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CLIMATOECONOMIC ROOTS OF SURVIVAL VERSUS SELF-EXPRESSION CULTURES

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The circumstances under which societies adapt their cultural values to cold, temperate, and hot climates include the availability of money to cope with climate. In a country-level study, collective income, household income, and economic growth were conceptualized as moderators of the climate-culture link because money is primarily used to satisfy homeostatic needs for thermal comfort, nutrition, and health. The results demonstrate that members of societies in more-demanding climates endorse survival values at the expense of self-expression values to the extent that they are poorer ($n = 74$ nations), that household incomes in these lower-income societies are lower ($n = 66$ nations), and that they face more economic recession ($n = 38$ nations). In addition to theoretical implications, the findings have practical implications for the cultural consequences of global warming and the effectiveness of financing for human development.

Keywords: cultural adaptation; thermal climate; survival values; self-expression values

Different climates lead to the evolution of diverse flora and fauna. Since antiquity, scientists have wrestled with the question of whether different climates also produce dissimilar human societies (for overviews, see House, Hanges, Javidan, Dorfman, & Gupta, 2004; Parker, 1995, 2000; Sorokin, 1928). An important puzzle, with many missing pieces, concerns the impact of thermal climate on culture as the collective programming of the mind that distinguishes members of one society from those of another (Hofstede, 2001). Two persistent misconceptions seem to have interfered with progress in mapping and explaining the adaptation of culture to cold, temperate, and hot climates.

First, climate as the generalized cold or hot weather of an area is measured in degrees Celsius or degrees Fahrenheit, with an arbitrary zero point and a constant unit of measurement. For humans, as endotherms, a temperate climate should serve as the point of reference (e.g., 22°C; Van de Vliert, 2006). Also, differences in temperature should be given increasingly more weight in increasingly colder or hotter climates (e.g., squared deviations from 22°C) because in these climates humans find it more and more difficult to satisfy homeostatic needs for thermal comfort, nutrition, and health.

Second, climate-culture links are typically investigated independently of financial-economic circumstances (e.g., House et al., 2004; Peterson & Smith, 1997; Van de Vliert & Van Yperen, 1996; Van de Vliert, Schwartz, Huismans, Hofstede, & Daan, 1999). However, to directly or indirectly meet climate-contingent homeostatic needs, people buy clothing, housing, food, home appliances, household energy, medications, health and other care services, transportation, and so forth. In higher-income societies, families appear to

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spend up to 50% of their household income on a wide variety of such homeostatic goods (Parker, 2000, pp. 144-147). This figure rises to 90% in lower-income societies, and in cases of abject poverty in harsh climates, many needs for homeostatic goods cannot be met at all by a majority of the population (United Nations Development Programme, 2003).

It took me 10 years of trial and error to expose these two persistent misconceptions about climate-culture links, 10 years to detect that a valid climatological analysis of cultural adaptation should take into account both the deviation from temperate climate and the degree of collective wealth. Only recently, I have made my first and still unsteady steps on a promising path requiring a kind of triple jump to conquer the climate-money-culture gap.

STEPS, A PATH, AND A TRIPLE JUMP

THE FIRST UNSTEADY STEPS

To date, the joint climatoeconomic impact of the *deviation from temperate climate* and the *degree of collective wealth* on culture has been explored in two studies dealing with the occurrence of cooperative leadership cultures and the perceived effectiveness of autocratic leadership cultures, respectively. Van de Vliert and Smith (2004) found that leaders in more developed countries, especially in richer countries with more demanding climates, are more democratic in that they rely more on subordinates as sources of information and as targets of delegation. Conversely, building on that study, Van de Vliert (2006) demonstrated that autocratic leadership is seen as less ideal and effective in higher-income countries with more demanding climates but as more effective in lower-income countries with more demanding climates.

However, these cross-national investigations have several shortcomings. A first weakness is that both studies were restricted to managerial samples reporting autocratic versus democratic leadership cultures in organizations rather than elements of overarching societal cultures. In addition, both studies were implicitly based on the untested assumption that household incomes drive elements of culture. Last but not least, both studies can be criticized for investigation of a process—cultural adaptation—solely on the basis of cross-sectional observations.

The three-part study reported here was undertaken to overcome all three shortcomings. First, for reasons to be discussed shortly, the broad cultural syndromes of survival values versus self-expression values were chosen as targets of adaptation of culture to climatoeconomic environments. Specifically, it was shown that survival versus self-expression cultures thrive in miserable versus enjoyable niches of thermal climate and collective wealth, respectively. Second, it was demonstrated that, in poorer countries with more demanding thermal climates, lower household incomes are related to stronger endorsement of survival values at the expense of self-expression values. Third, the expected longitudinal relationship between worsening climatoeconomic conditions and cultural change away from self-expression values toward survival values was substantiated. Thus, it was investigated from several perspectives whether the condition of money availability can help explain the impact of demanding thermal climate on survival versus self-expression cultures (i.e., whether money as a third factor alters climate-culture links).

A PROMISING PATH

No one calls in question that life in the animal world and in the vegetable world has adapted to cold, temperate, and hot climatic niches. Thus, it would be the number one wonder of the world if human culture were not adapted to thermal climate because it would mean that human evolution had somehow contrived to wipe out its own climatic underpinnings. Indeed, it would be absurd to propose that no climate-culture paths exist. But it would be equally absurd to propose that all components of all cultures can be traced back to climate. For example, I have no theory whatsoever to expect climate-culture links for individualism versus collectivism (e.g., Hofstede, 2001; House et al., 2004), for self-referenced versus other-referenced performance motives (Van de Vliert & Janssen, 2002), or for traditional versus secular-rational values (Inglehart & Baker, 2000).

A more realistic approach to the puzzle of climate-culture paths is to adopt the viewpoint that atmospheric cold and heat elicit homeostatic needs for thermal comfort, nutrition, and health and to then search for those elements of culture that have insightful relationships with the gratification of these basic survival needs. Maslow (1954), who contrasted lower-order needs for nutrition and health with higher-order needs for the expression of capacities and talents, has suggested that cultures differ in the extent to which they go beyond the gratification of survival needs toward the gratification of self-expression needs. An obvious and promising further speculation associates miserable climatoeconomic niches with survival culture and enjoyable climatoeconomic niches with self-expression culture.

In the present climate-culture investigation, I focused on the endorsement of survival versus self-expression values for theoretical, methodological, and practical reasons. The theoretical reason was that, more than any other cultural syndrome, survival versus self-expression cultures have insightful relationships with the climate-contingent needs for thermal comfort, nutrition, and health. The methodological reason was that four waves of the World Values Surveys have consistently produced a cultural dimension of survival versus self-expression values (Inglehart, 1997; Inglehart & Baker, 2000; Inglehart, Basáñez, Díez-Medrano, Halman, & Luijkx, 2004; Inglehart, Basáñez, & Moreno, 1998). And the practical reason was that a climate-culture path for survival versus self-expression cultures integrates my own line of climatological research and the World Values Surveys, the largest longitudinal investigation ever conducted of cultural differences around the globe.

A TRIPLE JUMP: CLIMATE-MONEY-CULTURE

Through nastier daily weather, colder or hotter climates make life much more difficult and demanding than do temperate climates. Harsher climates entail a wider variety of thermoregulatory requirements and adjustments, greater relocation risks, less amenable vegetation, greater risks of food shortage and food spoilage, stricter diets, more health problems, and so forth (e.g., Parker, 2000; Parsons, 1993; Sachs, 2000). Acclimatization, that is, long-term adjustment in anatomy and physiology, is not enough. More demanding thermal climates require special clothing, housing, and working arrangements, special organizations for the production, transportation, trade, and storage of food, special care and cure facilities, and so forth.

In psychological terms, more demanding cold or hot climates arouse a chain of primary, secondary, and tertiary needs shared by all inhabitants of a residential area:

primary homeostatic needs for thermal comfort, nutrition, and health; *secondary needs* for homeostatic goods to satisfy the primary homeostatic needs for thermal comfort, nutrition, and health; and *tertiary needs* for money to satisfy the secondary needs for homeostatic goods. In the long run, the continuous arousal of this chain of needs may have effects on the level of collective wealth. Notably, the climate-based need for money may explain why colder countries, with much larger deviations from 22°C than hotter countries, are wealthier (cf. Parker, 2000; Williamson & Moss, 1993). By contrast, here, the availability of money is not conceptualized as a long-term consequence of climate, but as a determinant of the long-term impact of climate on elements of societal culture.

Indeed, if cultural adaptation to cold, temperate, and hot climates occurs at all, climate-based needs for homeostatic goods are bound to play a crucial part in conjunction with the available money. Compared to higher-income societies in harsher climates, lower-income societies in harsher climates are expected to value greater cognitive, affective, and behavioral investments in survival and competitiveness rather than in personal growth and cooperativeness (cf. Van de Vliert, 2006). For the theoretical, methodological, and practical reasons discussed above, this hypothesis was put to the test using the World Values Surveys' dimension of survival values versus self-expression values (Inglehart & Baker, 2000; Inglehart et al., 2004). Members of societies on the survival pole of this dimension (e.g., Ukraine and Zimbabwe) perceive that meeting existence needs is precarious, give priority to physical and economic security, tend to mistrust others, and value material possessions and income. Members of societies on the opposite pole of this dimension (e.g., Netherlands and United States) take survival for granted, give priority to self-expression and quality of life, tend to trust others, and value social involvement and subjective well-being.

Inglehart and Baker (2000) have argued and demonstrated that economic development produces systematic cultural changes away from survival values toward self-expression values. However, they based this conclusion about cultural adaptation on cross-sectional wealth data rather than on longitudinal economic-growth data. In addition, and more importantly, they overlooked climate as the starting point of the triple jump of climate-money-culture. The current study was used to enrich Inglehart and Baker's contributions by testing the three-part hypothesis that societies in more demanding thermal climates endorse survival values over self-expression values to the extent that they are economically deprived in terms of collective income, household income, and economic growth.

METHOD

OVERVIEW

The study consisted of hierarchical regression analyses of culture data gathered in four waves of the World Values Surveys, carried out between 1981 and 2002 (<http://www.worldvaluessurvey.org>; Inglehart et al., 1998, 2004). The interactive climate-money-culture hypothesis was tested three times (Tests A, B, and C). Test A was a cross-sectional country-level analysis with survival versus self-expression culture as the dependent variable, climate as the main predictor, and collective income as a moderator. Test B, too, was a cross-sectional analysis, now with the within-country correlation of household income and individual survival versus self-expression values as the dependent variable, climate as the main predictor, and collective income as a moderator. Thus, although Test A used the climatoeconomic country context as a predictor of culture as such, Test B used the climatoeconomic

country context as a predictor of culture as a function of household income. Test C was a longitudinal country-level analysis with cultural change in survival versus self-expression values as the dependent variable, climate as the main predictor, and economic decline versus economic growth as a moderator. Although Test A in 74 nations and Test B in 66 nations were based on the 1999 to 2002 surveys, Test C was based on cultural changes in 38 nations during 8- to 19-year periods between 1981 and 2002 ($M = 14$ years).

To examine the discriminant validity of the crucial variables of culture, climate, and money availability, this set of confirmatory A-B-C tests of the main hypothesis was followed by three sets of A-B-C tests in which I pretended to confirm, but actually intended to disconfirm, alternative hypotheses. To determine the discriminant validity of the dependent variable of survival versus self-expression culture, the first set of retests pretended to confirm the parallel hypothesis that societies in more demanding thermal climates also endorse traditional values over secular-rational values to the extent that they are economically deprived in terms of collective income, household income, and economic growth (for traditional vs. secular-rational culture, see again Inglehart & Baker, 2000; Inglehart et al., 2004).

To determine the discriminant validity of the independent variable of climate, the second set of retests pretended to confirm the rival explanation that precipitation accounts for, or qualifies, the interactive effect of demanding thermal climate and money availability on survival versus self-expression culture. Finally, to examine the discriminant validity of the economic predictors, the third set of retests pretended to confirm the rival explanation that income inequality instead of collective income and economic growth influences the occurrence of climate-culture links.

SAMPLE

A total of 74 nationally representative subsamples of adult interviewees ($N = 111,296$ for Test A, $N = 62,172$ for Test B, and $N = 107,388$ for Test C) were included, for which both reliable culture data and economic data were available for analysis. The 74 countries represented more than 80% of the world's population. To reduce the impact of biased sampling of nations, each country's contribution to the regression equations was weighted (w) for the within-continent underrepresentation of the number of countries or more than 10,000 square kilometers (Europe, North America, Australia, and New Zealand $n = 38$, $w = 1$; Asia $n = 18$, $w = 2.56$; South America $n = 9$, $w = 2.44$; Africa $n = 9$, $w = 5.22$). However, when all countries were weighted equally, the pattern of results was basically the same. Thus, no indication of limited cross-national generalizability was found.

MEASURES

The World Values Surveys team adopted a well-thought-out strategy to construct two culture indexes that are neither too heterogeneous nor too homogeneous—survival versus self-expression values (S-SE) and traditional versus secular-rational values (T-SR). This innovative research strategy is described in Appendix A, the validity of the resulting S-SE and T-SR culture indexes is discussed in Appendix B, and the item-level measurement details are elaborated here.

Dependent variable for test A: Culture. A country's S-SE factor score was initially based on 14 items (Inglehart, 1997) but was later restricted to 8 items that appeared in the

same format in all waves of the World Values Surveys (Inglehart & Baker, 2000). The 8 items with varying response scales (to avoid response bias) include a 4-item subindex tapping whether the respondent gives priority to self-expression and quality of life over physical and economic security (2-point scales) and 4 singular items tapping whether the respondent “has signed a petition” (3-point scale), “thinks that homosexuality is justifiable” (10-point scale), “would say that most people can be trusted” (2-point scale), and “taking all things together” describes himself or herself as “happy” (4-point scale). In subsamples of countries, this 8-item S-SE index was almost perfectly correlated with the initial 14-item S-SE index, Pearson $r(43) = .96, p < .001$ (Inglehart & Baker, 2000, p. 25) and had a high test-retest reliability, Spearman $r_s(8) = .98, p < .001$, after 1 to 2 years; $r_s(9) = .83, p < .01$, after 2 to 3 years (own calculations). The S-SE index ranged from -1.93 in Moldova (high survival, low self-expression) to 2.17 in Sweden (low survival, high self-expression).

Analogously, a country’s T-SR factor score was initially based on 14 items (Inglehart, 1997) but was later restricted to 8 items that appeared in the same format in all waves of the World Values Surveys (Inglehart & Baker, 2000). These 8 items include a 4-item subindex tapping whether it is more important for a child to learn obedience and religious faith than independence and determination (2-point scales) and 4 singular items tapping whether “God is very important in respondent’s life” (10-point scale), the respondent “favors more respect for authority” (3-point scale), the respondent “has a strong sense of national pride” (4-point scale), and the respondent “thinks that abortion is never justifiable” (10-point scale). In subsamples of countries, this 8-item T-SR index was almost perfectly correlated with the initial 14-item T-SR index, Pearson $r(43) = .95, p < .001$ (Inglehart & Baker, 2000, p. 25) and had a sufficient test-retest reliability, Spearman $r_s(8) = .81, p < .02$, after 1 to 2 years; $r_s(9) = .63, p < .07$, after 2 to 3 years (own calculations). The T-SR index ranged from -2.23 in El Salvador (high traditional, low secular-rational) to 1.73 in Japan (low traditional, high secular-rational).

The measurement equivalence of the S-SE and T-SR culture constructs across climate-economic niches I established in four steps. First, the 10 above-listed S-SE and T-SR subindexes and items were intercorrelated at the individual level ($99,851 < N < 111,296$), resulting in a matrix with 45 intercorrelations. Second, 4 sets of 2 countries were selected on the basis of a systematic 2 (demanding climate: extremely temperate vs. extremely harsh) \times 2 (collective wealth: extremely poor vs. extremely rich) sampling design. The countries sampled were Nigeria and Tanzania (temperate/poor), Belarus and Russia (harsh/poor), New Zealand and Taiwan (temperate/rich), and Canada and Finland (harsh/rich). Third, similar to Step 1, for each country, a matrix with 45 intercorrelations was produced ($698 < N < 2,427$). Fourth, the 9 sets of 45 intercorrelations were intercorrelated (for a justification and explanation of this procedure, see Van de Vliert, Euwema, & Huismans, 1995). The associations between the world set and the country sets of intercorrelations demonstrated equivalence of the worldwide conceptualization of S-SE and T-SR culture and the country-specific conceptualizations of S-SE and T-SR culture in Nigeria ($r = .62, p < .001$), Tanzania ($r = .82, p < .001$), Belarus ($r = .81, p < .001$), Russia ($r = .85, p < .001$), New Zealand ($r = .86, p < .001$), Taiwan ($r = .87, p < .001$), Canada ($r = .96, p < .001$), and Finland ($r = .91, p < .001$).

Dependent variable for Test B: Income-culture link. Household income was measured by showing a card with local-currency income figures and asking in what group the respondent’s household belonged, counting all wages, salaries, pensions, and other

incomes, after taxes and other deductions (1 = lowest decile, 10 = highest decile). The within-country correlation between the respondent's household income and the respondent's personal endorsement of the above cultural values served as the dependent variable in Part B of the study. These income-culture correlations ranged from .04 in Uganda to .45 in Portugal for S-SE ($M = 0.22$, $SD = 0.08$) and from $-.12$ in Ukraine to .28 in Israel for T-SR ($M = 0.08$, $SD = 0.09$).

Dependent variable for Test C: Culture change. The annual culture change was expressed in two ways: as the difference between the S-SE or T-SR factor scores at the two points in time divided by the number of years between these two points in time and as the annual percentage of change in the S-SE or T-SR factor score (after addition of an increment of 3 to allow the percentage to be calculated from positive scores above 1). These slightly different operationalizations, $r(38) = .97$, $p < .001$ for S-SE, and $r(38) = .96$, $p < .001$ for T-SR, produced virtually the same results. Results for the annual percentage of culture change are reported because this percentage is identical in form with its main predictor—economic growth rate. The annual culture change rate ranged from -4.60 in Russia to 3.89 in Nigeria for S-SE ($M = 0.60$, $SD = 1.66$) and from -3.16 in Portugal to 1.64 in Poland for T-SR ($M = 0.07$, $SD = 1.04$).

Independent variable for Tests A, B, and C: Demanding climate (Parker, 1997, pp. 201-226). Temperate versus harsh cold or hot climate was operationalized as the sum of the squared deviations from 22°C for the average lowest and highest temperatures in the coldest winter month and in the hottest summer month (linear instead of quadratic deviations from 22°C produced almost identical results). The reference point for a temperate climate was set at 22°C because it is the approximate midpoint of the range of comfortable temperatures and because, cross-nationally, 22°C is also the highest temperature in the coldest month (on the Marshall Islands) and the lowest temperature in the hottest month (on the Faeroe Islands). The scores for demanding thermal climate ranged from 356 in Indonesia to 4,231 in Canada ($M = 1,889$, $SD = 1,067$).

Weighting procedures were used to address the potential problems of large variations in within-country temperatures and of a restriction of range on the tropical side of the spectrum. First, giving countries with large winter-summer differences in temperature a much smaller weight—25% or even 10%—in the analyses produced essentially the same results. Second, giving countries with hotter summers a higher weight on the basis of their midrange temperature in the hottest month produced more support for my hypothesis in each of the three tests. However, not to overstate my case at this point, I report the results of the most conservative tests.

Moderator variable for Tests A and B: Collective income. Collective income was operationalized as the natural logarithm of gross domestic product per capita (GDP/c) in 2000 (purchasing power parity U.S. dollars; United Nations Development Programme, 2002). Ln GDP/c ranged from 6.26 in Tanzania to 10.82 in Luxembourg ($M = 9.04$, $SD = 1.01$).

Moderator variable for Test C: Economic growth. As usual, economic growth was the percentage of annual decline versus growth in GDP/c (World Bank, 1965-2002). This negative versus positive growth rate was computed during periods ranging from 5 years before the earliest culture survey to the year of the latest culture survey. After the distribution of

the 9 negative and 29 positive growth rates was transformed into a 5-point ordinal scale, there were no departures from normality. Economic growth, ranging from -2 in Latvia, Lithuania, and Russia to 2 in Chile, China, and South Korea ($M = 0$, $SD = 1.04$), was insignificantly related to $\ln \text{GDP}/c$, $r(38) = .31$, *ns*.

Climatic complication for Tests A, B, and C: Precipitation. Precipitation (Parker, 1997, pp. 201-226), measured in millimeters and operationalized as the square root of the midrange level of rain or snow in the driest month and in the wettest month, ranged from 1.58 in Egypt to 15.57 in Nigeria ($M = 8.57$, $SD = 2.63$).

Economic complication for Tests A, B, and C: Income inequality. The Gini index (United Nations Development Programme, 2001, pp. 182-185), used to measure inequality over the entire distribution of income or consumption on a 100-point scale, ranged from 19.50 in Slovakia to 59.30 in South Africa ($M = 36.15$, $SD = 9.73$).

RESULTS

Table 1 contains a listing of the relationships between the dependent variables of cultural values and the climatoeconomic predictors used in each of the three parts of the study. Note that the two cultural dimensions (S-SE and T-SR) are not only independent ($r = .14$, *ns*; Test A) but do not change in tandem either ($r = .04$, *ns*; Test C). Perhaps the most interesting figures are in the second-to-last row of Tests A, B, and C in Table 1. In agreement with Inglehart and Baker's (2000, pp. 29-33) cross-sectional conclusion, both collective income ($r = .67$, $p < .001$, for Test A; $r = .44$, $p < .001$, for Test B) and economic growth ($r = .44$, $p < .01$, for Test C) appear to be related to self-expression culture at the expense of survival culture. Contrary to Inglehart and Baker's conviction, however, collective income ($r = .54$, $p < .001$, for Test A; $r = .50$, $p < .001$, for Test B) is, whereas economic growth ($r = .15$, *ns*, for Test C) is not, related to secular-rational culture at the expense of traditional culture.

TESTS OF THE CLIMATE-MONEY-CULTURE HYPOTHESIS

The results of the hierarchical regression analyses with standardized predictors supported the hypothesis in each part of the study. Test A revealed that societies in more demanding thermal climates endorsed survival values over self-expression values if they were relatively poor (e.g., Armenia and Moldova) but self-expression values over survival values if they were relatively affluent (e.g., Canada and Sweden; see Test A in Table 2 and Figure 1A; temperate = -1 *SD*, harsh = 1 *SD*). Thus, in addition to the predicted downward slope toward survival values for lower-income countries ($b = -.79$, $p < .001$), the unpredicted upward slope toward self-expression values for higher-income countries ($b = .25$, $p < .05$) also reached significance. This finding supports the notion that temperature-based demands unmatched by wealth-based resources undermine sociopsychological functioning, whereas temperature-based demands matched by wealth-based resources underpin sociopsychological functioning (Van de Vliert, 2006; Van de Vliert, Huang, & Levine, 2004; Van de Vliert, Huang, & Parker, 2004; Van de Vliert & Smith, 2004).

Test B focused on the strength of the positive within-country correlation between household income and personal endorsement of self-expression values over survival

TABLE 1
Intercorrelations of Culture, Climate, and Money Availability, for Tests A, B, C

Test A ^a	Survival vs. self-expression (S-SE) culture					
	Traditional vs. secular-rational (T-SR) culture	.14				
	Demanding thermal climate	-.07	.67***			
	Precipitation	.01	-.12	-.35**		
	Collective income	.67***	.54***	.38***	-.23*	
	Income inequality	-.17	-.64***	-.52***	.17	-.38***
Test B ^b	Income-culture correlation for S-SE values					
	Income-culture correlation for T-SR values	.50***				
	Demanding thermal climate	.31*	.15			
	Precipitation	-.17	-.29*	-.34**		
	Collective income	.44***	.50***	.36**	-.22	
	Income inequality	-.16	-.17	-.49***	.11	-.36**
Test C ^c	Change in S-SE culture					
	Change in T-SR culture	.04				
	Demanding thermal climate	-.61***	.16			
	Precipitation	.27	.03	-.29		
	Economic growth	.44**	.15	-.37*	.17	
	Income inequality	-.08	-.08	-.42**	.15	.04

a. $n = 74$.

b. $n = 66$.

c. $n = 38$.

* $p < .05$. ** $p < .01$. *** $p < .001$.

values. As expected, only for members of lower-income societies in more demanding thermal climates did a person's own household income make a difference. Unlike inhabitants of richer countries in harsher climates (e.g., Finland and United States; simple slope $b = -.01$, ns), inhabitants of poorer countries in harsher climates (e.g., Belarus and Latvia; $b = .03$, $p < .01$) endorsed survival values over self-expression values to the extent that they earned less (see Test B, Table 2 and Figure 1B; temperate = $-1 SD$, harsh = $1 SD$). Apparently, higher household incomes drive culture away from survival values toward self-expression values but do so only in miserable climatoeconomic niches. In enjoyable climatoeconomic niches, household incomes have a negligible impact on cultural adaptation.

Test C represented the longitudinal perspective. Again as expected, with collective income controlled for, societies in more demanding climates appeared to have moved more from self-expression values toward survival values to the extent that they had economic decline rather than economic growth (see Test C, Table 2 and Figure 1C; temperate = $-1 SD$, harsh = $1 SD$; $b = -1.39$, $p < .001$ for low economic growth; $b = -.25$, ns , for high economic growth). Given the view of most theorists that cultures are extremely stable over time, this significant degree of covariation of economic change and culture change is striking for the limited span of time investigated. Of course, the longitudinal evidence in Test C allowed a more causal interpretation of the observed climatoeconomic impact on culture than did the cross-sectional evidence in Tests A and B.

RETESTS FOR T-SR CULTURE

A related question was whether S-SE values have a unique relationship with demanding thermal climate and money availability or whether they share this relationship with other cultural values. When the A-B-C tests were repeated with T-SR values as the dependent

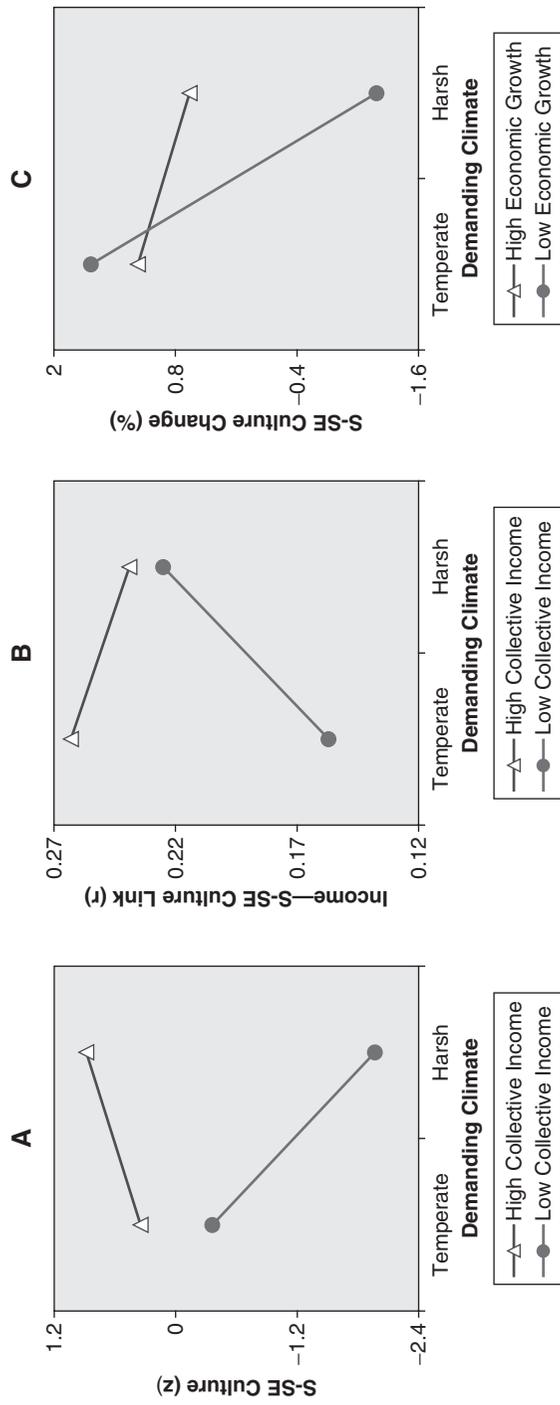


Figure 1: Joint Effects of Demanding Thermal Climate and Money Availability on Survival Versus Self-Expression (S-SE) Culture for Tests A, B, C

TABLE 2
Results of Regressing Survival Versus Self-Expression Culture (S-SE) on
Demanding Thermal Climate and Money Availability for Tests A, B, C

	<i>Test A</i>		<i>Test B</i>		<i>Test C</i>	
	<i>S-SE Culture</i>		<i>Income—S-SE Link</i>		<i>S-SE Culture Change</i>	
<i>N</i> _{countries}	74		66		38	
<i>M</i> _{interviewees per country}	1,504		942		2,826	
<i>Predictors</i>	ΔR^2	b	ΔR^2	b	ΔR^2	b
Demanding climate (DC)	.01	-.27***	.16***	.01	.46***	-.83***
Collective income (CI)	.38***	.89***	.21***	.03**	.00	-.03
DC \times CI	.25***	.54***	.05*	-.02*		
Economic growth (EG)					.03	.35
DC \times EG					.12**	.58**
<i>R</i> ²	.64***		.42***		.60***	

NOTE: All analyses are at the level of countries. Regression coefficients shown are unstandardized beta weights from the final step.

* $p < .05$. ** $p < .01$. *** $p < .001$.

variable, the climatoeconomic interaction terms in Parts A, B, and C of Table 2 accounted for .005% of the variation in culture on average. This negligible percentage attests to the discriminant validity of S-SE culture in its relationships with composites of demanding thermal climate and collective income, household income, and economic growth.

RETESTS WITH PRECIPITATION AS CLIMATIC COMPLICATION

Because more demanding thermal climates have less precipitation (see Table 1), the role of rainfall and snowfall was at issue as well. Therefore, the A-B-C tests were repeated using the following additional predictors: precipitation, the two-way interactions of precipitation and temperature and of precipitation and money availability, and the three-way interaction of precipitation, temperature, and money availability. However, in none of the analyses could precipitation account for, or qualify, the joint impact of demanding thermal climate and money availability on cultural values as reported in Table 2. Notably, the average proportion of variation in culture accounted for by the three climatoeconomic interaction terms in Table 2 only decreased from .14 to .12. This insignificant 2% decrease attests to the discriminant validity of demanding thermal climate in its income-dependent relationships with S-SE culture.

RETESTS WITH INCOME INEQUALITY AS ECONOMIC COMPLICATION

Table 2 and Figure 1 might be misleading also because collective income is confounded with income inequality (see Table 1). As a result, the A-B-C tests were repeated once more, now including income inequality and a complete set of two- and three-way interactions. This time, the average proportion of variation in culture accounted for by the climatoeconomic interaction terms in Table 2 decreased from .14 to .09. Nonetheless, in each of the three analyses, demanding thermal climate and either collective income or economic

growth retained their interactive impact on S-SE values, and this impact was not qualified by income inequality. The robustness of the initial results attests to the discriminant validity of collective income and economic growth in their climate-dependent relationships with S-SE culture.

RETESTS TO ADDRESS DIRECTION OF CAUSALITY

A remaining issue was whether collective income and economic growth are causes or effects of S-SE culture. The alternative interaction hypothesis, in which economy and culture change places, proposes that societies in more demanding thermal climates are more economically deprived to the extent that they endorse survival values over self-expression values. In Test A, a “reversed test” showed that the interaction of demanding climate and culture could not predict collective income ($\Delta R^2 = .00$). Similarly, in Test C, with collective income and culture controlled for, the interaction of demanding climate and culture change did not predict economic growth ($\Delta R^2 = .06$, *ns*). In combination with the corresponding results in Tests A and C in Table 2, these findings suggest that economy drives culture rather than the other way round.

DISCUSSION

A bird’s-eye view of the climate-money-culture field reveals that this research has defined rather than solved a problem. Do composites of thermal climate and money availability really drive societal culture? Does money really make more of a difference to cultural adaptation in demanding cold or hot climates than in temperate climates? If so, what makes S-SE values sensitive to the climatoeconomic context? Inspired by these questions, further attention was paid to the roots of culture from a climatic and from an economic perspective and to the strengths, weaknesses, and implications of the study.

ROOTS OF CULTURE FROM A CLIMATIC PERSPECTIVE

Climate-culture links have a deterministic flavor. This bad flavor can be traced back to two false implicit assumptions. The first assumption is that climate controls a large part of all elements of culture, including individualism or collectivism, uncertainty avoidance, gender egalitarianism, and performance orientation. A more realistic hypothesis, proposed by Gupta and Hanges (2004), is that “physical climate accounts for small variance in societal culture and leaves overwhelming flexibility for societies to shape their societal cultures” (p. 212). In support of their hypothesis, they found that only about one third of the variation in cultural values and practices may be attributed to differences in physical climate. In a similar vein, in the present study, joint effects of thermal climate and money availability on S-SE culture but not on T-SR culture were uncovered.

The second false assumption is that climate can only have main effects on culture (e.g., House et al., 2004, pp. 208-215, 259-261, 320-322, 352-353, 418-422, 549-551, 580-581, 638-639). Indeed, by definition, interactive effects indicating that climate-culture links depend on other factors are not at all deterministic. The data in Table 2 and in Figure 1 suggest that members of societies use collective income, household income, and economic growth to influence the otherwise deterministic impact of cold, temperate, or hot climate on

their culture. The inhabitants of the cold and poor Baltic states, for example, have inevitably been driven toward survival values, particularly those who earn less, and more so after the economic collapse during the 1990s (for a more extensive but climateless discussion, see Inglehart & Baker, 2000, pp. 40-42). The inhabitants of the neighboring cold but rich Scandinavian countries, however, have used their ever-growing money resources to move away from survival values toward self-expression values. Compared to both clusters of North European countries in cold climates, South American countries in more temperate climates have shown weaker relationships between economic change and culture change.

Contrary to their deterministic flavor, climate-culture links in terms of primary homeostatic needs for thermal comfort, nutrition, and health, secondary needs for homeostatic goods, and tertiary needs for money to convert the homeostatic needs into homeostatic goods represent a truly interactionist framework. Ultimately driven by internal body conditions, humans react to increasingly demanding external conditions of colder or hotter climate and lower income with increasingly salient and motivating survival values rather than values that emphasize self-expression, tradition, or secular-rational courses of action. All findings in the present study support this basic interactionist view of the development, enactment, and adjustment of human culture in response to thermal climate.

ROOTS OF CULTURE FROM AN ECONOMIC PERSPECTIVE

Economy-culture links are a classic example of a chicken-and-egg problem. On one hand, the economy-drives-culture camp (e.g., Bell, 1976; Inglehart & Baker, 2000; Marx, 1867) argues that economic development tends to propel societies in the direction of rising educational levels, more individual autonomy, changing gender roles, less obedience to authority, broader political participation, and the like. On the other hand, the culture-drives-economy camp (e.g., Hampden-Turner & Trompenaars, 1993; Harrison & Huntington, 2000; Huntington, 1996; McClelland, 1961; Weber, 1904/1958) argues that a deep psychological structure of shared values and achievement motives is the invisible hand that tends to propel societies in the direction of more or less economic growth.

If we learn anything from the history of economic development, it is that culture makes almost all the difference. Witness the enterprise of expatriate minorities—the Chinese in East and Southeast Asia, Indians in East Africa, Lebanese in West Africa, Jews and Calvinists throughout much of Europe, and on and on. (Landes, 2000, p. 1)

This ongoing debate about the economy as cause or effect of culture is generally based on insufficiently reliable information sampled from a variety of case descriptions. My more systematic approach demonstrated that cross-sectional and longitudinal comparisons of economy and culture may or may not lead to the same inference about their interrelationship. Higher levels of collective income and economic growth do produce the same conclusion about related decreases in survival values and increases in self-expression values. By contrast, unlike higher levels of collective income, higher levels of economic growth are not related to decreases in traditional values and increases in secular-rational values. Thus, by using cross-sectional and longitudinal case descriptions only, Inglehart and Baker (2000) seem to have drawn the wrong overall conclusion that economic development is related not only to culture change away from survival values toward self-expression values but also to culture change away from traditional values toward secular-rational values.

The chicken-and-egg debate is further hampered by the fact that economy and culture are theoretically equivalent candidates for holding the position of independent variable, dependent variable, or both. Here, this problem of the direction of causality was tackled by alternately anchoring economy and culture in the independent status of demanding thermal climate. Climatoeconomic interaction was used to predict culture, and the interaction of climate and culture was used to predict collective income and economic growth. This statistical solution yielded a clear decision in favor of the economy-drives-culture camp, thus supporting the first part of Inglehart and Baker's (2000) premature overall conclusion, that economic growth drives culture change away from survival values toward self-expression values.

STRENGTHS AND WEAKNESSES

This three-part study is no exception to the rule that every investigation has inherent strengths and weaknesses as a result of the methods employed. The strength of using the well-researched World Values Surveys dimensions of S-SE values and T-SR values came with the weakness of a convenience sample of countries. The strength of investigating broad cultural syndromes of S-SE values came with the weakness of theory building on the basis of a rather heterogeneous, empirically derived construct (for a discussion of whether this weakness is also a strength, see Appendix A). Finally, the strength of including thermal climate, precipitation, collective income, household income, economic growth, and income inequality as possible roots of culture came with the weakness of leaving multiple historical, political, institutional, and religious explanations out of consideration.

THEORETICAL AND PRACTICAL IMPLICATIONS

Twenty-five years after Hofstede's (1980) pioneering publication, cross-cultural psychology may be ripe for a paradigm shift from *culture's consequences* to *climate's cultural consequences*, from the fruits of culture to the roots of culture. In the transformed paradigm, societal cultures would be conceptualized as first-stage consequences of climatic composites and as second-stage intermediaries between these climatic composites and their indirect consequences for the sociopsychological functioning of markets, organizations, teams, and individuals. Some foreshadowings of such a paradigm seem to exist already. Cultural masculinity seems to mediate the negative relationship between demanding thermal climate and domestic political violence (Van de Vliert et al., 1999), and cultural uncertainty avoidance seems to mediate the joint impact of demanding thermal climate and national prosperity on delegative leadership in organizations (Van de Vliert & Smith, 2004).

At first sight, theoretical connections between atmospheric climate and sociopsychological functioning, especially individual-level functioning, seem farfetched. The gap narrows when one realizes that societal culture is both climate dependent and man made. And the discovery of the pivotal role of money, highlighted here, is beginning to integrate thermal climate, the warm-blooded human being, and the evolution of shared individual values and practices. A major challenge for scholars in this interdisciplinary field is to now weave a more complex web of relationships among lifelong exposure to thermal climate, hypothalamic monitoring of homeostasis, homeostatic utility maximization, money-based consumption of homeostatic goods, and collective adaptation (for more on several parts of this web of relationships, see Parker, 2000).

Theoretical advances regarding the cultural effects of demanding thermal climate and money availability are desirable also with a view to better management of the problems of

global warming and global poverty. If the present findings are valid and reflect causality rather than simultaneity, global warming produces living conditions that reinforce self-expression values in lower-income societies in cold climates (e.g., Baltic states and Russia) but survival values in lower-income societies in hot climates (e.g., Sub-Saharan Africa). Related to this, to enable people to enjoy a decent standard of living (freedom from want) and to secure freedom from fear, discrimination, injustice, and exploitation, freedom of speech, and freedom to develop and realize one's potential (United Nations Development Programme, 2000, pp. 1-13), financing for human development should be fine-tuned to the harshness of climate. The present findings suggest that foreign aid, debt relief, and expanding access to innovations and markets are more effective in securing "the seven freedoms" in lower-income societies living in harsher climates.

APPENDIX A

Combining Apples, Oranges, and Bananas

Survey researchers face the problem of combining responses to individual items into meaningful indexes. In fact, there are three potential problems. The survey responses to be combined can be too heterogeneous, too homogeneous, or too far from the best of both worlds (i.e., not sufficiently homogeneous and heterogeneous at the same time). Interestingly, scholars from different scientific disciplines, notably psychologists, economists, and macrosociologists, weigh these methodological problems differently.

Psychologists overemphasize the heterogeneity problem. They preach and teach that you should never add apples and oranges, let alone bananas. Each index should be internally consistent and factorially independent. Measurement validity is built on specificity rather than generality. For example, Triandis and colleagues (Singelis, Triandis, Bhawuk, & Gelfand, 1995; Triandis & Gelfand, 1998) have developed internally consistent, factorially independent, and cross-culturally applicable scales to tap individuals' endorsement of horizontal individualism, vertical individualism, horizontal collectivism, and vertical collectivism.

In striking contrast, economists overemphasize the homogeneity problem. They preach and teach that you should always combine as many fruits as possible to get indexes that adequately represent inevitably complicated realities. Measurement validity is built on generality rather than specificity. For example, annually, the World Economic Forum in Geneva produces a number of competitiveness indexes aimed at highlighting the factors and policies that determine the sharply different growth experiences of more than 100 economies. The most recent Global Competitiveness Index (Lopez-Claros, Blanke, Drzeniek, Mia, & Zahidi, 2005) combines 90 variables representing institutions, infrastructure, macro-economy, health and primary education, higher education and training, market efficiency, technological readiness, business sophistication, and innovation.

The still ongoing World Values Surveys are conducted by macrosociologists who, unlike psychologists and economists, attempt to overcome both the heterogeneity problem and the homogeneity problem. They profess that they "deliberately selected items covering a wide range of topics," that they could have obtained "more tightly correlated clusters of items" referring to a specific topic but that they refused to do so because their "goal was to measure broad dimensions of cross-cultural variation" (Inglehart & Baker, 2000, pp. 24-25). Thus, measurement validity is built on both specificity and generality. Exploratory factor analyses with varimax rotation of the data aggregated to the national level, consistently produced two independent bipolar dimensions of survival versus self-expression values (S-SE) and traditional versus secular-rational values (T-SR; Inglehart, 1997; Inglehart & Baker, 2000; Inglehart, Basáñez, Díez-Medrano, Halman, & Luijckx, 2004; Inglehart, Basáñez, & Moreno, 1998). With a view to the aggregability of the S-SE and T-SR dimensions, I made certain that the between-country differences in S-SE and T-SR were significantly larger than the within-country differences in S-SE ($F = 522.47$, $df_1 = 73$, $df_2 = 76,672$, $p < .001$) and T-SR ($F = 400.92$, $p < .001$).

The most recent S-SE index contains a homogeneous four-item materialist/postmaterialist values subindex (S-SE loading .86), supplemented with heterogeneous items about signing a petition (S-SE loading .80), the justifiability of homosexuality (S-SE loading .78), trust (S-SE loading .56), and happiness (S-SE loading .81). Similarly, the most recent T-SR index contains a homogeneous four-item autonomy subindex (T-SR loading .89), supplemented with heterogeneous items about the importance of God (T-SR loading .91), respect for authority (T-SR loading .72), sense of national pride (T-SR loading .82), and justifiability of abortion (T-SR loading .82; for isomorphic individual-level factor analyses and other details, see Inglehart & Baker, 2000, pp. 23-28).

APPENDIX B

Validating Fruit

The independent culture indexes of survival versus self-expression values (S-SE) and traditional versus secular-rational values (T-SR) have both face validity and intergenerational construct validity.

The face validity is apparent from a series of two-dimensional S-SE by T-SR maps (Inglehart, 1997; Inglehart & Baker, 2000; Inglehart, Basáñez, Díez-Medrano, Halman, & Luijckx, 2004; Inglehart, Basáñez, & Moreno, 1998) that accurately replicate the already known positions of the 74 countries in the following cultural clusters: Africa, South Asia, Latin America, ex-communist, Confucian, English speaking, Catholic Europe, and Protestant Europe (for criterion maps, see Hofstede, 2001; House, Hanges, Javidan, Dorfman, & Gupta, 2004; Huntington, 1996; Ronen & Shenkar, 1985).

The intergenerational construct validity, defined as evidence that values and practices are indeed cultural phenomena because they are passed on from generation to generation, rests on a criterion of my own making. At the University of Groningen, we have recently developed a number of cross-national indexes of enculturation of children around the globe (Van de Vliert, Van der Vegt, & Janssen, 2006). Three of these indexes—egoistic, altruistic, and apathetic enculturation—I used as criteria for assessing the intergenerational construct validity of the two culture indexes of the World Values Surveys. In line with my expectations, the survival pole of S-SE culture appeared to be associated with egoistic enculturation, $r(72) = -.63, p < .001$, the self-expression pole of S-SE culture with altruistic enculturation, $r(72) = .59, p < .001$, and neither of them with apathetic enculturation, $r(72) = -.08, ns$. By contrast, the traditional pole of T-SR culture appeared to be associated with apathetic enculturation, $r(72) = -.43, p < .001$, but neither traditional nor secular-rational culture was associated with egoistic enculturation, $r(72) = -.15, ns$, or altruistic enculturation, $r(72) = .09, ns$.

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