4)	(1.1)	(1.9)	(1.9)
TIME	-.053	-.033**	1.973**	-.025**	.160*	-.048*
	(1.1)	(11.2)	(6.1)	(4.6)	(2.2)	(2.2)
MOBIL	-.106	-.075**	-.700*	.028**	.110**	-.033**
	(1.1)	(11.6)	(1.8)	(4.2)	(8.1)	(8.1)
LIFE	.352**	.002	.794**	-.013	.264**	-.080**
	(4.7)	(.4)	(2.9)	(2.8)	(17.0)	(17.0)
COSMO	-.628**	.037**	-1.107**	.021**	.029*	-.009*
	(9.0)	(8.6)	(4.7)	(5.3)	(2.1)	(2.1)
TRADE	.087	.033**	-1.694**	.007	.011	-.003
	(1.1)	(6.8)	(4.4)	(1.1)	(.7)	(.7)
HEALTH	.178**	-.045**	1.365**	-.006	.062**	-.019**
	(2.1)	(8.6)	(3.1)	(.8)	(3.7)	(3.7)
Adj. R^2	.70	.71	.59	.57	.88	.88

(t-statistics are reported in parentheses)

*$\alpha < .05$
**$\alpha < .01$

Japan (high context), Belgium (medium context), and Denmark and Norway (low context). However, the second cluster for CD-players consists solely of low context cultures (Norway, Sweden, Switzerland, and the U.S.). Overall, there is little evidence of linkage between the diffusion-based country clustering and Hall's high-low context schema.

2. Does information on country characteristics provide any insights on diffusion-based country segments?

Earlier we found that country segmentation on the basis of macro-level data provides little information on diffusion process similarities. Rather than examining the segments, we now look to the individual country macro-level measures. Our goal is to establish whether we can locate measures that will help us discriminate between these diffusion patterns. To address this question, we ran an OLS regression for the innovation and imitation coefficients derived in the latent class estimation for all three durables. Given the small number of observations,[7] we ran the regression analyses for the pairwise differences in the values of these estimated coefficients (i.e., p_i–p_j and q_i–q_j, $i \neq j$) for all 66 pairs of countries. The predictor variables (likewise difference) included the five dimensions identified in the factor analysis (see Table 2) and introduction time. The latter is included to incorporate lead-lag effects. Takada and Jain (1991) found that lagged introductions in a country lead to an accelerated diffusion of that product within that marketplace. The resulting parameter estimates are given in Table 6. The results in Table 6 summarize the directional impact of the variables. Judging from the values of the adjusted R^2s, ranging from about .6 to .9, the overall fit generally appears high. This suggests that the constructs bear some relationship to the diffusion parameters. Unfortunately, the directional impact of the country characteristics is not systematic across product innovations. Sign reversals or lack of significance occur for each of the variables. Ignoring the nonsignificant cases, the only systematic instances are related to the effect of "life-style" (positive), "health status" (positive), and the lead/lag gap (positive) on the internal influence parameters, p. According to the parameter estimates reported in Table 6, more developed countries with a high "life-style" appear to have a higher propensity to innovate. We note that this finding agrees with the positive relationship between income and innovativeness found in the diffusion research literature (Rogers 1983; Gatignon and Robertson 1985). Larger gaps between the introduction times are apparently coupled with higher propensities to innovate. The same variables ('life-style," "health status," and lead/lag gap) are also the only variables that show a consistent pattern (when significant) for the imitation coefficient. Countries rated high on cosmopolitanism appear to manifest stronger tendencies to imitate. Gatignon, Eliashberg, and Robertson (1989) found a mixed pattern for the impact of this variable on the imitation coefficient. On the other hand, high levels of economic development are coupled with lower propensities to imitate. Higher spending on leisure activities appears to be associated with stronger propensities to imitate. No systematic patterns were found for the "trade" measure. The results found for the effect of the timing variable on the imitation parameter contradict the findings documented by Takada and Jain (1991). The negative signs indicate that the diffusion process would decelerate in the lag-country. This is an intriguing finding that may be peculiar to the sets of products and/or countries examined here. To summarize, we find that there are certain country constructs that may relate to new product diffusion patterns. However, it is not always clear when such variables will

[7]This also hindered our analysis of the cluster assignments by, for instance, discriminant analysis.

have an impact and in which direction, especially among different product classes.

3. Do similarities in diffusion patterns for earlier introduced products offer information on multinational diffusion processes for future and different product introductions?

Finally, we examine whether one can learn anything about the multinational diffusion patterns for future new product introductions, given the observed dynamics for past innovations. To that end, we assess how stable the diffusion-based segments are across three consumer durables. The three consumer durables that we analyzed were launched sequentially over time in each of the market places. The respective partitionings (see Table 5) show very little congruence in terms of the number of segments and their composition. In fact, the only countries that consistently fall into the same grouping for all three consumer durables are Belgium and Denmark. (However, as Lee 1991 aptly demonstrated, one must be cautious in classifying countries in terms of so few and restrictive product categories.) We computed Rand indices for the color TV set-VCR, color TV set-CD player, and VCR-CD player, partitioning comparisons. They are −.116, −.115, and .013, respectively. These low values formalize this observation. Notice that the CD player analysis yields only two country clusters. Given that this product was marketed most recently, it will be interesting to see whether further product introductions in these countries will also lead to so few country segments. If so, such phenomena might signal a shift towards increasing globalization of durable goods markets (Quelch and Buzzell 1989).

Managerial Implications and Summary

Comparative cluster analysis has been proposed as a device to partition countries into homogeneous segments. The variables that are typically used as inputs cover a broad gamut of socioeconomic, political, and cultural characteristics. Presumably, such classifications can assist the international marketing manager in entry and resource allocation decisions. Some scholars have expressed skepticism about the value of such traditional, macro-level country segments. Country segmentation studies may be plagued by shortcomings such as the lack of comparable data, appropriateness for product/service-specific markets, or the absence of validity over time (Cavusgil and Nevin 1981). Furthermore, there are a number of technical issues, such as which macro-level variables to select in the data set, that may complicate the use of this methodology. (Some of the later technical problems can be overcome by utilizing more advanced clustering algorithms such as SYNCLUS [DeSarbo et al. 1984] or CONCLUS [Helsen and Green 1991], which allow for differential variable weighting.)

In this article, we delve into a more fundamental issue: Given a certain segmentation partitioning, can we make inferences about likely new product diffusion patterns? To that end, we analyzed the diffusion patterns for three recently launched durable goods in twelve countries across the globe. To derive segments, we modified a latent structure methodology for linear regression (here, to accommodate the Bass model). This methodology allows countries to fractionally belong to multiple segments. This corresponds to the notion of "mixed-market" segments in international markets, as advocated by Toyne and Walters (1993). Our findings indicate that, for all practical purposes, little agreement exists between the traditional-derived country segments and diffusion-based country segments. Some of the macro-level variables (e.g., "life-style") may assist the international marketing analyst in speculating about probable diffusion patterns. However, it is not always clear what, if any, the directional impact of such variables will be. As an alternative, one could investigate segments on the basis of past new-product introductions. That is, do countries that manifested similar diffusion patterns for one innovation show similar patterns for subsequently introduced products? Our segmentation comparisons showed no stability of diffusion-based segments across time-spaced new-product introductions. Therefore, managers should be cautious in presuming similar product diffusion patterns for countries that are classified as being similar. However, this does not imply that country segmentation studies are useless. There are many applications for which grouping of countries along certain criteria will prove helpful (see Jeannet and Hennessey 1992, pp. 164–5).

The message to international marketing managers is clear. First, insights on the basis of such analyses may prove useful in screening international market opportunities (Day, Fox, and Huszagh 1988). Second, traditional country segmentation schemes derived on the basis of macro-level socioeconomic, political, and/or cultural criteria may provide little guidance as to the success of specific new product introductions. Third, differences among countries' diffusion processes are not well explained by these macro-level characteristics. Finally, the same country may exhibit substantially different diffusion processes for time-spaced new-product introductions and may therefore need to be classified into different market segments varying by product class.

Given the limited set of products we analyzed, it is hard to draw general conclusions stretching to other types of products. However, the two-step latent structure/profiling approach that we detailed can be employed fruitfully to analyze multinational diffusion patterns for other new product innovations. As we showed earlier, some of the (dis)similarities in cross-country diffusion processes could be explained with macro-level variables or entry time differences. Furthermore, differences in micro-level variables such as the intensity of competition (Gatignon and Robertson 1989), pricing policies, and/or advertising spending could lead to distinct diffusion patterns.

There are a number of areas for further research. It would be interesting to incorporate marketing mix variables in the diffusion parameters. However, such information is usually impossible to collect in international marketing studies. All three products were closely related (consumer entertainment electronics). It would be interesting to see if the major thrust of our findings would differ for a more varied set of products. On the methodological side, efforts could be undertaken to relax the normality assumption or allow for a mixture of nonlinear regression models (Srinivasan and Mason 1986). Another important extension would be to allow for time-varying country descriptors in country segmentation. Typically, the analyst is forced to take the mean over time of the country measures used in the segmentation. A methodology that allows usage of longitudinal data would therefore be of great interest. Further empirical research could explore the precise nature of the derived segment dissimilarities. Finally, in light of the emergence of major trading blocks (e.g., EC '92), it would be of interest to track diffusion-based segments for future technologies.

Appendix

Let k denote membership in a country cluster (k = 1,...,K), c index countries (c = 1,...,C), and t index time periods (t = 1,...,T). We model country c's diffusion process, conditional on it belonging to country cluster k, using the discrete-time formulation of the Bass model in equation 1. Thus,

$$\text{(A-1)} \qquad y_{c,t} \mid k = x_{c,t} - x_{c,t-1} = [p_k + q_k x_{c,t-1}][1 - x_{c,t-1}] + u^k_{c,t},$$

or in matrix form:

$$\underset{\sim}{Y}^c \mid k = \left[(\underset{\sim}{1} - \underset{\sim}{x}_c) \mid \underset{\sim}{x}_c(\underset{\sim}{1} - \underset{\sim}{x}_c) \right] \begin{bmatrix} p_k \\ q_k \end{bmatrix} + \underset{\sim}{U}^k_c,$$

$$= \underset{\sim}{X}_c \underset{\sim}{\beta}_k + \underset{\sim}{U}^k_c,$$

where $x_{c,t} = X_{c,t}/m_c$ refers to the cumulative penetration in country c at time t, $\underset{\sim}{x}_c = (x_{c,t})$, $\underset{\sim}{Y}_c \mid k = (y_{c,t} \mid k)$, m_c is the market potential in country c, p_k and q_k are the coefficients of innovation and imitation, respectively, and $\underset{\sim}{U}^k_{c,t} = (u^k_{c,t})$ is a Tx1 vector of error terms assumed to follow a conditional multivariate normal distribution with mean $E(\underset{\sim}{U}^k_c) = \underset{\sim}{0}$ and covariance matrix $\underset{\sim}{\Delta}_k$. Therefore, $\underset{\sim}{Y}_c \mid k$ follows a conditional multivariate normal distribution (MVN) with mean vector $\underset{\sim}{X}_c\underset{\sim}{\beta}_k$ and covariance matrix $\underset{\sim}{\Delta}_k$. Like Gatignon, Eliashberg, and Robertson (1989), we also assume that the values for market potential, m_c, are derived from an external source.

The K country clusters are called latent classes since they are not observed; they are inferred from the diffusion data. Countries that belong to the same latent class (cluster) are characterized by the same diffusion process (p_k,q_k). Therefore, the objective of the methodology is to simultaneously infer the country cluster membership and the cluster-specific diffusion parameters. This is achieved through a latent structure analysis that we describe subsequently.

Let $\underset{\sim}{w} = (w_1,...,w_k)'$ denote the vector of the K mixing proportions such that $w_k > 0$ and $\sum_{k=1}^{K} w_k = 1$. The w_ks can be construed as the prior probability of any country belonging to country cluster k. Hence, since $\underset{\sim}{Y}_c \mid k$ has a conditional MVN $(\underset{\sim}{X}_c\underset{\sim}{\beta}_k, \underset{\sim}{\Delta}_k)$, the unconditional distribution of $\underset{\sim}{Y}_c = (y_{c,1},...,y_{c,T})'$ is a finite mixture of K such densities. That is,

$$\text{(A-2)} \qquad \underset{\sim}{Y}_c \sim \sum_{k=1}^{K} w_k f_{ck}(\underset{\sim}{Y}_c \mid \underset{\sim}{X}_c, \underset{\sim}{\beta}_k, \underset{\sim}{\Delta}_k),$$

where each $f_{ck}(\bullet)$ refers to a conditional multivariate normal density function with mean $X_c\beta_k$ and covariance matrix $\underset{\sim}{\Delta}_k$.

Estimates of the coefficients $\underset{\sim}{\beta}_k = (p_k,q_k)'$, the covariance matrices $\underset{\sim}{\Delta}_k$, and the mixing proportions w_k (k = 1,...,K) are derived via a maximum likelihood approach using an EM algorithm (see DeSarbo et al. for technical details). This method is suited for estimating models that deal with unobserved data (e.g., latent class membership). It iterates between and *E*xpectation step and *M*aximization step till convergence. In the E-step the country cluster memberships are estimated by their expected value given provisional estimates for $\underset{\sim}{\beta}_k$, $\underset{\sim}{\Delta}_k$, and w_k (k = 1,...,K). In the M-step, the provisional estimates for $\underset{\sim}{\beta}_k$, $\underset{\sim}{\Delta}_k$, and w_k are updated in light of the newly estimated values of country cluster membership. Once maximum likelihood estimates of $\underset{\sim}{\beta}_k$, $\underset{\sim}{\Delta}_k$, and w_k are found, one can then estimate the posterior probability (conditional on the parameter estimates) of country c assigned to cluster k as

$$\text{(A-3)} \qquad P_{ck} = \frac{w_k f_{ck}(\cdot)}{\sum_{p=1}^{K} w_p f_{cp}(\cdot)}$$

These posterior probabilities represent a fuzzy classification of the C countries into K clusters based on the similarity of their diffusion processes. This approach of country classification has the benefit of allowing countries to belong to several clusters in the spirit of cross-country segmentation (Jain 1993).

When estimating our latent class diffusion model, the number of country clusters is unknown *a priori* and therefore must be inferred from the diffusion data. We make such inference by running the estimation procedure for a varying number of clusters and select the K that best represents the data. The appropriate number of country clusters is selected based on the minimum value of the Akaike's information criterion:

$$\text{(A-4)} \qquad AIC_K = -2\ln L_K + 2N_K,$$

where ln L is the log-likelihood and N_K is the number of parameters. The AIC heuristic penalizes the log-likelihood for estimating additional parameters (i.e., more segments).

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