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National Culture, Income, and Diffusion of New Products and Technologies

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Abstract

S-shaped diffusion curves can be derived mathematically using social contagion or heterogeneity in the intrinsic tendency to adopt as the chief driver of the diffusion process. I present and evaluate hypotheses as to when either social contagion or heterogeneity will be more pronounced in the diffusion process. I investigate these hypotheses using a meta-analytic test of the q/p ratio from applications of the Bass model to consumer durables. I operationalize various types of social contagion using the GLOBE dimensions of national culture and operationalize heterogeneity using income inequality. Four of the GLOBE cultural dimensions are shown to have a significant effect on new product adoption. The results suggest that social contagion is driven largely by status considerations and social normative pressures. Interestingly, GLOBE's practices measures vary with the q/p ratio as expected, whereas GLOBE's values measures do not. Income inequality is also shown to be a significant determinant of the diffusion process. Competing standards are shown to overwhelm both income and culture when such factors are considerations in new product adoption.

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1.0 Abstract

S-shaped diffusion curves can be derived mathematically using social contagion or heterogeneity in the intrinsic tendency to adopt as the chief driver of the diffusion process. I present and evaluate hypotheses as to when either social contagion or heterogeneity will be more pronounced in the diffusion process. I investigate these hypotheses using a meta-analytic test of the q/p ratio from applications of the Bass model to consumer durables. I operationalize various types of social contagion using the GLOBE dimensions of national culture and operationalize heterogeneity using income inequality. Four of the GLOBE cultural dimensions are shown to have a significant effect on new product adoption. The results suggest that social contagion is driven largely by status considerations and social normative pressures. Interestingly, GLOBE's practices measures vary with the q/p ratio as expected, whereas GLOBE's values measures do not. Income inequality is also shown to be a significant determinant of the diffusion process. Competing standards are shown to overwhelm both income and culture when such factors are considerations in new product adoption.

2.0 Introduction

Diffusion is the process in which an innovation is communicated through certain channels over time to members of a social system (Rogers, 1969). Understanding the diffusion process not only aids in the introduction and sale of new products but also in the introduction and adoption

of life saving medical treatments and practices. As a result, the diffusion of new products and innovations has long been of interest to marketers, venture capitalists, entrepreneurs, macro-economists, sociologists, and policy makers.

Quantitative analysis of the diffusion process began in 1969 when Frank Bass introduced the seminal Bass diffusion model, shown below.

$$N(t) - N(t-1) = [p + qN(t-1)/m] x [m - N(t-1)]$$

Equation 1: Bass Diffusion Model

$N(t)$ represents the number of adopters in time t , m is the total size of the target market, p represents an individuals' intrinsic tendency to adopt, and q captures social contagion, the tendency to adopt in response to other individuals' knowledge, attitudes, and perceptions of the product.

As for what drives the diffusion process, prior research has resulted in some conflicting conclusions. Researchers have shown that the sigmoid diffusion curves of most products can arise from either social contagion processes or simply from heterogeneity in the intrinsic tendency to adopt. To complicate things further, social contagion itself can take many forms, including social learning under uncertainty, status or competitive considerations, or social normative pressures, all of which are indistinguishable in data.

My study builds off of Van den Bulte and Stremersch (2004), who investigated which of social contagion or heterogeneity plays the larger part in diffusion. The authors posited that though it is not possible to test which diffusion process is at work from a single diffusion curve, it is possible to draw inferences from patterns across multiple curves. To study the effects of social contagion, the authors studied how the q/p ratio varied across different cultures for a number of consumer durables. To study the effects of heterogeneity in the intrinsic tendency to

adopt, the authors studied the relationship between q/p ratio and national income. Van den Bulte and Stremersch (2004) found that even after controlling for heterogeneity, national culture and, as a result, social contagion plays a significant role in new product adoption.

My research strategy also consists of hypothesizing when the different contagion mechanisms or heterogeneity are more pronounced in the diffusion process. I then test these hypotheses through a meta-analysis of the q/p ratio obtained from applications of the Bass model to the diffusion of consumer durables. My point of departure from Van den Bulte and Stremersch is the parameterization of national culture. Van den Bulte and Stremersch used four dimensions of national culture propounded by Geert Hofstede, who pioneered the field of cross cultural research. I will be employing the nine dimensions of national culture put forth by the Global Leadership and Organizational Behavior Effectiveness (GLOBE) research program.

My results consist of four main findings. First, I find that culture does indeed play a significant role in explaining the diffusion of new products over and above income level and distribution. Second, both income level and distribution vary significantly with the q/p ratio; however, the effects of both run counter to expectations. Additionally, competing standards are shown to swamp both income and culture when they factor into new product adoption. Lastly, this study finds that GLOBE's practices measures were consistent with expectations and prior diffusion studies, whereas its values measures were not, which raises questions regarding the meaning of GLOBE's values measures.

3.0 Hypotheses

3.1 Social Contagion and National Culture

Completed in 2004, the GLOBE research program is a highly impressive and expansive study of national culture. The research program surveyed middle managers from financial services, food processing, and telecommunications firms in sixty-two countries. GLOBE parameterized national culture across two domains and along nine dimensions. This paper seeks to study adoption behavior using the full eighteen GLOBE parameters, building off prior consumer adoption research that has generally employed data from Hofstede's pioneering study of national culture. Building off of this prior research and introducing some original arguments, I first discuss GLOBE's two cultural domains and then hypothesize how the q/p ratio should vary across the nine cultural dimensions after controlling for income heterogeneity.

3.1.1 Practices versus Values

The GLOBE research project published its findings for each of its cultural dimensions across two domains, practices and values. According to GLOBE, practices are acts or "the way things are done" in a given culture, and values are judgments about "the way things should be done". Prior to GLOBE, cross cultural research suggested that cultural practices are driven by cultural values and that there is a linear and positive relationship between them. Interestingly though, GLOBE found a negative and nonlinear relationship between its practices and values measures (House et al. 2004).

Relationships between individuals' cultural perceptions and their own cultural values notwithstanding, the appropriate question here is which of the two better predicts product adoption behavior. The GLOBE authors have suggested that a combination of their values and

practices measures provides the most accurate depiction of national culture (Javidan et al. 2006). However, given the negative correlation between practices and values for seven of the nine dimensions, using a combination of practices and values herein would likely result in considerable variance reduction and uninteresting regression results.

The prevailing literature suggests that it is in fact values that underlie and determine social behavior including decisions such as college major, occupational role, and group affiliation (Rokeach 1973). Researchers have also shown that personal values play a significant role in product adoption and consumer innovativeness (Steenkamp et al. 1999). Though this does not prove that perceptions of cultural practices do not explain adoption behavior, it suggests that GLOBE's values measures should better explain product adoption behavior than its practices measures.

GLOBE's survey items, however, raise some doubts as to whether GLOBE's values measures accurately gauge individuals' values (Hofstede 2006). For example, to measure individuals' values regarding the future orientation cultural dimension, one of GLOBE's survey items asked respondents to state their agreement on a scale of one to seven to the following statement: "I believe that the accepted norm in this society should be to plan for the future or accept the status quo (House et al. 2004, p. 302)." A second example for the uncertainty avoidance cultural dimension asked for respondents to state their agreement to the following: "In this society, orderliness and consistency should be stressed, even at the expense of experimentation and innovation (House et al. 2004, p. 620)." Though GLOBE surveyed presumably educated middle managers, these survey items are formulated at a high level of abstraction, and it is possible that the respondents did not interpret them as the GLOBE authors expected. Further, to obtain accurate cross cultural results, the respondents would have had to be

capable of accurately judging their country relative to others on each of the cultural dimensions. Given the international experience required to do so properly, it is possible that GLOBE's respondents were not up to the task.

Ironically, GLOBE's practices measures may actually be more indicative of personal values, since individuals' observations about practices are motivated by their personal values. Though GLOBE's practices survey items required respondents to accurately judge their country relative to others on each of the cultural dimensions similar to the values survey items, the practices survey items are not formulated as at high a level of abstraction as the values survey items. The practices survey items do not require respondents to make normative statements but only positive ones, which is a simpler task. Indeed, this is similar to what Hofstede suggests in his critique of GLOBE (Hofstede, 2006). In light of the previous, I make no assertion as to whether GLOBE's practices or values measures will better predict consumer adoption behavior and present results for both.

3.1.2 Future Orientation

Future orientation is the degree to which individuals in an organization or community engage in future oriented behaviors such as planning, investing in the future, and delaying gratification (House et al. 2004). As the tendency to delay gratification implies a tendency to delay or reduce consumption, a negative relationship between future orientation and p is expected. This assertion is reinforced by the fact that concern and a preoccupation with the future are associated with saving money and curtailing spending (Rose et al. 2007, House et. al 2004).

If an individual in a future oriented society observed that a number of his peers had purchased an item, he would deem the item necessary to his own success, as his future oriented

peers have already given the item their stamp of approval. Consequently, to the extent that social contagion arises from competitive concerns, there is likely a positive relationship between future orientation and q . This assertion is reinforced by the positive relationship between future orientation and performance orientation, institutional and in-group collectivism, and uncertainty avoidance, all of which are expected to be positively associated with q (House et al. 2004).

The preceding suggests the following hypothesis:

H1: A positive relationship between future orientation and the q/p ratio is expected. The relationship should be weaker for productivity enhancing goods.

3.1.3 Power Distance

Power distance is the degree to which members of an organization or society expect and agree that power should be shared unequally (House et al. 2004). Societies that score high on power distance are characterized by low levels of health, knowledge, and literacy and a low standard of living. Information is not widely shared in such cultures and society is stratified based on several criteria including gender (House et al. 2004). The low literacy levels and localization of information in high power distance societies suggests that most individuals are unable to make independent assessments of new products. Thus, a negative relationship between power distance and p is expected.

The acceptance of social inequalities in high power distance cultures suggests a desire to maintain the status quo and an adherence to existing social norms. People will therefore adopt in order to maintain the existing status ordering and when social norms dictate adoption. As a result, to the extent that social contagion is driven by status considerations and social normative

pressures, a positive relationship between power distance and q is expected. The preceding suggests the following hypothesis:

H2: A positive relationship between the q/p ratio and power distance is expected.

This hypothesis is consistent with Van den Bulte and Stremersch (2004) who show that the q/p ratio is positively associated with Hofstede's power distance dimension.

3.1.4 Uncertainty Avoidance

Uncertainty avoidance is the extent to which individuals in a society or organization seek orderliness, consistency, structure, formalized procedures, and laws to cover situations in their daily lives (House et al. 2004). Individuals in cultures characterized by high uncertainty avoidance are averse to innovation as innovation often results in unanticipated changes (Shane, Venkataraman, and MacMillan 1995). Consequently, a negative relationship between p and uncertainty avoidance is expected.

To the extent that new product adoption is driven by social learning under uncertainty, one would expect a positive relationship between q and uncertainty avoidance. This is perhaps justified by the notion that as more people adopt a new product, its attributes become more widely communicated and perceptions of risk fall. The preceding suggests the following hypothesis:

H3: A positive relationship between the q/p ratio and uncertainty avoidance is expected.

3.1.5 Humane Orientation

Humane orientation is the degree to which an organization or society encourages and rewards individuals for being fair, altruistic, friendly, generous, caring, and kind to others (House et al.

2004). According to culture theory (Triandis 1995), in societies with high humane orientation, the need for belongingness and affiliation, as opposed to self-fulfillment, pleasure, material gain, and power, are likely to be the dominant motivating bases. Also, several cross cultural studies (e.g. Kagitcibasi 1982) have demonstrated that societies high in humane orientation encourage obedience and interdependence among family members whereas societies low in humane orientation encourage autonomy and independence among family members.

Given that materialism and autonomy are eschewed in societies high in humane orientation, a negative relationship between p and humane orientation is expected. Additionally, since adherence to authority, belonging, and affiliation are strong motivators in societies with high humane orientation, to the extent that diffusion is driven by social normative pressures or status concerns, a positive relationship with q is expected. The preceding suggests the following hypothesis:

H4: A positive relationship between humane orientation and the q/p ratio is expected

3.1.6 Collectivism

The GLOBE study included two measures of societal level collectivism: in-group collectivism and institutional collectivism. In-group collectivism measures the degree to which individuals express pride, loyalty, and interdependence in their families. Institutional collectivism measures the degree to which institutional practices at the societal level encourage and reward collective action. Based on these definitions, I omitted in-group collectivism from my analysis and focus on institutional collectivism since it measures societal level pressures and is more appropriate to this study.

Cultures that score high on collectivism are characterized by individuals who are more likely to take part in group activities, and such societies are characterized by close family ties, respect for authority, and conformity to social norms (House et al. 2004). Consumer innovativeness involves a tendency to initiate new behaviors independent of others (Midgley and Dowling 1978). Such behaviors are expectedly viewed negatively in societies marked by high collectivism. Further, societies low in collectivism appreciate novelty and variety more (Roth 1995). Consequently, a negative relationship between p and collectivism is expected. Given the inclination toward group activity, the respect for authority in collectivistic societies, and the emphasis on conformity to social norms, a positive relationship between q and collectivism is expected to the extent that social contagion is driven by social normative pressures. The preceding suggests the following hypothesis:

H5: A positive relationship between collectivism and the q/p ratio is expected.

This hypothesis is consistent with Van den Bulte and Stremersch (2004) who show that the q/p ratio is positively associated with Hofstede's measure of collectivism.

3.1.7 Performance Orientation, Assertiveness, Gender Egalitarianism, and Hofstede's Masculinity Dimension

With the exception of Humane Orientation, all of the preceding GLOBE cultural dimensions map directly to a corresponding cultural dimension formulated by Hofstede in his pioneering survey of national culture. The final three GLOBE cultural dimensions, Performance Orientation, Gender Egalitarianism, and Assertiveness, map to Hofstede's masculinity dimension.

Performance orientation is the degree to which an organization or society encourages and rewards innovation, high standards, and performance improvement. Performance oriented

societies attach high importance to a can-do, independent spirit, and value innovation (House et al. 2004). Gender egalitarianism reflects a society's beliefs about whether its members' biological sex should determine the roles that they play in their homes, businesses, and communities (House et al. 2004). Assertiveness reflects beliefs as to whether people are or should be encouraged to be assertive, aggressive, and tough, or nonassertive, non-aggressive, and tender in social relationships (House et al. 2004).

Hofstede's masculinity dimension reflects the extent to which social gender roles are clearly distinct: men are supposed to be assertive, tough, and focused on material success; women are supposed to be more modest, tender, and concerned with the quality of life (Hofstede 2001). With regard to consumer behavior, masculine societies put more emphasis on wealth, achievement, and success (de Mooij 1998, Steenkamp et al. 1999). Also, prior research has documented a positive relationship between Hofstede's masculinity dimension and the q/p ratio (Van den Bulte and Stremerch 2004).

Based on their formulations, Performance Orientation is expected to capture the success striving that is characteristic of masculine cultures, Assertiveness is expected to capture the assertiveness, toughness, and focus on material success that is characteristic of masculine cultures, whereas Gender Egalitarianism is formulated as very much the opposite of Hofstede's masculinity dimension. As shown in Table 1, however, the effects of Assertiveness and Performance Orientation are largely tied up with income. Gender egalitarianism is therefore preferred for the statistical model since of the three dimensions, it is least correlated with the income variables, which suggests that it is more likely to explain variance in the q/p data caused by differences in culture.

Table 1: Correlations between independent variables

	Correlations								
	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Uncertainty Avoidance									
2. Power Distance	-0.322								
3. Collectiveness	0.179	-0.292							
4. Gender Egalitarianism	0.156	-0.400	-0.096						
5. Assertiveness	-0.030	-0.485	-0.331	0.029					
6. Performance Orientation	0.004	-0.587	0.206	-0.166	0.679				
7. Future Orientation	0.534	-0.648	0.528	-0.108	0.368	0.630			
8. Humane Orientation	0.057	-0.315	0.310	-0.065	-0.414	0.054	-0.177		
9. LN(Real GDP/Capita)	0.229	0.495	0.019	0.256	0.775	0.541	0.434	-0.371	
10. LN(Gini)	0.078	-0.689	-0.246	0.238	-0.568	-0.764	-0.575	-0.132	-0.412

As stated, gender egalitarianism reflects a society's beliefs about whether its members' biological sex should determine the roles that they play in their homes, businesses, and communities. Societies that seek to minimize differences between roles of males and females are regarded as gender egalitarian. Societies scoring higher on gender egalitarianism achieve a greater standard of living, knowledge, and longevity for their members. Additionally, GLOBE's findings suggest that these societies have members who are more active, vocal, and open to change (House et al. 2004). Talukdar et al. (2002) finds a negative relationship between consumer's literacy level and p (at the 1% level). These facts, although based on correlates of the dimension, suggest a positive relationship between gender egalitarianism and p for consumer durables.

The greater knowledge and openness to change on the part of individuals in high gender egalitarian societies suggests less reliance on others for information and when making purchase decisions. Accordingly, Hirschmann (1980) finds that educated consumers are more inclined to make independent assessments of new products. Thus, to the extent that social contagion is

motivated by social learning under uncertainty, gender egalitarianism is expected to be negatively associated with q .

The preceding suggests the following hypothesis:

H6: A negative relationship between gender egalitarianism and the q/p ratio is expected.

3.2 Heterogeneity and National Income

Economic theory and prior diffusion research suggest that for consumer durables, income is a relevant driver of heterogeneity in the intrinsic propensity to adopt (e.g., Bonus 1973, Chatterjee and Eliashberg 1990, Dernburg 1958). Thus to investigate the relationship between heterogeneity and new product adoption, I use real GDP per capita and the Gini coefficient as independent variables. Using both measures helps ascertain the marginal explanatory power of income distribution and level.

3.2.1 Real GDP per capita

Though not always the case, high real GDP per capita has been shown to generally go hand in hand with high consumption and disposable income (Svennebye 2008). As individuals who have greater means to consume will likely be less inhibited from making substantial purchases than those with less means to consume, a positive relationship between p and GDP per capita is expected. It is difficult to posit a defensible relationship between q and income level based solely on economic grounds, and so, q is not expected to vary meaningfully with the income level. The preceding suggests the following hypothesis:

H7: GDP per capita is negatively associated with the q/p ratio.

3.2.2 Gini Coefficient

A high Gini coefficient indicates an unequal distribution of wealth while a low Gini coefficient indicates an equitable distribution of wealth. Therefore, in countries with high Gini coefficients, either the entire population is able to afford a particular product or only a small segment of the population is able to afford the product. Once a product becomes affordable to the masses, its adoption should increase, suggesting a positive relationship with q . This suggests the following hypothesis:

H8: The Gini coefficient is positively associated with the q/p ratio.

4.0 Methods

4.1 Research Design

My research design, methodology, and data borrow heavily from Van den Bulte and Stremersch (2004). I use a meta-analysis of published q/p ratios of consumer durables to test my hypotheses. I focus on consumer items since the income heterogeneity and social contagion hypotheses do not necessarily hold for businesses, and I use only durable items as opposed to non-durables since adoption of durables is more likely to convey status and their high prices are more likely to present financial risk.

4.2 Variables

4.2.1 Dependent Variables

I use the natural logarithm of the q/p ratio as my dependent variables to ensure normal i.i.d residuals. The q/p data were graciously provided by Professor Christophe Van den Bulte, Associate Professor of Marketing at the Wharton School. The 293 observations span 52 different

consumer durables in 28 countries. Color televisions account for 60 observations, VCRs for 57, cell phones for 43, and microwave ovens for 16. The United States accounts for 210 observations, Asia for 36, Europe for 33, and Latin America for 14.

4.2.2 Independent Variables

4.2.2.1 National Culture

I use GLOBE's cultural dimensions as my independent variables for national culture. The data were obtained from surveys of middle managers in the financial services, food processing, and telecommunications industries from sixty two countries around the world. The data collection effort began in 1995 and ended in 1997 (House et al. 2004).

4.2.2.2 Income Heterogeneity

Real GDP per capita data was obtained from the Penn World Tables published by the Center for International Comparisons at the University of Pennsylvania (Summers and Heston 1991). Real GDP per capita is expressed in 1996 international prices.

I use the Gini coefficients calculated by Deininger and Squire (1996) and published by the World Bank. To stay consistent with my use of real GDP per capita for average income, Gini coefficient values computed using personal rather than household income are used. When multiple values are available for a country, the values are linearly interpolated between the years.

As both Gini coefficients and real GDP per capita vary with time, the average Gini coefficient and income values observed over the course of the period used to estimate p and q are used. Since I used the logarithm of the q/p data, the same transform is applied to both income variables.

4.2.2.3 Competing Standards

Van den Bulte and Stremersch (2004) show that competing standards overwhelms both national culture and income if it factors into the product adoption decision. As a result, a dummy variable for competing standards is included. It is equal to one for PCs, VCRs, and cell phones and is equal to zero for all other products.

4.2.3 Control Variables

Several control variables are included in the statistical model to account for variance in the q/p data that arises from methodological differences in the way the q/p data were collected. First, differences in the estimation techniques are accounted for. Using nonlinear least squares as a baseline, three dummy variables are included: ESTOLS for OLS, ESTMLE for maximum likelihood, and ESTOH for others. Second, CONTTIME is included to account for whether the model was formulated in discrete or continuous time. Third, two variables are used to control for the number of observations used in the estimation. WINDOW10 captures the number of years covered by the data series, expressed in decades. LNFREQ is the natural logarithm of the data frequency (1 for annual, 4 for quarterly, 12 for monthly). A fourth issue is the use of data on sales rather than actual adoptions or penetration rates, which leads to contamination by replacement and additional purchases, a problem likely to be exacerbated in data series covering many years (Van den Bulte and Stremersch 2004). Hence, a NONADOP dummy taking value 1 when either sales ($N=196$) or production ($N=6$) data were used and taking value 0 when adoption or penetration data were used ($N=91$), as well as an interaction term $\text{NONADOP} * \text{WINDOW10}$ are included. Fifth, three dummies indicating whether p ,

q , or m (the ceiling parameter) were allowed to vary as a function of covariates (P_CONTROL, Q_CONTROL, M_CONTROL) are included. Finally, the dummy variable PROPCEILING indicates whether m was allowed to vary over time as a proportion of the total population

A number of dummy variables pertaining to product level aspects of the q/p data are also included. BRAND captures whether the data pertain to the product of a particular manufacturer or a product category. INFRA equals 1 for one-to-many broadcasting products requiring large investments in infrastructure (black-and-white TV, cable TV, color TV, and radio). STARTC is the year in which the data series starts centered around the sample mean (1972.8).

4.3 Statistical Model

My statistical model is the same as that used by Van den Bulte and Stremersch (2004). Since the data set consists of p and q estimates for different products and countries in different time periods, with some of the products, countries, and time periods repeated, the regression amounts to a panel data analysis. Consequently, a multilevel model allowing for random effects in the slope and intercept across both countries and products is used. Using subscript i to denote a product, j to denote a country, k to denote a replication, and s to identify a covariate, the model structure used to explain variation in $\ln(q/p)$ is:

$$\ln(q/p)_{ijk} = \gamma_{0ij} + \sum_s \gamma_{sijk} + \varepsilon_{ijk} \quad (s:1,\dots,S), \text{ where}$$

$$\gamma_{sij} = \gamma_s + U_{si} + U_{sj} \quad (s:0,\dots,S),$$

$$\varepsilon_{ijk} \sim N(0, \sigma^2), \quad U_{si} \sim N(0, \tau^2), \text{ and } U_{sj} \sim N(0, \nu^2).$$

The model is estimated using residual maximum likelihood and t-tests are used to determine whether the slope and intercept coefficients are significantly different from zero.

5.0 Results

Regression results are reported in Tables 3 and 4. The cultural model was fitted by starting with variables that have previously been shown to be predictive of adoption behavior, namely the four GLOBE variables that correspond directly to the Hofstede cultural variables: Gender Egalitarianism, Uncertainty Avoidance, Power Distance, and Collectivism. Model 1 contains results for the values measures corresponding to these variables, and Model 2 contains results for the practices measures corresponding to these variables. Humane Orientation and Future Orientation were added piecewise to this four variable model. Model 3 contains results for the marginal impact of Future Orientation, and Model 4 contains results for the marginal impact of Humane Orientation. Model 5 contains regression results when using only the income variables, and Model 6 contains both income and cultural variables.

Model 1 supports hypotheses H2 and H6 but does not support hypotheses H3 or H5. Model 1 therefore demonstrates that the GLOBE values dimensions do not behave as expected. Uncertainty Avoidance is not significant and the coefficient on Collectiveness contradicts that anticipated by prior diffusion theory and empirical work. Model 2 supports hypotheses H2, H3, H5, and H6. It uses GLOBE practices measures and shows that they are all significant and behave as expected. GLOBE's practices measures are therefore used in the rest of the regressions.

Model 3 is consistent with Model 2 and shows that future orientation does not have any marginal significance, although the future orientation competing standards interaction term is significant. This is not unexpected since individuals with an eye for the future are likely to take into account the impact of competing technological standards when making a purchase decision. Model 4 is also consistent with Model 2 and shows that both humane orientation and its competing standards interaction term are marginally insignificant when added to Model 2. Thus, the statistical analyses lend support to cultural hypotheses H2, H3, H5, and H6 but not H1 or H4.

Model 5, the standalone income model, supports both income hypotheses H7 and H8. Model 6, which incorporates the cultural variables from Model 2 and the income variables in Model 5, lends support to the cultural hypotheses, H2, H3, H5, and H6 but does not support either income hypothesis, H7 or H8. Although both income distribution and level are shown to be significant in Model 6, the signs on the corresponding coefficients run counter to expectations. This suggests a potential collinearity artifact between the cultural variables and income variables.

Results for the control variables in all six models are consistent with Van den Bulte and Stremersch (2004). The methodological significance of these results is discussed in depth in their paper.

Additionally, a point of clarification regarding the competing standards interaction term is necessary. The interaction term between competing standards and the income and culture variables pertains to products only with competing standards. It captures whether the effect of the paired variable is different from those for products without competing standards. The competing standards variable that is not paired with income or culture variables can be

interpreted as the main effect of competing standards-it explains whether or not competing standards are important in general.

Finally, the squared Pearson correlation coefficient which measures the correlation between the predicted and actual values, indicate that all six models capture the variation in the q/p ratio equally well.

Table 2: Models 1-4

Independent Variables	Model 1: National Culture (Values)		Model 2 National Culture (Practices)		Model 3 National Culture (Practices) with Future Orientation		Model 4 National Culture (Practices) with Humane Orientation	
	β	t-value	β	t-value	β	t-value	β	t-value
Intercept	4.83	8.87***	4.86	9.08***	4.87	9.04***	4.85	9.07***
Culture Values								
Uncertainty Avoidance(V)	1.46	1.58						
Power Distance (V)	18.12	3.62***						
Collectiveness (V)	-4.83	-2.35**						
Gender Egalitarianism (V)	-3.04	-2.60***						
Practices								
Uncertainty Avoidance(P)			4.24	3.97***	3.69	3.11***	3.42	1.91*
Power Distance (P)			4.48	3.52***	4.23	3.45***	3.34	3.32***
Collectiveness (P)			7.27	4.81***	6.92	4.40***	7.16	4.72***
Gender Egalitarianism (P)			-2.49	-2.42**	-2.02	-1.70*	-2.80	-2.39**
Future Orientation (P)					1.37	1.00		
Humane Orientation (P)							-0.73	-0.56
Income								
LN(Real GDP/capita)								
LN(Gini Coefficient)								
Competing Standards								
CS (Main)	1.31	1.59	2.79	3.15***	3.12	3.46***	2.69	3.01***
CS*Uncertainty Avoidance	-1.09	-1.03	-5.53	-4.71***	-4.60	-3.47***	-4.69	-2.51**
CS*Power Distance	17.28	3.40***	-4.03	-3.69***	-5.66	-3.97***	-3.93	-3.54***
CS*Collectiveness	4.29	1.99**	-6.83	-4.13***	-6.06	-3.49***	-6.76	-3.82***
CS*Gender Egalitarianism	3.68	2.71***	2.13	1.66*	1.00	0.7	2.43	1.73*
CS*Future Orientation					-3.05	1.73*		
CS*Humane Orientation							0.77	.54
CS*LN(Real GDP/capita)								
CS*LN(Gini Coefficient)								
Control Variables								
INFRA	-2.18	-3.61***	-2.04	-3.57***	-2.06	-3.59***	-1.93	-3.24***
BRAND	-9.31	-7.93***	-9.52	-7.9***	-9.51	-7.76***	-9.53	-7.96***
STARTC	-0.74	-2.55**	-0.09	-2.68***	-0.09	-2.63***	-0.09	-2.61***
WINDOW10	-9.68	-2.73***	-1.11	-3.01***	-1.16	-3.12***	-1.10	-3.00***
LNLFREQ	-2.41	-2.05**	-0.26	-2.45**	-0.26	-2.47**	-0.26	-2.41**
NONADOP	-1.39	-2.29**	-1.16	-1.91*	-1.23	-2.00**	-1.21	-1.95*
NONADOP*WINDOW10	1.08	2.61***	1.06	2.64***	1.09	2.71***	1.10	2.67***
ESTOLS	.038	.06	-0.76	-1.36	-0.51	-.9	-0.77	-1.30
ESTMLE	.756	2.09**	0.32	.93	0.49	1.37	0.30	.85
ESTOTH	1.48	2.68***	1.23	2.25**	1.27	2.34**	1.24	2.24**
CONTTIME	.5494	1.83*	0.23	.84	0.26	.92	0.25	.84
P_control	-.3454	-.96	-0.28	-4.02***	-0.27	-.85	-0.28	-.83
Q_control	-.65	-1.56	-0.63	-.86	-0.62	-1.64	-0.63	-1.62
M_control	-.701	-2.03**	-0.61	-1.63	-0.58	1.83**	-0.62	-1.92**
PROPCEILING	-1.19	-3.86***	-1.22	-1.90*	-1.22	-3.98***	-1.24	-4.06***
-2 Res LL	912.3		892.30		884.80		888.80	
Pearson Correlation (%)	96.57%		97.23%		97.31%		97.20%	
***significance at p<.01								
**significance at p<.05								
*significance at p<.10								

Table 3: Models 5-6

Independent Variables	Model 5: Income Heterogeneity		Model 6: Full Model	
	β	t-value	β	t-value
Intercept	4.73	8.73***	4.808	9.12***
Culture				
<i>Values</i>				
Uncertainty Avoidance(V)				
Power Distance (V)				
Collectiveness (V)				
Gender Egalitarianism (V)				
<i>Practices</i>				
Uncertainty Avoidance(P)			3.67	3.12***
Power Distance (P)			11.79	3.17***
Collectiveness (P)			8.41	5.12***
Gender Egalitarianism (P)			-3.94	-2.78***
Future Orientation (P)				
Humane Orientation (P)				
Income				
LN(Real GDP/capita)	-1.44	-5.32***	2.52	2.31**
LN(Gini Coefficient)	5.52	3.44***	-7.29	-2.00**
Competing Standards				
CS (Main)	1.62	1.90*	3.16	3.44***
CS*Uncertainty Avoidance			-4.52	-3.47***
CS*Power Distance			-11.55	-3.02***
CS*Collectiveness			-8.33	-4.61***
CS*Gender Egalitarianism			3.94	2.42***
CS*Future Orientation				
CS*Humane Orientation				
CS*LN(Real GDP/capita)	1.22	2.36**	-2.55	-2.13**
CS*LN(Gini Coefficient)	-8.58	-3.83***	4.44	1.04
Control Variables				
INFRA	-2.28	-3.76***	-1.37	-2.12**
BRAND	-9.66	-9.66***	-9.89	-8.40***
STARTC	-0.05	-1.75*	-0.13	-3.60***
WINDOW10	-0.88	-2.52**	-1.48	-3.70***
LNREQ	-0.25	-2.2**	-0.28	-2.42**
NONADOP	-1.21	-2.04**	-1.63	-2.55**
NONADOP*WINDOW10	1.01	2.50**	1.35	3.19***
ESTOLS	-0.36	-.64	-0.37	-.67
ESTMLE	0.45	1.27	0.51	1.42
ESTOTH	1.48	2.76***	1.36	2.40**
CONTTIME	0.43	1.63	0.38	1.33
P_control	-0.34	-.99	-0.24	.73
Q_control	-0.61	-1.51	-0.64	-1.63
M_control	-0.68	-2.04	-0.62	-1.90
PROPCEILING	-1.18	-3.81***	-1.31	-3.60
-2 Res LL		919.1		876.30
Pearson Correlation (%)		96.80%		97.20%
***significance at p<.01				
**significance at p<.05				
*significance at p<.10				

5.1 Robustness Checks

Gender Egalitarianism was preferred for the full model over Assertiveness and Performance Orientation since of the three, it is least correlated with the income variables, which suggested that it should explain variance in the q/p data caused by differences in culture. This appears to be the case, since substitution of either Assertiveness or Performance Orientation for Gender Egalitarianism in the full model had the effect of rendering the income variables insignificant, while leaving the sign and significance of the other cultural variables unaffected.

Future Orientation and Humane Orientation were omitted from the full model, Model 6, since they were not shown to be significant determinants of the q/p ratio in the culture only models, Models 3 and 4. As a robustness check, both Future Orientation and Humane Orientation were added piecewise to the full model, Model 6. Neither was shown to have marginal significance and results for the other variables did not differ meaningfully than the results reported for Model 6 in Table 3.

As stated, the standalone income model, Model 5, lends support to the hypothesis regarding income level and income distribution; however, the full model, Model 6 does not. This may have been caused due to an interaction between income level and distribution that was not included in the model. However, the model was also run using Van den Bulte and Stemersch's (2004) scale variable, which combines both income level and distribution. This addition resulted in all three income variables losing their statistical significance but no meaningful changes in the coefficients of the cultural variables.

5.2 Results of Theoretical Interest

There are three main results. First, the cultural models, Models 1-4, lend support to hypotheses H2, H3, H5, and H6. As a result, the social contagion explanation of the diffusion process is also supported. The cultural hypotheses supported also shed some light on the nature of the contagion process. More Collectivistic societies have higher q/p ratios, which is consistent with the notion that social contagion is driven by social normative pressures. Societies high in Power Distance have higher q/p ratios while societies high in Gender Egalitarianism tend to have lower q/p ratios. These findings are consistent with the notion that social contagion is motivated by status considerations and social normative pressures. Societies high in Uncertainty Avoidance also tend to have higher q/p ratios, which is consistent with the notion that social contagion is driven by the process of social learning under uncertainty.

Secondly, the findings also demonstrate that competing standards not only has a large main effect, but that the interaction terms are significant as well. With few exceptions, the coefficients on the interaction terms are of the same magnitude as the corresponding linear effects, but opposite in sign, suggesting that competing standards completely dominates culture and income when it is a factor in new product adoption.

Lastly, the model findings raise some questions as to the GLOBE values measures. Specifically, one wonders if they were measuring what they were intended to measure. Diffusion theory and results from psychology have established that people act based on their values; however, the results obtained by using the GLOBE values measures in the regression contradicted not only logical but established results in diffusion theory.

6. Discussion and Conclusion

6.1 Comparison with Van den Bulte and Stremersch (2004)

There are three meaningful comparisons to be made with Van den Bulte and Stremersch (2004): results for the standalone cultural models, results for the standalone income model, and results for the full model. The statistical results for the stand alone cultural model, Model 2, are consistent with that of Van den Bulte and Stremersch (2004). As all of the cultural variables used map to the Hofstede measures of national culture used in Van den Bulte and Stremersch (2004), the results obtained herein are robust for both the GLOBE and Hofstede cultural data. Additionally, that only the GLOBE cultural variables which correspond to the Hofstede cultural dimensions were shown to be significant determinants of the q/p ratio suggests that GLOBE's parameterization of culture may have been overdefined, at least as far as diffusion research is concerned.

As for the standalone income model, Model 5, results are consistent with those in Van den Bulte and Stremersch (2004). Van den Bulte and Stremersch (2004) find income distribution to be positively associated with the q/p ratio and an income scale variable, which can be interpreted as the reciprocal of income level, also to be positively associated with the q/p ratio. These results are consistent with Model 5, which shows income distribution to be positively associated with the q/p ratio and income level to be negatively associated with the q/p ratio.

Results for the full model, Model 6, are only partially consistent with Van den Bulte and Stremersch (2004). Results for the cultural variables are consistent with Van den Bulte and Stremersch (2004) as with the stand alone cultural models; however, results for the income

variables are not. In their model incorporating the effects of both income and culture, Van den Bulte and Stremersch (2004) find income distribution to be positively associated with the q/p ratio whereas their income scale variable does not have a statistically significant effect.

One possible explanation for the income variables' coefficients in the full model is collinearity between the income and culture variables. As shown in Table 1, Power Distance is highly correlated with income level and distribution. Additionally, although Gender Egalitarianism itself is not strongly correlated with either of the income variables, Gender Egalitarianism measures an aspect of culture that is intertwined with income, as demonstrated by the correlation between Assertiveness and Performance Orientation and the income variables.

6.2 Practical Implications

The overall takeaway from this study definitely appears to be that culture indeed plays a significant part in new product diffusion over and above the effects of income. In light of this result, this study provides marketers with a cultural game plan with which to approach international marketing. Given that each of three of the four statistically significant cultural variables—collectiveness, power distance, and gender egalitarianism through its mapping to Hofstede's masculinity dimension—explain social contagion via status considerations and social normative pressures, the findings also suggest that these are the two dominant social contagion processes at work.

Using the empirical relationships determined herein, a marketer could tailor his campaign in a given country based on the cultural dimensions and the social contagion processes likely to predominate in the target country. For example, when seeking to market new products or

innovations in a country high in uncertainty avoidance and power distance, the marketer would have to be sure to clearly communicate his products' uses and benefits to counter the target country's strong aversion to risk and new items. However, due to the effect of power distance in the country, the marketer would have to be especially careful in his selection of endorsers so that the product does not become associated with the wrong class of people.

6.3 Directions for Future Research

The collinearity observed between the income and culture variables suggests that the relationship between culture and income deserves more attention. Unless a definitive relationship between income and culture is defined, it will not be possible to determine the marginal effects of culture on consumer behavior after controlling for income. This is an especially relevant concern due to the wealth being created in numerous emerging economies and the vast new markets they promise. For any marketer to be successful in these new environments, it will be necessary to gauge how higher incomes will affect these nations' cultures and how the combined effects will impact consumer behavior.

Additionally, although not the focus of this research effort, this study raises the question of what is the best way to measure a society's collective values. GLOBE's values measures contradicted intuition and previous research, suggesting that its method of gauging a society's collective values were perhaps misguided. GLOBE asked each respondent to independently gauge their society's values on a certain cultural dimension; however, it appears that asking for each respondent's observations of society resulted in a more accurate portrait of societal level values. Further research and clarification of this issue would be immensely help not only to diffusion theorists but also to cross cultural researchers in general.

6.4 Conclusions

The findings herein indicate that culture and as a result, social contagion play a large role in explaining the diffusion process. Additionally the cultural variables shown to be most strongly associated with diffusion suggest that social contagion is motivated principally by status considerations and social normative pressures. Income heterogeneity was also shown to be a significant determinant of product adoption behavior.

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