NEW METHODS FOR *EX POST* EVALUATION OF REGIONAL GROUPING SCHEMES IN INTERNATIONAL BUSINESS RESEARCH: A SIMULATED ANNEALING APPROACH*

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ABSTRACT

International business research has long acknowledged the importance of regional factors for foreign direct investment ("FDI") by multinational corporations ("MNCs"). However, significant differences when defining these regions obscure the analysis about how and why regions matter. In response, we develop and empirically document support for a framework to evaluate alternative regional grouping schemes. We demonstrate application of this evaluative framework using data on the global location decisions by US-based MNCs from 1980-2000 and two alternative regional grouping schemes. We conclude with discussion of implications for future academic research related to understanding the impact of country groupings on MNC FDI decisions.

Keywords: *Simulated Annealing, Regional Groups, Foreign Direct Investment, Multinationals*

INTRODUCTION

International business ("IB") research on determinants of country attractiveness for foreign direct investment ("FDI") by multinational corporations ("MNCs") has long emphasized the importance of a country's regional grouping. Countries in the "Triad" of North America, Western Europe and Greater Japan (Ohmae, 1985; Rugman & Verbeke, 2004) are considered more attractive for investment than similarly-situated countries outside this Triad. Countries from Latin America with civil law traditions are less attractive for lending and investment than South Asian countries with common law traditions (La Porta *et al.*, 1998). Alternative regional groupings based on cultural affinity (Hofstede, 2001 [1980]; Ronen & Shenkar, 1985), geo-political orientation (UN, 2006), and or economic development levels (Vaaler & McNamara, 2004) are also considered important in understanding individual country attractiveness for MNC FDI.

But this IB research stream faces challenges related to the ex ante grounding of these regional groupings. Sometimes their justification follows from research intuition, bald assumption or anecdotal support. Even when grounded in theory, regional groupings are often vulnerable to reasonable refinements that can substantially change their power to explain important IB phenomena, including but not limited to MNC FDI. These concerns undermine regional grouping concepts, constructs and measures and impair the validity and reliability of theoretical and empirical IB research relying on them. In this context, we see an opportunity to contribute methodologically with an alternative approach to assessing regional grouping schemes. This approach complements *ex ante* theoretical assessment of regional grouping schemes with *ex post* assessment of their robustness to reasonable refinements. It promises insight on current and future IB research regarding the absolute and comparative robustness of different regional grouping schemes important

to the study of MNC FDI patterns and broader questions of individual country attractiveness for lending and investment.

In Section 2, immediately below, we begin to develop these points, first by surveying the theoretical and practical grounding of alternative regional grouping schemes used in recent IB research. We hold that some grouping schemes lack *ex ante* theoretical grounding and follow from *ad hoc* researcher assertion or intuition. Alternatively, *ex ante* theoretical grounding is often weak, thus rendering schemes vulnerable to substantial change after reasonable refinements. In this context, we propose an *ex post* empirical technique for complementary evaluation of alternative grouping schemes using a novel algorithm based on simulated annealing.

As we describe in greater detail in Section 3, simulated annealing permits iterative refinements and optimization of initial grouping schemes where the number of alternative grouping schemes is great and global optimization of the scheme based on desired criteria is challenged by the existence of several local optima (Fox, Srinivasan, & Vaaler, 1997; Goffe, Ferrier, & Rogers, 1994). Given an initial regional grouping scheme and some theorized relationship between the grouping scheme and some phenomenon of IB research interest, we can then iteratively estimate, refine, and then re-estimate the impact of alternative grouping schemes as the algorithm heads toward the global optimum. Comparison of differences in grouping schemes before and after simulated annealing provides the basis for *ex post* evaluation of regional grouping scheme robustness. Schemes with more (less) change in the number of groups, more (less) change in the sign and significance of non-group factors, and more (less) change in overall regression equation explanation of variation in phenomenon of interest are less (more) effective at supporting research inferences of interest.

In Section 4, we illustrate our approach to *ex post* evaluation of alternative regional grouping schemes using a recent empirical analyses reported in Flores & Aguilera (2007) . They estimate the likelihood of US MNC FDI in countries around the world in 1980 and 2000 using a panel *general estimating equation* (GEE) technique with several country-specific economic and cultural factors as well as regional group dummies. We re-create their analyses using two different regional grouping schemes: One based on continental location (North American, South American, Europe, Africa, Australia-Asia); and another based on a scheme proposed by Vaaler and McNamara (2004) to explain differences in country sovereign risk (North America, Latin America-Caribbean, Western Europe, Central-Eastern Europe, Africa-Middle East, Australia-Asia). After initial Logit estimation of the likelihood of US MNC investment in foreign countries using these country specific variables and one of these two alternative regional grouping schemes, we submit the initial schemes to simulated annealing analysis. At the conclusion of this analysis, we compare the extent of before and after change for each case, and assess the robustness of each scheme alone and in comparison.

We conclude with Section 5, where we summarize the central issue and findings of this methodologically-focused paper. We note several implications for IB and related management research streams that rely on the validity and reliability of these country groups, whether they be regionally or otherwise defined. We propose practical strategies for implementing such *ex post* schemes for evaluating schemes and suggest how simulated annealing itself might be incorporated into future empirical work.

REGIONAL GROUPING SCHEMES IN IB RESEARCH

MNCs, FDI and Regional Groups

How and why are regional grouping schemes important in IB research? To address this question and set the context for our survey of alternative grouping schemes we rely primarily on

Aguilera, Flores & Vaaler (forthcoming), who tackle this question in detail. The last two decades of research in IB and related management fields have seen substantial debate about the significance, and relative importance of a country location for understanding its attractiveness for MNC investment. Democratization in local polities, privatization, and deregulation in local economies, as well as international regimes promoting trade liberalization have all promoted the position of MNCs as instruments of country investment and growth, as well as instruments of regional integration and, indeed, globalization of formerly segmented national markets (Dicken, 1998; Giddens, 1999; Held, 2000).

Yet, research on central tendencies in MNC internationalization remains inconclusive and requires more systematic analysis. On the one hand, IB scholars such as Rugman and Verbeke (Rugman & Verbeke, 2004, 2007) claim that MNCs locational patterns have become increasingly regional as opposed to global. Thus, understanding the impact of regional country groupings is increasingly important for explaining whether and how MNCs internationalize. This "regional argument" contrast with other arguments championed by other IB scholars who emphasize the value of global scale and scope in MNC operations (Agmon, 2003; Bird & Stevens, 2003; Clark, 1997; Clark & Knowles, 2003; Clark, Knowles, & Hodis, 2004). Regional patterns of operation are still important to study from this alternative view, however, as they represent intermediate steps in the internationalization trajectories of firms transforming themselves from domestic to regional, to worldwide competitors. Thus no matter the side researchers take in this debate, understanding alternative regional grouping schemes and their impact on MNC internationalization behavior becomes critical. We survey those schemes and raise issues related to their prudential use, validity and reliability in recent IB research.

Defining Regional Groups

In this context of debate over MNC internationalization patterns and the impact of regions, we see value first in seeking to define the concept of central interest. The term *region* might be intuitively defined as a "fairly large area of a country or of the world, usually without exact limits" (Longman, 1995). This definition implies proximity between countries based on physical dimensions of measurement. As we will see below, however, scholars in IB and related fields have defined regions by alternative dimensions of proximity. Countries have been grouped based on broad patterns of trade and economic relationships (e.g., Rugman & Verbeke, 2004), based on broad cultural indices (e.g., Hofstede, 2001 [1980]), based on key components of culture such as language, religion, law, politics and popular media (e.g., Guiso, Sapienza, & Zingales, 2006) as well as on shared physical proximity (e.g., Vaaler & McNamara, 2004). We survey some such schemes and note their key findings related to debate over MNC internationalization patterns below.

Regional Grouping Schemes Based on Economics and Trade

Though readers might intuit that physical proximity is the most common dimension for grouping, dimensions related to common levels of economic development tend to dominate most schemes in IB research. Several studies stress the need of looking at the outcomes of regional economic integration (Frankel, 1997). One of the forerunners of this approach was Ohmae (1985), who grouped countries into a Triad of three regions centered on Japan, the US and Western Europe, primarily France, Germany, and the UK. He claimed that MNC survival required some dominant market positioning in at least one these three national economies, and by implication, the North American, European and or Asian countries that depended on each Triad leader.

Building on Ohmae's insights, Rugman and Verbeke note that regional FDI by MNCs follow multilateral trade regimes such as the North American Free Trade Agreement (NAFTA), the

Association of Southeast Asian Nations (ASEAN) and the European Union (EU) (Rugman, 2005; Rugman & Verbeke, 2004, 2005). Researchers have highlighted the relevance of countries' membership in key transnational organizations such as the Organisation for Economic Co-operation and Development (OECD) (Buckley & Ghauri, 2004; Dunning, 2001; Gatignon & Kimberly, 2004). On the other hand, an emerging literature in political economy suggests that regional FDI follows a more complex regional grouping based on multilateral regimes *and* bi-lateral investment treat arrangements (Simmons, Elkins, & Guzman, 2006). Thus, regional trading blocs and economic arrangements might benefit from refinement based on additional bilateral dyads and arrangements.

Regional Grouping Schemes Based on Culture

Those scholars grouping countries according to some common cultural dimensions have usually used different personal attitudes and beliefs[1]. Perhaps the prominent application of cultural dimensions to group countries together for explanation of MNC behavior comes from Hofstede (2001 [1980]). He first surveyed IBM employees in 53 countries in the 1970s to derive four cultural dimensions. Relying on a statistical technique (hierarchical clustering) for the cultural dimensions he uncovered in his studies (power distance, uncertainty avoidance, masculinity/femininity and individualism/collectivism), Hofstede ended up defining a 12-group regional structure (Hofstede, 2001 [1980]: 62).

Hofstede's indexes have provided the basis for subsequent empirical studies that have documented similarity (dissimilarity) between MNC investment and competitive behaviors within (between) regions defined by different factors and clusters (see Kirkman, Lowe, & Gibson, 2006 for a complete review of the consequences of Hofstede's framework). Later, Ronen and Shenkar (1985) offered their own scheme, partially using the work of Hofstede, where 45 countries were

[1] (see Earley, 2006; Hofstede, 2006; Javidan *et al.*, 2006; Smith, 2006 for current debate over culture in international business)

grouped into nine cultural clusters, while Furnham, Kirkcaldy and Lynn (Furnham, Kirkcaldy, & Lynn, 1994) offered their own scheme of 41 five cultural clusters. More recently, a large survey focused on cultural dimensions, the World Values Survey (Abramson & Inglehart, 1995), is finding more use in IB research. The so-called GLOBE project represents yet another stream flowing from Hofstede's culturally focused research (House *et al.*, 2002). Gupta, Hanges and Dorfman (2002) have used GLOBE project data in discriminant analyses to identify seven regional groups for 61 countries involved in the GLOBE project, while Brodbeck and a large team of researchers in European countries (Brodbeck et al., 2000) and Lenartowicz and Johnson in Latin America (Lenartowicz & Johnson, 2003) have used GLOBE project data to identified intra-regional grouping schemes relevant to MNC behavior.

Regional Grouping Schemes Based on Institutions

Yet another approach to using social dimensions relies less on aggregate indices and more on specific cultural traits such as language, religion, law, politics and media. This approach comprises both culture defined by individual attitudes and beliefs and culture-as-institutions, that is, the collective legal, political and social arrangements that spring from such attitudes and beliefs and together guide basic rules of economic exchange (North, 1990). Language and religion are particularly important cultural components, such as in work by Chetty and his colleagues (forthcoming), Dow and Karunaratna (2006), and Leung and his colleagues (2005).

Under this approach, regional groupings based on: similar economic development (Dunning, 1998, 2001), similar levels of corruption, bureaucratic efficiency, media and voice, or respect for law (Globerman & Shapiro, 2003; Kaufmann, Kraay, & Zoido-Lobaton, 1999; La Porta *et al.*, 1999) may explain MNC FDI and lending actions. La Porta and his colleagues, for example, document that countries with Anglo-American common law traditions providing stronger investor

and creditor protections draw more foreign investment, have deeper and broader debt markets compared to countries with French civil law traditions. Aguilera and Cuervo-Cazurra (2004) note that their findings support the idea that countries with more protective (of minority shareholder rights) legal systems tend to develop stronger and better-enforced codes of good corporate governance. On the other hand, Bercowitz, Pistor and Richard (2003) show that many results obtained by La Porta and his colleagues vary once more refined country groupings are defined. Bercowitz and colleagues distinguish between common and civil law countries where the legal system was imposed by force or developed organically. Countries where legal system developed organically, whether civil or common law in nature, provide more protection than in countries where the system was forcibly "imported."

Regional Grouping Schemes Based on Geography

Physical proximity and contiguity present the most straightforward dimensions for creating regional grouping schemes. Here, shared geography overlaps with, and contributes to, other similarities along dimensions previously surveyed above. Dividing the world into continental groupings such as Europe, Asia, America, Africa and Oceania often appears in IB research. Kwok and Tadesse (2006) choose continental groupings to study the free market-orientation of financial systems in 41 countries. Similarly, Katrishen and Scordis (1998) find that the continent from which MNC insurers are domiciled is significantly linked to MNC insurer likelihood of achieving economies of scale. Geringer, Beamish and daCosta (1989) also control by continent of origin when assessing performance of 200 MNCs with differing levels of diversification and internationalization. Vaaler and McNamara (2004) find that continental regional specialization by major credit rating agencies significantly and substantially changes their sovereign risk assessments in the late 1980s and 1990s.

The United Nation's Statistics Division may offer more fine-grained partition of these geographic regions(UN, 2007). The UN scheme breaks up countries into 19 regions (*i.e.*, Australia and New Zealand, Caribbean, Central America, Eastern Africa, Eastern Asia, Eastern Europe, Melanesia, Middle Africa, Northern Africa, Northern America, Northern Europe, South America, South-Central Asia, South-Eastern Asia, Southern Africa, Southern Europe, Western Africa, Western Asia, Western Europe). Flores and Aguilera (2007) used this scheme to explain US MNC country location decisions in 1980 and 2000.

Use, Validity and Reliability Issues in Recent IB Empirical Research

Our review of the empirical literature related to regional effects in IB and related fields reveals clear differences regarding dimensions for grouping countries, and the consequential explaining of MNC behavior and performance within and across such groupings. No doubt this often follows from the eclecticism of IB research interests, theoretical perspectives and empirical analytical methods. Even so, some such dimensions are provided without any *ex ante* theoretical grounding, thus undermining concept, construct and measurement validity. Even where *ex ante* theoretical grounding is provided, we note in many cases that alternative schemes based on similar theories and methods yield different results, thus impairing reliability claims as well.

For example, Ronen & Shenkar (1985) refined Hofstede's regional clusters with differing results regarding MNC executive attitudes, while Simmons and her colleagues (2006) suggest that refinement of regional trading blocs based on assessment of bilateral investment treaties may change previous results based on multilateral trade agreements alone. And more fine-grained regional grouping schemes based on legal system differences reported by Bercowitz and her colleagues (2003) yield different insights on the extent of investor and creditor protection for MNCs compared to more coarse-grained measures and groupings proposed by La Porta and his colleagues.

A NEW *EX POST* APPROACH TO ASSESSING REGIONAL GROUP VALIDITY AND RELIABILITY: SIMULATED ANNEALING

*Ex Pos*t Approaches to Assessing Regional Grouping Schemes

We take such findings as the departure point for our own alternative approach to evaluation of regional grouping schemes. Rather than attack the theoretical validity and reliability of prominent regional grouping schemes reliant on economic, cultural, institutional and other dimensions *ex ante*, we propose an alternative *ex post* evaluative technique based on iterative refinements and re-estimation using a simulated annealing approach. However, the regional scheme is structured, the *ex post* question to be posed is *whether and how much such a scheme is subject to change after reasonable refinements*. Schemes that are vulnerable to substantial change have weaker validity and reliability than schemes exhibiting less change. Evidence of robustness after submission to this *ex post* evaluation responds to criticisms noted above with empirical evidence demonstrating the stability of key grouping assumptions grounded in whatever theory IB researchers choose initially to justify their regional grouping scheme.

Consider, for example, an empirical model of MNC country location defined as follows:

$$MNCSubsidiary_{ijmt} = \alpha_0 + \sum_{k=1}^{k=l} CountryFactors_{it} + \sum_{n=1}^{n=p} MNCFactors_{jt} + \sum_{q=1}^{q=r} YearFactors_{t} + \sum_{s=1}^{s=u} \mathrm{Re}\, gionalDummies_{m} + \varepsilon_{ijmt} \quad (1)$$

In (1), the dependent variable is a 0-1 indicator equal to 1 when MNC *j* has a subsidiary operation in country *i* part of region *m* in year *t*. We explain the likelihood of MNC location of a subsidiary operation based on country factors *i* (*k*=1-*l*), MNC factors *j* (*n*=1-*p*) and time (year) factors *t* (*q*=1-*r*). In addition, we define a regional grouping scheme in the form of fixed regional dummies *m* (*s*=1-*u*). The structure of this regional grouping scheme is presumably grounded ex ante in theory related to the significance of economic, cultural, institutional and or geographic factors. Logistic or Probit estimation of this model provides insight on the impact of regional grouping based on evaluation of

the regional dummies for their individual and collective significance and practical impact.

Our approach implies re-estimation of (1) after iterative *ex post* refinement of the initial regional grouping schemes. This implication raises new challenges related to the extent of these refinements. In concept, alternative regional groupings are limited only by the number of countries and potential country combinations. It is unfeasible to search all of these possible alternative schemes. A partial search seeking to refine the grouping scheme based on some simple optimization criterion may reduce search time, yet challenges still persist. Consider, for example, a search to refine some initial regional grouping scheme based on minimization of the regression equation's unexplained variance, that is, the error sum of squares ("ESS") generated by logistic estimation. If the number of alternative grouping schemes with refinement is still large, simple minimization using conventional algorithms such as Newton Raphson or Davidson-Fletcher-Powell is likely to move greedily to a local minimum but search no further. Thus, we may end search and refinement of initial regional grouping scheme prematurely, thus leaving the global minimum ESS unidentified and the researcher unsure as to the stability of initial results.

Ex Post Evaluation Based on Simulated Annealing

An alternative "simulated annealing" search algorithm improves on these and other "hill-climbing" heuristics. Usually the cooling process for molten metal is used to detail how this procedure works. On those 'cooling' processes where the temperature of the metal is continuously reduced, after a slow cooling (annealing), the metal arrives to a minimum energy state. Innate random variations in energy allow the annealed system to escape local energy minima. Even though this technique is not flawless in finding the global minimum, it tends to achieve an ending point closer to the global minimum than do conventional algorithms (Alrefaei & Andradóttir, 1999; Goffe *et al.*, 1994). Perhaps the best-known application of simulated annealing is to the "traveling

salesman" problem, where the goal is to find the minimum trip distance connecting several cities. Academic applications of this technique range from optimal land use and irrigation design (Aerts & Heuvelink, 2002) to micro-circuit design (Kirkpatrick, Gelatt, & Vecchi, 1983). Within the management realm, Han (1994) uses simulated annealing for optimal information filing, while Carley & Svoboda (1996) model optimal organizational adaptation to environmental shocks. Semmler & Gong (1996) optimize the size of industry groupings in analyses of real business cycle parameters, while Fox, Srinivasan & Vaaler (1997) use simulated annealing to refine business membership in standard industry classes and assess the impact of such intra-industry strategic groups on business performance in the US during the 1970s.

To explain how the annealing algorithm functions in our application, consider an initial partitioning of countries into regional groups based on (1): $\{P_s\} = (p_{s=1}, p_{s=2}\ldots, p_{s=u})$. Here, p_s represents the s^{th} regional group composed of n countries. Coefficients are estimated for this initial partition. Next, a new partition [P_s'] is made by varying the group structure of the whole set of countries. The variation may be of two types:

1. It may be a random exchange of two countries from different regional groups, p.
2. It may be a random perturbation changing the size of a given region, p_s, resulting in a change in the number of countries n in the region from $x \geq 3$ to $x - c \geq 3$ where c is some integer.

After re-estimation, if the new ESS' is less than the old ESS, the new regional group structure, $\{P_s'\}$, structure replaces the old regional group structure, $\{P_s\}$, and the algorithm moves downhill. If the new ESS' is greater than or equal to the old ESS, then acceptance is stochastic. A criterion developed by Metropolis and his colleagues (1953) decides on acceptance of an uphill move. Thermodynamics analogies also motivated the Metropolis criterion. The value:

(1) $$Metropolis = e^{-(ESS'-ESS)/T}$$

is estimated and compared to *Metropolis'*, a uniformly distributed random number ranging from [0,1]. If *Metropolis* is greater than *Metropolis'*, the new structure is accepted, $\{P_s\}$ is updated to $\{P_s'\}$, and the algorithm moves uphill. Otherwise, $\{P_s'\}$ is rejected and the search for alternative regional grouping schemes minimizing unexplained variance in (1) continues.

From equation (1), obviously two factors decrease the likelihood of an uphill move: lower 'temperature' (T) and larger differences in the function's value. After several iterations, the temperature is reduced in steps and the annealing process continues. As temperature is lowered, large moves uphill are discouraged and the algorithm favors smaller refinements leading towards the global minimum. The annealing schedule, that is, the initial temperature and the size of stepwise decreases, is *ad hoc* and requires experimentation. Successful annealing depends on the schedule and size of perturbations to the system considered at each iteration. The smaller the extent of a perturbation, the more likely the search will efficiently find the global minimum. The random choice of the initial regional group scheme will also influence the efficiency of the annealing process. The algorithm stops when some preset criterion is met. In general, the algorithm finishes during the final step in cooling after the rate of change in the ESS term fails to meet some preset rate of change related to the CPU speed of the computer doing the various calculations.

We apply these simulated annealing parameters to develop an executable program which follows the pseudo-code detailed below:

1. Define empirical model (1)
2. Read data into (1).
3. Run a logistic regression with an original regional grouping scheme.
4. Randomly select a regional group. Count the number of countries in it.
5. If there are six or more countries in the group, then randomly choose between changing group based on break up into two groups or randomly swap a country from that group with another group randomly chosen.
6. If there are fewer than six countries in the group, then randomly swap one country from group with another group randomly chosen.
7. Run the logistic regression with new group structure.

8. Compare new ESS' with previous ESS and apply Metropolis criterion to accept or reject change in group structure.
9. Repeat steps 3-8 at least 50 times at the given temperature. Stop iterations at given temperature and decrease temperature based on random stopping criterion
10. Repeat step 9 until final temperature decrease in annealing schedule is accomplished and overall stopping criterion is met.
11. Print final group structure, final logistic regression coefficient estimates and p-values, final pseudo R^2 and final ESS.

Once annealing is completed, we are in a position to assess the robustness of the original regional grouping scheme based on three criteria: 1) percentage change in the number of regional groups ($(u_{end} - u_{beginning})/u_{beginning}$ where u is the number of regional groups before (beginning) and after (end) annealing); 2) percentage change in overall MNC FDI model explanation (pseudo R^2_{end} – pseudo $R^2_{beginning}$/ pseudo $R^2_{beginning}$ where pseudo R^2 is the coefficient of variation before and after annealing; and 3) percentage change in MNC FDI model coefficients ($(w_{beginning} - w_{end})/w_{end}$ where the difference in w is the number of non-group terms retaining the original coefficient sign and significance after annealing). We can multiply each of these three measures by 100 to obtain percentages of change. A regional grouping scheme is less (more) robust *ex post* to the extent that each of these three percentages exceeds (verges on) 0%.

ILLUSTRATION OF OUR *EX POST* APPROACH

Data Sources, Sampling and Empirical Model for Illustration

We illustrate this ex post approach to evaluating different regional grouping schemes based on US MNC data used in Flores & Aguilera (2007). They examined the country location of 100 largest US MNCs in 1980 and 2000. Consistent with (1) above, the dependent variable, *MNC Subsidiary*, is a 0-1 variable taking the value of 1 if the MNC has a subsidiary in the country in the year of observation. These data are obtained from the Directory of American Firms Operating in Foreign Countries (Angel, 1991, 2001), which includes all major US firms' investments abroad. US

MNC investment abroad is where "American firms have a substantial direct capital investment and have been identified by the parent firm as a wholly or partially owned subsidiary, affiliate or branch. Franchises and noncommercial enterprises or institutions, such as hospitals, schools, etc., financed or operated by American philanthropic or religious organizations are not included."(Angel, 2001: i) This operationalization of US foreign location choice allows us to address, at least partially, some of the criticisms of drawing on sales as an overarching measure to capture MNC activities overseas (Clark & Knowles, 2003; Clark *et al.*, 2004; Dunning, Fujita, & Yakova, 2007). US firms in the sample cover 27 different two-digit SIC industry code from oil and gas exploration to pharmaceuticals manufacturing. The US MNCs in this sample have on average substantial direct capital investment on 22.9 countries in 1980 and 28.9 countries in 2000. The total number of substantial foreign capital investments for the 100 MNCs is 2,288 and 2,891 in 1980 and 2000, respectively, an increase of 26% over 20 years.

Again consistent with (1) we define several country-related, MNC-related and time- (year-) related variables. We include in (1) 10 country terms (with expected sign): 1) *Country Wealth* (+), which we operationalize as Gross Domestic Product in billions of current US dollars measures affluence in each year; 2) *Country Size* (+), which we operationalize as the total number of inhabitants in millions; 3) *Country Physical Infrastructure* (+), which we operationalize as the total number of phone lines per thousand inhabitants; 4) *New Country* (-), which we operationalize as a 0-1 term where 1 equals a country that did not exist in 1980; 5) *Country Political Institutions* (+), which we operationalize as a 0-1 term where 1 equals a country judged as democratic; 6) *Country Legal System* (+), which we operationalize as a 0-1 term where 1 equals a country with an Anglo-American common law tradition; 7) *Country Language* (+), which we operationalize as a 0-1 term where 1 equals a country where English is an official language; 8) *Country Geographic Distance* (-

), which we operationalize as distance in thousands of miles, between Washington, DC and the capital of each country; 9) *Cultural Distance* (-), which we operationalize based on Kogut and Singh's (1998); and 10) *Economic Development* (+), which we operationalize as a 0-1 term where 1 equals an OECD member country. Data for these terms come from the World Bank's World Development Indicators (*Country Size, Country Physical Infrastructure, New Country*), the *CIA FactBook* (*Country Political Institutions, Country Language, Country Economic Development*), Reynolds & Flores (1989) (*Country Legal System*), *Great Circle Distances Between Capital Cities* (Eden, 2006) (*Country Geographic Distance*) and International Institute of Culture (*Country Cultural Distance*).

Again consistent with (1) we include two firm (MNC) terms: 1) *Firm Size* (+), which we operationalize as the total number of employees; and 2) *Firm Performance* (+), which we operationalize as the total return to investors in the previous ten years. Data for these variables come from the UN Center for Transnational Corporations (UNCTAD, 2005). Finally, we include a 0-1 *Year* (-) dummy that equals 1 when year is 1980. We have complete data for foreign investments by 100 US MNCs operating in 105 countries in 1980 and 2000, a total of 19,635 observations for foreign investments made by this group of 100 US firms in 105 countries, total of 19,635 MNC country year observations. Descriptive statistics and pair-wise correlations for this sample are reported in Table 1.

******Insert Table 1 Approximately Here******

Regional Grouping Schemes and Annealing Schedule for *Ex Post* Evaluation

We add to the logistic regression model for estimating the likelihood of US MNC investment in various foreign countries regional dummies linked to two regional grouping schemes: 1) four regional dummies corresponding to a five-region grouping scheme based on the ***continental*** membership of countries (America (Canada and Latin America/Caribbean), South America, Europe, Africa and Asia); and 2) six regional dummies corresponding to a seven-region grouping scheme based on ***Vaaler and McNamara's*** (2004) research on sovereign risk rating around the world (North America-Caribbean, Latin America, Western Europe, Central and Eastern Europe, Africa-Middle East, Asia and Oceania). We omit North America from the continental regional grouping scheme, and omit Western Europe from the regional grouping scheme based on Vaaler and McNamara (2004). Once we estimated our base model for each of the two regional schemes, we submit them for iterative re-estimation and simulated annealing according to the following schedule:

Initial Temperature	100
Temperature Reduction Factor	0.98
Ending Temperature	0.05
Maximum Steps	100
Minimum Number of Iterations/Step Required	50
Maximum Number of Iterations/Step Permitted	25,000
Actual Total Number of Iterations	16,445 (Continental), 17,172 (Vaaler & McNamara)
Running Time on Workstation Computer	8 hours

Results Before and After Annealing

Results from initial logistic estimation based on both regional grouping schemes are presented in Tables 2 to 4. Case A results follow from the continental regional scheme while Case B results follow from the Vaaler and McNamara regional scheme. We first examine results in Table 2, that is, the "Beginning" country, firm and year coefficients for Case A and Case B. These

coefficients yield intuitive results. For the Case A continental scheme, 11 of the 13 country, firm and year coefficients have the predicted sign and 10 of the 11 are significant at commonly accepted (10% or better) levels. For the Case B Vaaler and McNamara scheme, 10 of the 13 coefficients have the predicted sign and all 10 are significant at commonly accepted levels. US MNCs are more likely to locate FDI in countries abroad if they are more profitable and larger MNCs, if it is in 2000 rather than 1980, and if the host country has the following characteristics: greater wealth and size, better infrastructure, is not newly independent, has more democratic political institutions, a common law legal system, less cultural distance from the US and a higher level of economic development.

******Insert Table 2 Approximately Here******

What about the explanatory power of each regional grouping scheme at initial estimation? Here, we see clear contrasts in Tables 3 and 4. With Case A's continental scheme, we see that two regions, Africa and Asia are significantly less likely to receive US MNC FDI, and we note that these four continental dummies as a whole add significant additional explanation to the logistic regression. On the other hand, with Case B's Vaaler and McNamara scheme, we find no significant regional dummies at the beginning. Were we to stop here, we might conclude that a simple continental scheme emphasizing geography and physical distance adds significantly and practically to the overall explanation of MNC FDI patterns over time.

******Insert Tables 3 and 4 Approximately Here******

However, submission of these two schemes to iterative refinement and re-estimation based on simulated annealing leads to a different view. We set minimization of the error sum of squares as

our annealing criterion and follow the schedule noted above. In this way, the annealing algorithm is set to search for additional explanation within the model, through iterative refinements of each grouping scheme. We track that search in Figure 1. Two panels in Figure 1 illustrate along the x-axis the number of iterations, that is, attempted refinements in grouping scheme, over the 100 temperature steps in the algorithm. Along the y-axis, we note changes in overall model explanation using a pseudo-R^2 measure commonly reported with logistic regression.

******Insert Figure 1 Approximately Here******

With Case A's continental scheme, the annealing schedule results in 16,455 iterations over 100 steps while Case B's Vaaler and McNamara scheme results in 17,172 over 100 steps. The number of iterations per step ranges from the minimum of 50 to more than 1,000. Either because the ESS is reduced, or because of stochastic criterion permitting acceptance where ESS is not reduced (*i.e.*, Metropolis criterion), we note more than 10,000 changes in both regional grouping schemes over the entire schedule that took approximately eight hours to implement on a state-of-the-art workstation computer.[2]

We note the similar patterns of change in both panels of Figure 1. With Case A's continental scheme, a seemingly random search for refinements to minimize ESS is rewarded approximately 75% of the way through the annealing schedule. At approximately 11,000 iterations, we start an increase in the pseudo-R^2 indicating refinement of group structure yielding greater explanation of variation in the likelihood of US MNCE country FDI. The rate of increase begins to level off at approximately 15,000 iterations, near the final steps in the annealing schedule where

[2] We wrote the program using C++ language and used a MATLAB logistic regression module combined with a simulated annealing algorithm based on (Press *et al.*, 1992). Interestingly, the MATLAB logistic regression module proved much more time-consuming to implement than the annealing algorithm on our workstation platform.

stochastic jumps based on the Metropolis criterion are quite unlikely. From 11,000 iterations to the end of the annealing schedule at 16,445 iterations, pseudo-R^2 increases from 0.32 to 0.38. We observe a ((0.38 – 0.32)/0.32)) 18.75% increase in model explanation from the very beginning to the end of simulated annealing.

With Case B's McNamara and Vaaler scheme, the seemingly random search for refinements to minimize ESS is again rewarded approximately 75% of the way through the annealing schedule. At approximately 11,000 iterations, we again start an increase in the pseudo-R^2 indicating refinement of group structure yielding greater explanation of variation in the likelihood of US MNCE country FDI. But only 1,000 iterations or so later, refinements to group structure decrease pseudo-R^2 only to see that reversed again in an upward direction at approximately 12,500 iterations. The regional grouping landscape for this scheme is apparently more rugged than in the case of the simpler continental scheme. Even so, we then observe a steady increase in model explanation that begins to level off at approximately 14,000 iterations, near the final steps in the annealing schedule where stochastic jumps based on the Metropolis criterion are less unlikely. From 12,500 iterations to the end of the annealing schedule at 17,172 iterations, pseudo-R^2 increases from 0.325 to 0.37. From beginning to end of simulated annealing, we observe a ((0.37 – 0.325)/0.325)) 13.8% increase in model explanation.

With annealing completed, we return again to Tables 2-4 for review. We look first at the "End" coefficient estimates in Table 2. Ending firm, country and year coefficients in Table 2 show little change with Case A's continental scheme. Only one of the 13 terms has changed in sign or lost significance at commonly accepted levels. After refinement of the initial group structure, newly independent countries are no longer significantly less likely to have US MNC FDI. This translates into a small ((11 – 10)/10)*100%)) 10% change in key coefficient estimates. Ending

firm, country and year coefficients with Case B's Vaaler and McNamara scheme exhibit only slightly less robustness. After refinement of initial group structure, newly independent countries are no longer significantly less likely nor are English language-speaking countries significantly less likely to have US MNC FDI. This translates into a larger ((10-8)/8)*100%)) 25% change in key coefficient estimates.

Tables 3 and 4 report the ending group structures after annealing. In Table 3, Case A's continental group scheme jumps from five (four dummies) to 14 (13 dummies) sub-continental groups with three new sub-continental regions significant at commonly accepted levels compared to two at the beginning of the analysis. As a whole, the new group dummies no longer add significantly to overall model explanation at commonly accepted levels. The increase in groups is ((14-5)/5)*100%)) 180%. In Table 4, Case B's Vaaler and McNamara group scheme increases from seven (six dummies) to 15 (14 dummies) or an increase of ((15-7)/7)*100%)) 143%. Two of the new sub-group dummies are significant at commonly accepted levels, but all of the dummies as a group are not significantly different from zero.

We pull these results together for side-by-side comparison in Table 5 below:

Table 5: Side-By-Side Summary of Results after Simulated Annealing

Grouping Scheme→ **Annealing Evaluation Criteria↓**	*Case A's Continental Grouping Scheme (Table A-1)*	*Case B's Vaaler and McNamara Grouping Scheme (Table A-2)*
Change in Group Structure (%)	180	143
Change in Key Coefficients (%)	10	25
Change in Model Explanation (%)	18.75	13.8

Case A's continental scheme exhibits more variation in group structure and model explanation but less change in key firm, country and year coefficients explaining MNC FDI compared to Case B's Vaaler and McNamara scheme. These results prompt more caution in our earlier provisional

assessment that simple continental grouping schemes may be preferred to more detailed schemes incorporating geography, and level of economic development as in Vaaler and McNamara. The continental scheme of regional dummies may provide significantly more initial explanation before annealing compared to the Vaaler and McNamara scheme, but the continental scheme may also be more sensitive to change in regional group structure and change in overall model explanation. If, on the other hand, the central research aim is to assess the robustness of key coefficients, then our simulated exercise suggests additional support for use of the simpler continental scheme. Even after refinement, more key coefficients retain their original sign and significance compared to the alternative grouping scheme based on Vaaler and McNamara. No matter the research focus, our simulated annealing exercise sheds helpful *ex post* analytical light on *ex ante* defined regional grouping schemes used previously to help explain core IB research phenomenon.

DISCUSSION AND CONCLUSIONS

Central Results

The central aim of this paper is methodological. We sought to show how empirical models of MNC FDI combined with simulated annealing, can help us understand the impact of regional grouping schemes on a core IB research phenomenon and debate. We showed conceptually and then through empirical demonstration how regional grouping schemes grounded in intuition or theory (or both) might be subjected to *ex post* evaluation through a process of iterative refinement and empirical model re-estimation. We developed the general logic for this *ex post* evaluation method –identifying the extent of before-and-after change through simulated annealing— and identified three potential dimensions for applying that logic. Our application of this method based on Flores & Aguilera (2007) model and data to two alternative grouping schemes, yielded helpful insight regarding the robustness of each initial group scheme to modest refinement and extended

search in a terrain of alternative sub-group structures with many local minima and maxima. Re-estimation with respectively refined group structure yielded additional insight on the robustness of initial model coefficient estimates and overall model explanation.

We think this *ex post* method for evaluating regional grouping schemes alone, or in comparison, represents a valuable complementary tool for researchers engaged in understanding the nature and impact of regions on MNC investment behavior. Our method can contribute to current debates over the regionalizing or globalizing nature of MNC expansion by identifying which regional grouping schemes are less (more) robust to reasonable refinements and thus less (more) reliable as indicators of true MNC expansion paths.

Implications for IB Research and Practice

Going forward, we see many implications for IB research and practice. Our method can complement not only *ex ante* groups defined by geography and or economic development levels as in this paper, but across any number of alternative dimensions. For example, we see value in implementing a series of pair-wise ex post comparisons of grouping schemes: We might consider ex post comparative evaluation of Hofstede's (2001 [1980]) versus Ronen and Shenkar's (1985) alternative grouping schemes based on cultural dimensions; we might consider the same for relatively simple law-related grouping schemes proposed by LaPorta and his colleagues (1998) versus more complex law-related schemes proposed by Bercowitz and company (2003). Indeed, we might use simulated annealing to compare any number of culturally-, geographically-, economically- and/or institutionally-derived grouping schemes, within and across these categories. Our comparative logic and measurable dimensions are sufficiently generic to permit this sort of study and gain greater insight on the value of alternatively defined schemes and their robustness to reasonable refinement.

We also see value extending such methods to other IB and related management phenomena of interest. The group concept is important to many fundamental issues in strategic management. As Fox and his colleagues (1997) as well as Short, Ketchen, Palmer and Hult (2007) have demonstrated, groups of firms within an industry space may have collective qualities determining firm behavior and performance, as apparently do groups of countries within a geographic, cultural, economic and or institutional space. If so, then results from initial estimation of strategic group effects for firms will benefit from ex post iterative refinement and re-estimation based on simulated algorithms and evaluative logics and dimensions similar to those developed in this paper. How soon do changes in group structure occur and how quickly do these refinements affect key coefficients and broader model explanation? Our *ex post* method of evaluating groups based on simulated annealing can render useful research insight across firms grouped within industries, across countries grouped within regions, and other grouping designations important to scholars in the broader management field.

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Table 1: Descriptive Statistics for Key Variables

Variable	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11
1. Capital Investment	0.18	0.38	1.00										
2. Firm Size	65 e+3	82 e+3	0.10***	1.00									
3. Firm Performance	11.2	9.6	0.01	-0.02**	1.00								
4. Country Language	0.34	0.47	0.01	0.00	0.00	1.00							
5. New Country	0.08	0.27	-0.03***	-0.00	0.09***	-0.21***	1.00						
6. Country Wealth	102.0	326.1	0.33***	-0.00	0.04***	-0.08***	0.01	1.00					
7. Country Population	33.2	119.2	0.12***	-0.00	0.01*	0.00	-0.03***	0.28***	1.00				
8. Country Phys Infrastr	147.0	182.6	0.32***	-0.00	0.10***	-0.03***	0.18***	0.39***	-0.06***	1.00			
9. Country Pol Institutions	0.54	0.50	0.21***	-0.00	0.12***	0.13***	0.13***	0.17***	0.01	0.39***	1.00		
10. Country Leg Institutions	0.34	0.47	0.12***	-0.00	0.02**	0.61***	-0.13***	0.08***	0.04***	0.07***	0.28***	1.00	
11. Country Geo Distance	5.53	2.16	-0.08***	0.00	-0.00	0.26***	-0.06***	-0.05***	0.11***	-0.20***	-0.16***	0.23***	1.00
12. Country Cult Distance	2.81	1.33	-0.14***	0.00	0.00	-0.05***	-0.11***	-0.12***	0.00	-0.35***	-0.04***	-0.10***	-0.04***

***** $p<0.05$**; **** $p<0.01$**; ***** $p<0.001$

Table 2: Logistic Regression Coefficients : Cases A & B

Control Variables	Case A: Continent Regional Scheme #		Case B: Vaaler & McNamara (2004) Regional Scheme #	
	Beginning	End	Beginning	End
Firm Performance	-0.0016***	-0.0026***	-0.0017***	-0.0018***
Firm Size	4.51E-06***	5.19E-06***	4.59E-06***	5.17E-06***
Country Wealth (GDP)	0.0016***	0.0002***	0.0016***	0.0009***
Country Size (Population)	0.0011***	0.0047***	0.0009***	0.0024***
Country Physical Infrastructure	0.0011***	0.0022***	0.0015619***	0.0031***
New Country Dummy	-0.2070*	1.1949	0.5805§	1.6686
Country Political Institutions	0.6521§	0.4019*	0.5980§	0.4800§
Country Legal Institutions	0.4404§	0.7296§	0.5122§	0.7738§
Country Language	-0.1670*	-0.5708§	-0.1668*	-1.0466
Country Distance to US	0.2536*	0.1890*	0.2641*	0.3434*
Country Cultural Distance to US	-0.1034**	-0.0096**	-0.0975*	0.0223**
Country Economic Development	1.1443	3.2142	0.4098§	0.8343§
Year Dummy	-0.1811*	-0.2154*	-0.2854*	-0.4910§
Constant	-4.7119	-4.3437	-3.9916	-8.0417
Pseudo R^2 (%)	31.32	37.92	31.90	37.02
ESS	2,428	2,195	2,407	2,227
N	19,635	19,635	19,635	19,635

Note: § p<0.10; * p<0.05; ** p<0.01; *** p<0.001.
#See Appendix A for a complete description of regional schemes and the countries.

Table 3: Logistic Regression Coefficients for Case A: Beginning and End of Annealing Process

Regional Dummies	Case A: Continent Regional Scheme#	
	Beginning	End
Africa Dummy	-0.6476§	
America Dummy	1.7423	
Asia Dummy	-0.5030§	
Europe Dummy	-1.0066	
Sub-Region Africa 1 Dummy		-1.9232
Sub-Region America 1 Dummy		2.2707
Sub-Region Asia 1 Dummy		-4.7510
Sub-Region Oceania Dummy		-2.7916
Sub-Region Europe 1 Dummy		-2.326
Sub-Region America 2 Dummy		-0.8007§
Sub-Region Africa 2 Dummy		-2.9281
Sub-Region Europe 2 Dummy		0.5654§
Sub-Region Asia 2 Dummy		-1.107
Sub-Region Africa 3 Dummy		-1.518
Sub-Region America 4Dummy		1.4897
Sub-Region Africa 4 Dummy		0.8054§
Sub-Region Asia 3 Dummy		-3.6295

Note: § $p<0.10$; * $p<0.05$; ** $p<0.01$; *** $p<0.001$.
#See Appendix A for a complete description of regional schemes and the countries.

Table 4: Logistic Regression Coefficients for Case B: Beginning and End of Annealing Process

Regional Dummies	Case B: Vaaler & McNamara (2004) Regional Scheme#	
	Beginning	End
Africa-Middle East Dummy	-1.3906	
Asia Dummy	-1.0863	
Central-Eastern Europe Dummy	-1.8068	
Latin America Dummy	0.99588	
North American-Caribbean Dummy	1.1123	
Oceania Dummy	-1.3398	
Sub-Region Africa-Middle East 1 Dummy		3.4168
Sub-Region Asia 1 Dummy		2.1287
Sub-Region Central-Eastern Europe 1 Dummy		1.7506
Sub-Region Latin America 1 Dummy		4.7575
Sub-Region North America-Caribbean 1 Dummy		4.8575
Sub-Region Not Considered Dummy		1.7539
Sub-Region West Europe 1 Dummy		3.386
Sub-Region Central-Eastern Europe 2 Dummy		-0.1685*
Sub-Region West Europe 2 Dummy		2.5836
Sub-Region Africa-Middle East 2 Dummy		0.2197*
Sub-Region Africa-Middle East 3 Dummy		2.3684
Sub-Region Africa-Middle East 4 Dummy		3.9958
Sub-Region Latin America 2 Dummy		3.3994
Sub-Region West Europe 2 Dummy		1.5181

Note: § p<0.10; ***** p<0.05**;** ****** p<0.01**;** ******* p<0.001.
#See Appendix A for a complete description of regional schemes and the countries.

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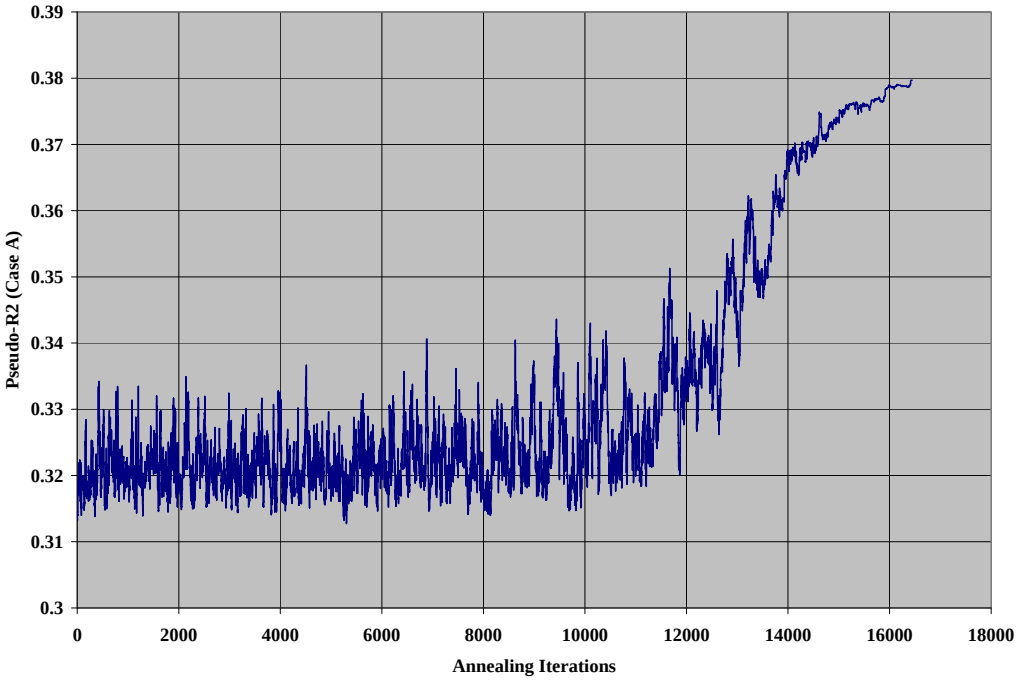
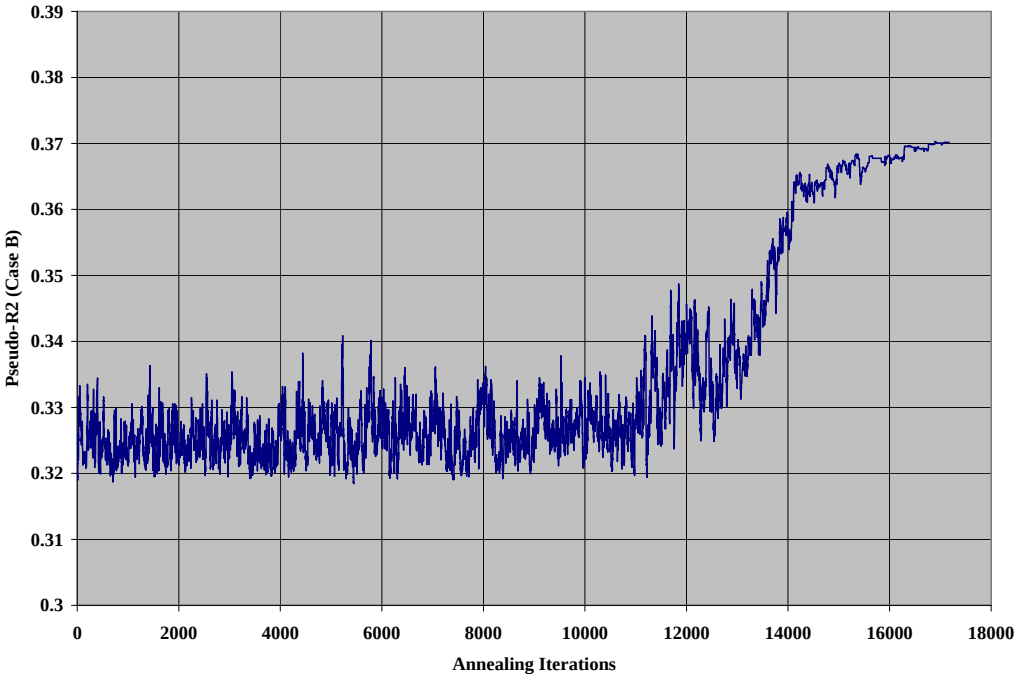
Figure 1: Logistic Regression's Pseudo-R2 vs. Annealing Iterations

(a) Case A: Continents Regional Scheme



(b) Case B: Vaaler & McNamara (2004) Regional Scheme



APPENDIX A: TWO REGIONAL GROUPING SCHEMES USED IN SIMULATED ANNEALING ANALYSES

Table A-1

Continental Regional Grouping Scheme

Region	Countries
Africa (43)	Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of Congo, Djibouti, Egypt, Ethiopia, Gabon, Gambia, Ghana, Guinea, Ivory Coast, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Tunisia, Uganda, Zambia, Zimbabwe
Americas (25)	Argentina, Bahamas, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Surinam, Trinidad & Tobago, Uruguay, Venezuela
Asia (37)	Azerbaijan, Bahrain, Bangladesh, Brunei, Cambodia, China (PRC), Cyprus, Hong Kong, India, Indonesia, Iran, Iraq, Israel, Japan, Jordan, Kazakhstan, Kuwait, Lebanon, Macao, Malaysia, Oman, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore, South Korea, Sri Lanka, Syria, Taiwan (ROC), Thailand, Turkey, Turkmenistan, United Arab Emirates, Uzbekistan, Vietnam, Yemen
Europe (37)	Albania, Austria, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Macedonia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Serbia & Montenegro, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom
Oceania (5)	Australia, Fiji, New Caledonia, New Zealand, Papua New Guinea

Source: http://unstats.un.org/unsd/methods/m49/m49regin.htm

Table A-2

Vaaler & McNamara (2004) Regional Grouping Scheme

Region	Countries
Africa-Middle East (55)	Algeria, Angola, Azerbaijan, Bahrain, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of Congo, Djibouti, Egypt, Ethiopia, Gabon, Gambia, Ghana, Guinea, Iran, Iraq, Israel, Ivory Coast, Kenya, Kuwait, Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Pakistan, Qatar, Saudi Arabia, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Tunisia, Uganda, United Arab Emirates, Uzbekistan, Zambia, Zimbabwe
Asia (25)	Bangladesh, Brunei, Cambodia, China (PRC), Cyprus, Hong Kong, India, Indonesia, Japan, Jordan, Kazakhstan, Macao, Malaysia, Oman, Philippines, Singapore, South Korea, Sri Lanka, Syria, Taiwan (ROC), Thailand, Turkey, Turkmenistan, Vietnam, Yemen
Central-Eastern Europe (19)	Albania, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Malta, Poland, Romania, Russian Federation, Serbia & Montenegro, Slovakia, Slovenia, Ukraine
Latin America (18)	Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Nicaragua, Panama, Paraguay, Peru, Surinam, Uruguay, Venezuela
North America-Caribbean (7)	Bahamas, Canada, Dominican Republic, Haiti, Jamaica, Mexico, Trinidad & Tobago
Western Europe (18)	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom
Not considered (5)	Australia, Fiji, New Caledonia, New Zealand, Papua New Guinea