

Chapter 10

Ceteris Paribus and Fixed Effects in Regional and Cultural Economics



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Abstract This chapter is inspired by Peter Nijkamp’s contribution “Ceteris Paribus, Spatial Complexity and Spatial Equilibrium” and his original take on the deficiencies of using the ceteris paribus assumption in regional economic modelling. After summarizing Nijkamp’s interpretative perspective of the ceteris paribus assumption within theoretical modelling, I suggest an analytical analogy between the ceteris paribus assumption in theoretical modelling and the use of fixed effects in empirical modelling. I argue that fixed effects have the economic meaning of the ceteris paribus assumption in empirical work and could lead to erroneous implications in empirical results, especially with regard to understanding cultural relativity across space. The chapter illustrates this point through an example focused on *religion* as one of the most important proxies for culture in the economic literature. The operationalization of the example draws on data from the World Value Survey (WVS) and employs detailed data decomposition and logistic regression analyses. The use of fixed effects is contrasted to precise quantification of cultural interactions, cultural relativity and cultural hysteresis. The chapter shows how significant effects from cultural complexity can be lost or overseen in the interpretative analysis of empirical findings when fixed effects are used in the spirit of the ceteris paribus assumption.

Keywords Ceteris paribus · Fixed effects · Religion · Culture · Decomposition · Logistic regression · Cultural interactions · Cultural complexity · Nonlinearity

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To Peter, with gratitude

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10.1 Introduction

Professor Peter Nijkamp is a global scholar and philanthropist, whose outstanding intellectual contribution spans widely from generous and most candid comments to every junior or not so junior scholar at their conference presentations, to a wealth of publications on a plethora of multidisciplinary topics, rendered in regional economic analysis. Always on the crest of the wave of lateral thinking about the socio-economic reality and the phenomena behind it, Nijkamp's work is founded on his precise and elaborate knowledge of regional economics as a science, backed by his vast imagination about the links between neoclassical economics fundamentals and other disciplines (sociology, history, geography, topology, neuroscience, to name a few). His work has generated novel conceptual and methodological insights of various nature.

The current chapter focuses on one particular original contribution by Peter Nijkamp, eloquently laid out in a paper published in 2007 in the *Journal of Regional Science and Urban Economics*. This particular Nijkamp's contribution explains in detail the defectiveness of the *ceteris paribus* classical economic assumption. The chapter starts by presenting Nijkamp's standpoint regarding the *ceteris paribus* assumption in regional economics. This standpoint is next reinterpreted with regard to the empirical practice of using fixed effects from a regional and cultural economics perspective. Thus, a Culture-Based Development (CBD) (Tubadji 2012, 2013) interpretation of the *ceteris paribus* deficiencies is analytically presented and illustrated with empirical examples, highlighting the statistical and practical policy implications of applying fixed effects as an empirical equivalent of *ceteris paribus* in econometric analysis.

The main take from this meditation on Peter Nijkamp's (2007) idea is that Peter's insight that we cannot harmlessly over-impose a *ceteris paribus* condition resonates with most novel regional and cultural economics considerations in empirical work. Peter's far-reaching mind and the seeds of novel out-of-the-box ideas that he has left for all of us throughout his work will always shed light on the way ahead in regional science. His constructive criticisms and novel insights will reveal their depth to us as we grow to understand how his ideas help us grasp better the subject matter and develop further the approaches in our research field. Thank you, Peter, for the inspiration! And happy 75th Birthday! To many more years ahead!

The structure of this chapter is as follows. Section 10.1 overviews the essence of the *ceteris paribus* notion and traces its roots in the history of economic thought. Section 10.2 summarizes Nijkamp (2007) take on the *ceteris paribus* condition. Section 10.3 explains the CBD take on fixed effects as an empirical equivalent of the *ceteris paribus* condition in econometric economic analysis. It outlines the regional and cultural economics implications of the use of fixed effects as a *ceteris paribus* empirical implementation. Section 10.4 offers an empirical illustration of the stated CBD implications of using fixed effects as *ceteris paribus* in empirical work. Section 10.5 concludes.

10.2 Ceteris Paribus in Economic Theoretical Literature

The ceteris paribus condition was potentially existent since 1311, as claimed by Persky (1990), yet in economics it was introduced to a large extent due to the work of Marshall (1898). In its essence, ceteris paribus implies focusing on a particular set of factors and outcomes, assuming the rest of the world remains constant. The application of ceteris paribus is noted by Arrow and Debreu (1954) as problematic with regard to ignoring certain contextual influences. The father of behavioural economics, Herbert Simon (1969) also clearly states that the complexity of the decision tree and the numerous possible solutions in the same moment of time makes ceteris paribus a problematic assumption that allows us to study only a fraction of the real space of possible decisions.

Adding to this discourse, Nijkamp (2007) notes that the use of ceteris paribus as a condition in economic modelling leads to avoiding to pay due attention to the interactions in the economic system. In this context, and supported by a plethora of preceding work in Nijkamp (2005), Nijkamp and Reggiani (1993, 1998, 2006), according to Nijkamp (2007) the use of ceteris paribus leads to avoiding the main question how complex network structures affect the spatial-economic equilibrium.

10.3 Ceteris Paribus and Peter Nijkamp's Approach

Nijkamp's approach to the ceteris paribus notion was inspired by Tobler (1970) who stipulated the first law of geography, stating that: 'everything in space is related to everything else, but near things are more related than distant things' (Tobler 1970, p. 236). The argument in Nijkamp (2007) is based on elucidating the characteristics of the space economy as an open system and the nature of the interactions within this system, which jointly create a complexity that generates an important effect on the spatial-economic equilibrium. According to Nijkamp (2007), imposing a ceteris paribus condition on the economic modelling leads to an amputation of this complexity as a main source of influence on the spatial-economic equilibrium, and thus makes the analysis void of explanation for the outcomes observed in reality.

In his expose on the matter, Nijkamp (2007) offers two especially important insights. Firstly, in line with Robbins (1932) comments on the time-relevance of empirical findings such as the '*fallacy of misplaced concreteness*' (pp. 48–54) and the limits of economic laws, again there, Nijkamp (2007) highlights that evolutionary processes in the external world may render certain model parameters time-dependent in their behaviour, which causes a conflict with the ceteris paribus condition. In a certain moment in time, some factors may be significant, but in the next moment, they may lose their significance as a factor for the output of interest. Secondly, the use of ceteris paribus and the entire general equilibrium analysis is highlighted as potentially problematic in light of the existing slow and fast dynamics in a complex economic system. Underlying slow and fast dynamics in the economic

system (such as path dependency and lock-in behaviour) may determine different equilibria in the presence of identical inputs.

In his original contribution, Nijkamp (2007) clearly specifies that culture, among other endogenous entities, such as education, is an important source of impact on the economic system. As stated by Nijkamp, again there, culture can create qualitatively different organizational and topological structures that ultimately determine the development of the space economy. The current chapter starts from this pivotal insight and employs cultural and regional economic arguments and analysis in order to clarify the importance of culture as a complex system itself and its impact on the space economy. This is done in order to ultimately clarify that the use of fixed effects has the same aftermaths in empirical work as the imposition of *ceteris paribus* in theoretical modelling, and is equally erroneous for the same or similar and connected reasons as *ceteris paribus* is in theoretical modelling, as explained by Nijkamp (2007).

10.4 Ceteris Paribus and Culture-Based Development in Empirical Work

It is worth noting here that in his work ‘Theory of Moral Sentiments’, Adam Smith (1759) states a view on cultural relativity of valuation that is very similar to Tobler (1970) take on geographical proximity. Namely, Smith (1759) suggests that every human decision is personally weighted through our value system, but this cultural weighting is applied more rigorously to decisions concerning near things and people than to decisions concerning distant ones. One of Smith’s examples is the moral valuation of awarding one’s sympathy for suffering people. A loss of many lives due to a natural disaster in China seems more negligible to an individual in Europe, than the immediate suffering of people in front of our own eyes, and even more negligible in comparison to a mere minor but personal physical misfortune (such as a loss of one’s finger). The current chapter argues that the complexity of the cultural and moral valuation as part of the economic decision-making process is lost in the empirical economic analysis when fixed effects are used under the premise that they account for the entire cultural effect. This loss has reasons much similar to the reasons specified by Nijkamp (2007) with regard to the loss of accounting for complexity when imposing a *ceteris paribus* condition in theoretical economic work.

With regard to Nijkamp (2007) and his two main insights, outlined in the previous paragraph, CBD offers cultural economic support in the form of empirical evidence. Firstly, CBD has provided evidence that due to the cultural construction of reality and its culturally-based rules of the game, different places experience different impact from one unit of input. For example, CBD has demonstrated that there is cultural relativity from the impact of immigrants from one and the same ethnic background in different localities across space (see Tubadji and Nijkamp 2015). There is also different innovation success in terms of percolations of new ideas,

depending on the cultural connectedness in the social network in different localities (see Tubadji and Nijkamp 2016). In other words, the marginal product is culturally relative across space. What is notable here is that CBD adds to Nijkamp (2007) the claim that one and the same input may vary in significance as input not only across time but across space as well. Secondly, CBD has demonstrated that culture is a source of cultural persistence, cultural path-dependence and cultural hysteresis. Both individual entrepreneurs and entire regional economies seem to react differently to the same global shocks due to cultural relativity of valuation of this shock (see Tubadji et al. 2016, 2019). Put differently, CBD adds to Nijkamp (2007) argument that slow and fast dynamics exist in the complex open systems, by identifying culture as a major source of this slow and fast dynamics.

Moreover, the current chapter highlights, above all, that culture itself is a complex system on its own right and generates a nonlinear impact on the socio-economic reality. This puts in question the adequacy of the practice of using fixed effects to account for cultural differences, which has become an unwarranted heuristic in empirical work (see, for example, Kuncze and Anderson 2002). It is argued here that the usual rendering of culture in an empirical setting where cultural-identity fixed effects are employed to impose an empirical *ceteris paribus* equivalent to the economic analysis can lead to entirely uninformative or even erroneous conclusions. There are some pioneering analyses pointing in their own way in this direction (Neumayer 2003a, b; Greene 2004; Tabellini 2010). The current chapter synthesizes the meaning and message of these pioneering studies on fixed effects from the point of view of Nijkamp's (2007) take on the *ceteris paribus* condition by identifying clearly the common reasons behind the bias created through *ceteris paribus* in theoretical work and through fixed effects in empirical work.

Namely, the current chapter aims to postulate that culture is a complex in nature form of capital, and specifically:

1. Culture is a composite proto-institution¹ that serves for the construction and deconstruction of the social perceptions of reality, thus setting all rules of all games throughout the system, rendering the same model parameter significant in one spatial open system and insignificant in another.
2. Some cultural elements evolve faster than others, so different culture-based rules experience their state of evolutionary revision and evolutionary stability in different moments in time, and this creates slow and fast dynamics in the economic system.

¹Tubadji (2012, 2013) defines culture and cultural capital, explaining how the latter is the potential of the former to influence the reality and defines the composition of culture into four main subdomains: living culture and cultural heritage, respectively, each being in tangible or intangible form. Besides this complexity, each of these subdomains is built of a wealth of attitudes and their related beliefs and norms, which sometimes have different direction of impact, see Tubadji and Pattitoni (2020). That is why culture is firstly a complex system itself. Second, due to defining attitudes as the core of this complex system, CBD can be considered a Neo-Weberian paradigm, as Weber (1905) approach to culture defines culture as an attitude to religion. Regarding the role of culture as a proto-institution in the hierarchy of institutions, see Tubadji et al. (2015).

Put differently, the current chapter reiterates the claim of Tubadji (2014) that the omission of culture as an input factor in the model causes under-specification of the model. This statement is further developed here from the point of view of empirical analysis. Accounting for the statistical presence of cultural grouping cannot easily be achieved via fixed effects, because their use cannot account for the complexity of culture as a factor and omits to account for the network and dynamics of evolution of the cultural interactions in the socio-economic system. The next section provides an empirical example for the above two points. A comparison is offered between the economic analysis based on the same data, yet implemented alternatively through the use of fixed effects and the use of other quantitative methods accounting for the cultural factor.

10.5 Illustration of the Ceteris Paribus and Fixed Effects Problem in Regional and Cultural Economics

10.5.1 Data

For the purpose of the illustration in this chapter, we shall use mainly the World Value Survey, in its six waves, covering a period from 1981 until 2014 and in total containing 100 countries and nearly 171,000 individual observations. A statistical summary of each variable in our analysis is available in Appendix 10.1.

The example in this chapter will be based on the context variable culture, which as noted in Nijkamp (2007) is in interaction with the economic system. Also, as said above, culture itself is a complex system on its own right. Therefore, it has been operationalized in the literature through various proxy variables: trust, ethnicity, cultural heritage, etc. (see Guiso et al. (2006) for a comprehensive literature review on the operationalization of culture in the empirical economic literature). However, one of the most prominent operationalizations of culture since Max Weber, until nowadays (see Bénabou and Tirole 2006, 2011; Bénabou et al. 2013, 2015) is culture as religion (see Knack and Keefer 1997). In a fully neo-Weberian manner, CBD defines culture from the point of view of it being a complex system of attitudes, as Weber (1905) underlines the significance of attitudes as culture (which affects economic outcomes). Thus, in the current chapter, we shall operationalize culture in specific through the cultural attitude to religion. In specific, this is the expressed self-reported valuation of religion as being an important element of one's life. This variable is labelled *religion_important* and is equal to 1 if the person has selected religion among the items they consider important—selecting it from a list of various aspects of life listed in the WVS questionnaire, such as: friends, family and leisure time.

Alternatively, and in order to illustrate the complexity and dynamics of culture across time and space, we shall use the data from Google n-grams, which reports the frequency of appearance of a word in 5% digitalized sample of all published texts

across the world libraries. Namely, we use the frequency of appearance of the word ‘*religion*’, in order to reflect how intensely (and therefore how importantly) this notion has been employed in the construction and deconstruction of our reality throughout the last two centuries (see Tubadji 2020; Tubadji and Pattitoni 2020; Tubadji and Webber 2020). The assumption here is that the frequency of use of a word is associated with the higher importance of this notion in the narrative and constructed reality of the period. Thus, in a sense, the frequency of use of the word ‘*religion*’ in a year can be thought of as an operationalization of the idea of how important religion is in this period. In this sense, our time-series data from Google n-grams can be considered a natural counterpart of the WVS question about the attitude to the importance of religion described above.

The World Value Survey has data on 100 countries. This clearly provides us with the opportunity to easily trace the variation of culture across space within one WVS wave as well as to compare between time and space effects, tracing the development of the attitudes to religion as an important part of life throughout the time window 1981–2014 in different countries. We focus the analysis on waves 2 and wave 5, as wave 1 has a too small number of countries for comparison with the following waves, and wave 6 is not comparable with the Google n-gram data which finishes in 2008.

In addition, our WVS variables used in this analysis will include the following. As an outcome variable, we will have a proxy for wage or economic welfare (equivalent to a 10-degrees variable from the WVS, ranking standardized income). Our independent variables will include the basic components of a Mincer equation, such as: age, age squared, gender, level of education, level of urbanization of the area where the person is located (a dummy variable labelled ‘*city*’, equal to zero if the respondent lives in a rural area, and one otherwise).

10.5.2 Method

The technical claim throughout the empirical literature is that the use of country fixed effects (country FE) eliminates all cultural differences, and, respectively, the impact of culture has been taken away from the analysis (see Kunce and Anderson 2002; Neumayer 2003a, b). We want to test three culture and economics related hypotheses, which build on Nijkamp (2007) argument against ceteris paribus condition, and suggest that the same argument applies for rendering the use of fixed effects equally erroneous and bias-creating as the ceteris paribus condition in theoretical modelling. These cultural economics hypotheses are:

H01: Even in the presence of country FE, the regression still contains influences from cultural interactions.

H02: Even in the presence of country and time FE, the regression still contains influences from cultural change over time and across space (i.e. cultural hysteresis and cultural relativity).

H03: Even in the presence of time FE within one country, the regression still contains influences from differences in cultural change within space (i.e. cultural path-dependence).

The methodological tools for operationalizing each of these hypotheses are as follows.

To test H01, we use the Mincer equation in its simplest specification, as shown below:

$$\text{Wage} = \alpha + \beta_1 \text{Age} + \beta_2 \text{Age_Sq} + \beta_3 \text{Female} + \beta_4 \text{Edu} + \beta_5 \text{City} + e \quad (10.1)$$

The estimation of Model (1) is implemented first with OLS, using the pooled dataset of the whole WVS, and including country and time fixed effects. This standardly supposes that all cultural effects are accounted for using the country fixed effects (see Kuncze and Anderson 2002). Next, using the exact same Model (1), we decompose the effect for two groups: *religion_important* (those who answered the WVS question regarding important items of their life including religion among them), and *religion_NOT_important* (those who did not choose religion among the potential answers offered in the WVS questionnaire). This decomposition is clearly based on a cultural distinction. If the decomposition shows no difference between the two groups, indeed all cultural differences across space have been successfully accounted for by the use of the culture/country related fixed effects. If the decomposition still finds a significant difference between the two culturally defined categories, this means that there are certain important culture-related interaction that the country fixed effects have not been able to account for. The latter will mean that we cannot falsify hypothesis H01. In that case, *religion_important* will be included as a regressor in Model (1) as well as its relevant interaction terms with elements of the Mincer equation (such as education and gender), as stated in Model (2) below:

$$\begin{aligned} \text{Wage} = & \beta_1 \text{Age} + \beta_2 \text{Age_Sq} + \beta_3 \text{Female} + \beta_4 \text{Edu} + \beta_5 \text{City} + \beta_6 \text{Relig} \\ & + \beta_7 \text{ReligInter} + e_2 \end{aligned} \quad (10.2)$$

The estimation of Model (2) (expressed here with a suppressed constant, for brevity) with the same estimator as Model (1) will allow us to test the interaction with the *religion_important* as an additional regressor in order to account for these interactions of the cultural factor in the presence of country FE analytically within the regression. The results will be compared with the initial FE model.

Yet, besides the fact that interactions exist, Nijkamp (2007) claims that they also vary across time. We add here that they vary not only across time but also importantly across space, the latter containing the cultural relativity across space. This is our claim in H02. We proceed to test H02 by showing the difference in estimating (Model 1 and 2) through using different compositions of the WVS, with different time and space dimensions to it.

Moreover, within space, the cultural change over time happens in a different pace, thus a cultural hysteresis exists as a process on a regional level and the estimations of

the cultural effect over time for different places can be substantially different. This is the claim reflected in our H03. We proceed to test H03 by showing the difference in estimating (Model 1 and 2) by using the data separately for individual countries in the WVS, and comparing the results about these countries by having used time fixed effects in our estimations. If the results are particularly unstable, this will mean that the use of country and time fixed effects and interaction terms are not able to account for nonlinearity and cultural hysteresis across time and cultural relativity across space.

Finally, we want to learn how exactly the cultural interactions themselves are prone to nonlinearity and complexity. In order to explore the effect of potential nonlinearity and cultural relativity across space and time, we employ a logistic regression, specified as stated in Model (3) below.

$$\text{Relig} = \alpha + \beta_1 \text{Age} + \beta_2 \text{Female} + \beta_3 \text{Edu} + \beta_4 \text{City} + e_3 \quad (10.3)$$

The dependent variable *Relig* is defined as being religious (*religion_important* = 1), as opposed to religion not being important in one's life (*religion_important* = 0). This outcome variable is explained: (a) in parsimonious form, only in terms of the level of education in relation to gender, and alternatively (b) in its full specification as shown in model (3) above, with special attention to the effect of education by age category (below 30 or above 60 years of age, respectively). Results for Switzerland and Brazil are compared to results for the full sample of WVS countries for all years in order to illustrate the discrepancies of FE-based results in comparison to the realistic picture inside a country. Odds ratios and marginal effects for education over gender and education over age are presented for the needs of the analysis.

10.6 Results

10.6.1 Fixed Effects and Cultural Interactions

We start by exploring the distribution of wage for the entire sample in comparison to its distribution for religious and non-religious groups of men and women as well as the same cultural distinction between educated and not highly educated individuals. Figure 10.1 shows the results, which demonstrate, that the non-religious female and non-religious non-educated seem to experience cultural interactions of visible difference. In order to explore the extent of this difference analytically, we implement a Blinder–Oaxaca detailed data decomposition analysis. Table 10.1 presents the results.

Table 10.1 has five main columns with results. The first column shows the estimation of Model (1) with country and time fixed effects. The second column presents the means for the religious and non-religious groups. The last three columns

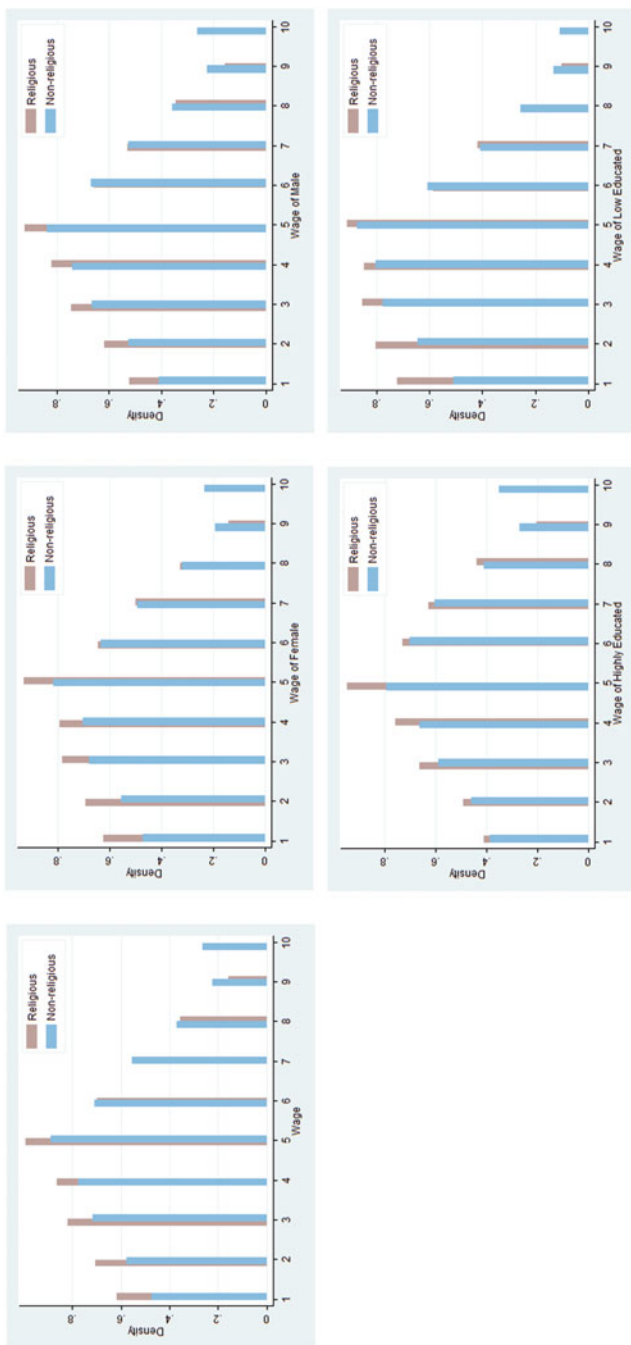


Fig. 10.1 Interactions of religion and wage—individual level. Notes: The figure represents the distribution of religiosity, in total, by gender and by education (WVS)

Table 10.1 Decomposition and cultural interactions beyond FE

dep. Var. Method	WAGE										
	OLS with country and wave FE		Mean		Decompositions		Religion is important		Pooled		
	Coef.	z-value	Religion NOT important	Religion is important	Coef.	z-value	Coef.	z-value	Coef.	z-value	
Differential											
Prediction_1					4.98	504.12	***	504.12	***	4.98	504.48
Prediction_2					4.63	737.85	***	737.85	***	4.63	738.06
Difference					0.35	29.74	***	29.74	***	0.35	29.76
Explained											
Age	0.031	18.93	***	41.22	0.038	10.89	***	10.93	***	0.045	13.07
age_sq	0.000	-23.73	***	1959.73	-0.042	-11.67	***	-11.65	***	-0.050	-13.29
Female	-0.111	-11.40	***	0.47	0.005	5.95	***	9.18	***	0.007	9.68
Edu	0.293	121.61	***	5.03	0.121	35.05	***	31.96	***	0.120	35.57
City	0.309	27.66	***	0.62	0.015	14.88	***	11.06	***	0.014	15.40
FE country	YES				YES			YES		YES	
FE wave	YES				YES			YES		YES	
_cons	3.631	47.16	***		0.224	20.29	***	12.91	***	0.215	25.31
Unexplained											
Age					0.683	4.54	***	4.54	***	0.676	4.54
age_sq					-0.415	-5.38	***	-5.38	***	-0.408	-5.38
Female					-0.049	-4.98	***	-4.98	***	-0.051	-4.98
Edu					-0.013	-0.48		-0.012	-0.48	-0.013	-0.47
City					-0.022	-1.42		-0.020	-1.42	-0.021	-1.40
Country dummies	YES				YES			YES		YES	
Wave dummies	YES				YES			YES		YES	
_cons					-0.005	-0.02		-0.005	-0.02	-0.005	-0.02
Total					0.124	8.38	***	-0.014	-0.47	0.133	10.25
Adj. R-square	0.1772				0.1728			0.1844		0.1773	
Sample size	188,285				188,285			188,285		188,285	

Notes: The table presents OLS compared to means for two groups and detailed Blinder-Oaxaca decomposition coefficients. The difference in decomposition shows the gap in economic welfare between non-religious people and religious individuals in the presence of country and year fixed effects

represent the detailed decomposition for, respectively, the non-religious, the religious and the pooled estimation, as recommended by Jann (2008).

The results in Table 10.1 show that the difference in the means of wages of religious and non-religious people (presented in column two) is statistically significant, and this is true in the presence of country fixed effects, which supposedly takes away the cultural differences across countries. Clearly, the country fixed effects do not manage to clean the cultural interaction of religion with the wage outcome. As seen in columns three, four and five, the cultural distinction in terms of religiosity is associated with a difference of about more than one third (35%) in the wage of the individuals, even when the estimation includes the country fixed effects. This result means that clearly there are cultural interactions that the use of country FE cannot account for successfully. Our H01 cannot be rejected, and Nijkamp (2007) has an important implication for the empirical deficiency of the use of FE as a *ceteris paribus* ‘curing’ the cultural influences in the economic processes.

10.6.2 Fixed Effects and Cultural Hysteresis in Time

One potential response to the existence of remaining unaccounted for cultural interactions after the use of fixed effects is to always use a cultural variable and its interaction terms in one’s regression when more than one country are present in the dataset (as suggested by Neumayer 2003a, b; Oyserman and Lee 2008; Davies et al. 2008; Tabellini 2010). However, according to Nijkamp (2007), there still are important time effects related to nonlinearities that cannot be accounted for even with the inclusion of interaction terms. We shall expand and explore here the claim of Nijkamp (2007) in the context of the cultural influence both over time and across space. I would argue that not only nonlinearities across time (cultural hysteresis) but also cultural relativity and cultural path-dependence across space and time will play a significant impact on the economic process and fixed effects cannot properly handle these effects. If we explore deeper the descriptive statistics about the cultural component, this becomes immediately evident, as seen from Fig. 10.2a and b, as well as Table 10.2.

As seen from Fig. 10.1, over time the intensity of the importance of religion for people seems to be decreasing—a disenchantment with religion, claimed by Max Weber and maintained as a thesis till nowadays (see Bénabou et al. 2015). However, the two waves of WVS (wave 2 and wave 5) coincide with the periods marked with red vertical lines in Fig. 10.1, and we see that between these two periods the importance of religiosity seems to have gone upwards. The conclusions based on viewing these different time windows of 200 and of about 35 years can clearly bring us to very different conclusions.

Also, as seen from Fig. 10.2b, a map of the world, representing the importance that the local interviewees of the WVS bestowed to religion in their lives, shows sizable cultural relativity across space. The map demonstrates that even within the same time window (the 35 years of the WVS), there is a very prominent

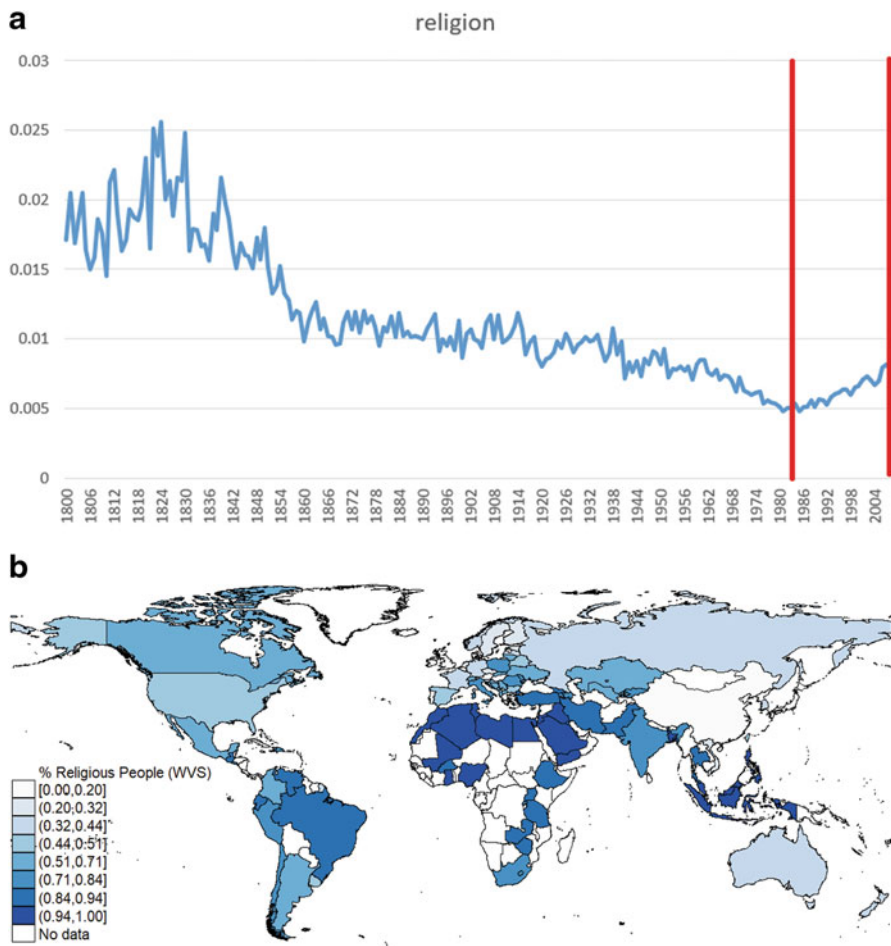


Fig. 10.2 (a) Religion over time. Notes: The figure represents the frequency of use of the word 'religion', 1800–2008 (Google n-grams). (b) Religion across space. Notes: The figure represents percentage of religious people by country, average 1981–2014 (WVS)

Table 10.2 Religion over time and across space

country	perc_relig_imp_wave2	perc_relig_imp_wave5
Switzerland	0.53	0.46
South Korea	0.58	0.49
Turkey	0.86	0.95
India	0.87*	0.85*
Brazil	0.87	0.92
South Africa	0.90	0.91

Notes: The table presents the percentage of religious people during wave 2 (1989–1993) and wave 5 (2005–2009) of the WVS. The table demonstrates that low percentage in wave 2 is followed by decrease of percentage in wave 5 and higher percentages in wave 2 are associated with increase of the percentage in wave 5, yet the effect seems not to be consistent, as shown by the *, for India, where a high percentage in wave 2 was followed by a decrease in wave 5

heterogeneity in religiosity across space. Indifferent of their religion, some places have been considering religion more important in their lives much more than other places during the same time period. These results confirm our alert about the inability even of interaction terms in a fixed-effects model to account for the complex cultural interaction and important nonlinear impacts from culture on the socio-economic process.

The information presented in Table 10.2 comes from the WVS and looks into the level of religiosity within a country and its change over time (in particular between wave 2 and wave 5 of the WVS). As we see, in most countries where the religiosity was relatively lower, it fell further lower as a percentage during wave 5; and in the countries where religiosity used to be high during wave 2, it increased even more during wave 5. Yet, even this bifurcation tendency is not systematically true for all countries, because as we see in India the religiosity was rather high during wave 2 (87%), and it fell with 2% in wave 5. These are strong descriptive indications for both nonlinearity, cultural hysteresis (as nonlinear cultural change over time) and cultural relativity across space (distinct path of the cultural process across different spaces). We use the example of Table 10.2 to choose Switzerland and Brazil as, respectively, a representative country for place that was with low religiosity that decrease over the last 35 years and a country with high religiosity which increased within the same period.

To explore our H02 regarding the remaining cultural time-sensitivity of the estimations when using FE and cultural interaction terms, we estimate Model (2) including the cultural interactions, but using different subsets of the data. The results are shown in Table 10.3.

As seen from Table 10.3, depending on the time period estimates, the impact of the cultural factor and its interaction terms with education and gender have a very different behaviour. While the pooled estimation identifies significant impact from the religiosity and its interactions with both education and gender, if we separate the sample into wave 2 and wave 5, the cultural interactions seem to entirely lose significance, together with religiosity itself, during wave 5. This means that Nijkamp (2007) and our interpretation of it for the presence of cultural hysteresis cannot be rejected with regard to FE not being able to play the role of *ceteris paribus* for the cultural component in empirical work.

10.6.3 Fixed Effects and Cultural Relativity Across Space

To test H03, regarding the within-country variation of culture over time, we explore Model (2) using the dataset for only one country at a time. Results are presented in Table 10.4.

According to the results in Table 10.4, the effect for Switzerland and the effect for Brazil are in contradiction. While Switzerland seems to experience a significant impact from the cultural factor of religiosity, Brazil does not seem to experience it. The effect of the interactions can no longer be captured for either country. This is

Table 10.3 Cultural FE and time

Dep. Var.	Wave 2 and 5										Wave 2										Wave 5									
	All					WAGE					All					WAGE					All					WAGE				
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value		
<i>Age</i>	0.03	18.93	0.03	18.93	0.04	14.16	0.04	14.16	0.04	14.16	0.09	9.02	0.09	9.02	0.09	9.05	0.04	12.68	0.04	12.68	0.04	12.68	0.04	12.68	0.04	12.68	0.04	12.67		
<i>age_sq</i>	0.00	-23.73	0.00	-23.50	0.00	-16.64	0.00	-16.66	0.00	-16.66	0.00	-10.24	0.00	-10.27	0.00	-10.27	0.00	-14.99	0.00	-14.99	0.00	-14.99	0.00	-14.99	0.00	-14.99	0.00	-14.99		
<i>Female</i>	-0.11	-11.40	0.00	-10.35	-0.17	-9.18	-0.18	-5.37	-0.17	-9.18	0.09	1.59	-0.06	-0.49	-0.06	-0.49	-0.10	-5.13	-0.19	-5.62	-0.19	-5.62	-0.19	-5.62	-0.19	-5.62	-0.19	-5.62		
<i>Edu</i>	0.29	121.61	0.29	121.04	0.30	67.64	0.33	39.90	0.30	67.64	0.32	20.92	0.32	20.92	0.32	20.92	0.32	20.92	0.32	20.92	0.32	20.92	0.32	20.92	0.32	20.92	0.32	20.92		
<i>City</i>	0.31	27.66	0.31	27.35	0.40	19.30	0.40	19.32	0.40	19.30	0.40	19.32	0.40	19.32	0.40	19.32	0.40	19.32	0.40	19.32	0.40	19.32	0.40	19.32	0.40	19.32	0.40	19.32		
<i>religion_impartment</i>	-	-	-0.13	-10.26	-0.17	-5.81	0.03	0.47	-0.07	-2.78	0.03	0.47	-0.35	-4.70	-0.43	-2.11	-0.35	-4.70	-0.04	-1.51	-0.04	-1.51	0.06	1.16	0.06	1.16	0.06	1.16		
<i>inter_relig_gender</i>	-	-	-	-	0.09	4.36	0.16	3.93	-	-	0.16	3.93	-	-	0.19	1.38	-	-	-	-	-	-	0.13	3.33	0.13	3.33	0.13	3.33		
<i>inter_relig_edu</i>	-	-	-	-	0.00	-0.34	-0.03	-3.63	-	-	-0.03	-3.63	-	-	0.00	0.05	-	-	-	-	-	-	-0.03	-3.65	-0.03	-3.65	-0.03	-3.65		
FE country	YES		YES		YES		YES		YES		YES		YES		YES		YES		YES		YES		YES		YES		YES			
FE wave	YES		YES		YES		YES		YES		YES		YES		YES		YES		YES		YES		YES		YES		YES			
<i>_cons</i>	2.558	38.92	2.629	39.80	2.650	38.79	1.939	18.81	1.863	17.03	1.863	17.03	-0.169	-0.73	-0.110	-0.40	-0.110	-0.40	3.276	33.77	3.276	33.77	3.190	30.72	3.190	30.72	3.190	30.72		
Adj. R-square	0.18		0.18		0.23		0.23		0.23		0.23		0.27		0.27		0.27		0.22		0.22		0.22		0.22		0.22			
Sample size	188,285		188,285		188,285		52,505		52,505		52,505		5534		5534		5534		46,971		46,971		46,971		46,971		46,971			

Notes: The table presents pooled OLS with country and year fixed effects. Estimations are done with four different subsets of the WVS dataset, differing time-wise, respectively, covering all the six waves in the WVS (Specification 1 to 3), data only for wave 2 and 5 (Specification 4-5), only data for wave 2 (Specification 6-7) and data only for wave 5 (Specification 8-9). The specifications differ in terms of including (a) only the religiosity as a cultural explanatory variable and (b) including religiosity and its interactions with education and gender

Table 10.4 Cultural FE and space

Specification	All countries						Switzerland						Brazil					
	Wave 2 and 5						Wave 2 and 5						Wave 2 and 5					
	Dep. Var.	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	
<i>WAGE</i>																		
<i>Age</i>	0.04	***	14.43	0.04	***	14.43	7.45	***	7.53	***	0.00083	0.06	0.00056	0.04				
<i>age_sq</i>	-0.00052	***	-16.93	-0.00052	***	-16.96	-8.75	***	-8.81	***	-2.8E-05	-0.18	-2.5E-05	-0.16				
<i>Female</i>	-0.07	***	-3.92	-0.18	***	-5.51	-3.77	***	-2.1	*	-0.26	-3.78	***	-0.54	-2.62	**		
<i>Edu</i>	0.30	***	67.76	0.33	***	41.01	3.92	***	4.43	***	0.32	18.64	***	0.36	8.08	***		
<i>City</i>	0.40	***	19.24	0.40	***	19.26	-1.48	***	-1.44	***	0.56	6.25	***	0.56	6.26	***		
<i>religion_important</i>	-0.07	**	-2.86	0.03	0.47	0.47	-3.56	***	1.15	***	-0.20	-1.83	***	-0.14	-0.57			
<i>inter_relig_gender</i>	-		-	0.16	3.99	3.99	-	***	-0.81	***	-	-	***	0.31	1.42			
<i>inter_relig_edu</i>	-		-	-0.03	-3.72	-3.72	-	***	-2.35	*	-	-	***	-0.04	-0.91			
FE country	YES			YES					-		-		-					
FE wave	YES			YES					YES		YES		YES					
<i>_cons</i>	1.939173		17.88	1.862759		16.35	1.82		0.669353		0.94		1.14749		3.94		3.17	
Adj. R-square	0.2314			0.2318					0.1609				0.2558				0.256	
Sample size	52,505			52,505					1097				1097				3069	

Notes: The table presents pooled OLS with country and year fixed effects. Estimations are done with three different subsets of the WVS dataset, differing space-wise, respectively, covering all countries in the WVS (Specification 1 and 2), data only for Switzerland (Specification 3 and 4) and data only for Brazil (Specification 5 and 6). The differences across specifications are as in Table 10.4

not likely to be due to the lack of a sufficient number of observations (which in all cases is above 1000 people). Rather, it reflects the cultural homogeneity within a country, thus clarifying that the cultural interactions are significantly different in each country and the FE could not account for within-country variations and complexities, as suggested here, following Nijkamp (2007).

Finally, we look at the decomposition of the cultural interactions using a logistic regression modelling. Tables 10.5 and 10.6 below present these results.

Table 10.5 shows us the odds from the logistic regression implemented using Model (3) in order to reveal the relationship between the cultural interactions between the outcome variable here (being religious, i.e. considering religion among the important things of your life) and the two main interactions considered in this chapter: religion with education and religion and gender. We present first a parsimonious estimation of these relationships only with fixed country and time effects. Next, in the following specifications in Table 10.5, an extended version of Model (3) is estimated, where we also control for age of the individual and type of habitat (city as opposed to rural area). To demonstrate the cultural relativity across space, we estimate these specifications once with the entire WVS sample and then separately, for Switzerland and Brazil, respectively. The results in Table 10.5 demonstrate that the strong overall effects observable on an aggregate level, when all countries are amassed, (reflected in high pseudo-R-squares) are lost when we look at the individual countries. At times, even the independent variables themselves lose explanatory power with the reduced sample. This means that cultural interactions matter as a distinction on a regional level, between contexts, much more than within a locality where perhaps the cultural variation is much weaker. This potentially would be in favour of using fixed effects for capturing culture.

However, Table 10.6 demonstrates the complexity of the cultural interaction between education and gender, on the one hand, and, between education and age (which is a previously not considered third source of cultural heterogeneity and cultural interaction, which is relevant to tap on here since we all know that the tastes of elder and younger generations tend to differ significantly, see Falk et al. 2018). The marginal effects show that there are differences in the level of the effect and differences in the magnitude of the effect for the different pairs of factors. Put differently, across-country nonlinearities in the relationship between these factors within the cultural affinity to religiosity seem to exist. The marginal effects on religiosity, decomposed (a) over education and gender and (b) over education and age, are also shown graphically in Fig. 10.3.

Figure 10.3 shows the complex web of sources of heterogeneity and nonlinearity in the cultural interactions. Most notably, in Brazil, the interactions between religiosity and education are always more sensitive for the higher educated than for the lower educated, the difference between educated women and men being double the difference between the lowest educated men and women. The same nonlinearity applies in Brazil for the relationship between religion, education and age, the elderly experiencing bigger differences than the youngsters. Moreover, the very direction of the relationship between religion and education is moderated differently by age in Switzerland (increasing with age) than in Brazil (decreasing with age). These results

Table 10.5 FE and nonlinearity in the cultural interactions—odds, logistic regression

Dep. Var.	Reduced specification						Extended specification								
	ALL WVS		Switzerland		Brazil		ALL WVS		Switzerland		Brazil				
	Odds	z-value	Odds	z-value	Odds	z-value	Odds	z-value	Odds	z-value	Odds	z-value			
<i>Age</i>							1.02	35.48	***	1.03	9.35	***	1.02	4.30	***
<i>Edu</i>	0.89	-33.88	***	0.98	-0.67		0.94	-15.07	***	1.06	1.70		0.92	-2.85	**
<i>Female</i>	1.62	34.57	***	1.70	5.49	***	1.69	30.87	***	1.91	5.26	***	1.89	5.16	***
<i>City</i>							0.83	-9.39	***	0.71	-2.53	**	0.62	-2.71	**
FE country															
FE wave															
<i>_cons</i>	1.23	2.46		1.01	0.05		0.68	-3.96	***	0.22	-5.73	***	4.50	5.58	***
Pseudo R-square	0.26			0.02			0.27			0.08			0.05		
Prob > chi ²	0.0000			0.0000			0.0000			0.0000			0.0000		
Sample size	144,025			1775			98,636			1203			2529		

Notes: The table presents odds estimated with logistic regressions, respectively, for all WVS countries and separately for Switzerland and Brazil, first with a reduced model (3) and then with the full model (3), aiming to analyse the statistical nature of the interaction between religiosity, education and gender, and other factors such as age

Table 10.6 FE and nonlinearity in the cultural interactions—marginal effects

Dep. Var.	ALL WVS				Brazil				Switzerland				Brazil							
	<i>Female</i>	<i>religion_important</i>	<i>z-value</i>	<i>religion_important</i>	Marginal effect	<i>z-value</i>	Marginal effect	<i>z-value</i>	Marginal effect	<i>z-value</i>	Marginal effect	<i>z-value</i>	Marginal effect	<i>z-value</i>	Marginal effect	<i>z-value</i>				
1	0	0.74	329.52	***	0.47	15.91	***	69.12	***	1	1	0.76	288.93	***	0.32	9.58	***	0.89	70.81	***
1	1	0.79	397.15	***	0.60	22.26	***	112.36	***	1	2	0.72	240.74	***	0.61	19.33	***	0.96	108.73	***
2	0	0.72	371.58	***	0.46	18.98	***	74.47	***	2	1	0.76	339.24	***	0.33	11.96	***	0.88	82.35	***
2	1	0.78	443.77	***	0.59	26.70	***	117.22	***	2	2	0.71	271.47	***	0.62	24.90	***	0.95	104.27	***
3	0	0.71	418.81	***	0.46	22.60	***	79.00	***	3	1	0.75	405.04	***	0.35	15.00	***	0.87	97.38	***
3	1	0.76	494.00	***	0.59	31.83	***	120.60	***	3	2	0.70	296.07	***	0.63	31.38	***	0.95	97.87	***
4	0	0.69	455.94	***	0.45	25.69	***	78.28	***	4	1	0.74	478.81	***	0.36	17.95	***	0.86	109.53	***
4	1	0.75	528.55	***	0.59	35.71	***	118.17	***	4	2	0.69	299.89	***	0.65	35.31	***	0.94	89.67	***
5	0	0.67	455.02	***	0.45	26.11	***	68.92	***	5	1	0.73	521.93	***	0.38	18.77	***	0.85	102.91	***
5	1	0.73	517.40	***	0.58	35.19	***	106.30	***	5	2	0.68	276.49	***	0.66	33.35	***	0.94	80.27	***
6	0	0.66	406.36	***	0.44	23.36	***	54.81	***	6	1	0.72	486.72	***	0.39	16.88	***	0.83	80.07	***
6	1	0.72	455.90	***	0.58	30.56	***	87.64	***	6	2	0.67	237.68	***	0.67	28.41	***	0.93	70.47	***
7	0	0.64	336.66	***	0.44	19.50	***	41.79	***	7	1	0.71	400.68	***	0.40	14.15	***	0.82	58.71	***
7	1	0.70	375.64	***	0.57	25.08	***	68.59	***	7	2	0.65	198.36	***	0.69	23.81	***	0.93	61.02	***
8	0	0.62	272.11	***	0.44	16.06	***	31.85	***	8	1	0.70	317.38	***	0.42	11.82	***	0.81	43.65	***
8	1	0.68	303.20	***	0.57	20.51	***	52.86	***	8	2	0.64	165.10	***	0.70	20.33	***	0.92	52.39	***

Notes: The table presents marginal effects for the effect of education on religiosity, over different genders (Specification 1–3) and over different age groups (below 30 and above 60) (Specification 4–6). The marginal effects for the entire WVS sample and separately for Switzerland and Brazil are presented for comparison

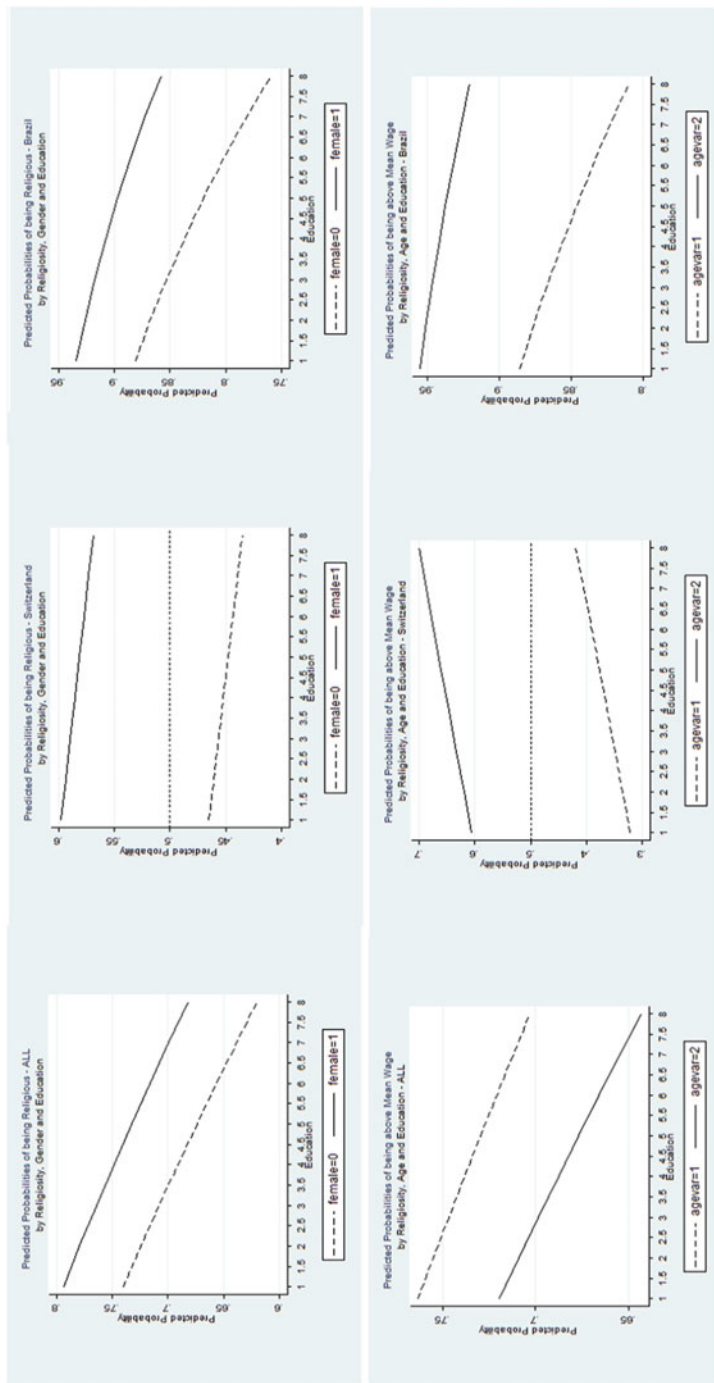


Fig. 10.3 Marginal effects from logistic regression with cultural FE. Notes: The figure represents marginal effects on religiosity from education, separately for two groups, respectively, female/male (Fig. 10.3.a, b, c, first row), and for people below .30 and above .60 (Fig. 10.3.d, e, f, second row). Each row presents first the entire WVS sample, and then the same information for Switzerland and finally for Brazil

show that aggregate handling of the cultural effects through fixed effects is non-advisable, as a very complex and important change may occur due to the different direction in which the changes in these cultural interactions will deviate the development of the local socio-economic system.

These results show that not only our H02 and H03 cannot be rejected, but further complexity and nonlinearity exists in the cultural interactions, both over time and space that cannot be fully accounted for through the use of cultural fixed effects and cultural interactions in a linear model. From policy implications point of view, the above-presented results have two important takes. Firstly, any model that is explored empirically through a culturally heterogeneous dataset has biased estimates if culture is not directly accounted in the model as a dependent variable, but only fixed effects are applied. This is due to under-specification of the model (as claimed by Tubadji 2014), but also because of the non-accounting for important interactions of this non-accounted for input variable (as argued here reinterpreting Nijkamp 2007). Secondly, even if a model contains cultural regressors, it needs to be carefully fitted according to its time and space statistical characteristics of the cultural component, in order to provide results with relevant and reliable economic meaning.

10.7 Conclusion

The current chapter is inspired by Nijkamp (2007) dealing with the use of *ceteris paribus* in theoretical modelling. I argue that the sources of bias in theoretical modelling that occurs due to the use of *ceteris paribus*, as outlined by Nijkamp (2007), are identical with the sources of bias that the use of fixed effects raises in empirical work.

The use of fixed effects in empirical economics is largely regarded by the community as accounting for the cultural heterogeneity across space. The current chapter argues that this is actually a misleading assumption that relies on reasonings akin to those required for applying the *ceteris paribus* in theoretical modelling. The sources of biases that *ceteris paribus* causes in theoretical work have then the same source as the biases that fixed effects causes in empirical work. Namely, these sources are the interactions of the context with the individual and the time and space nonlinearities of these interactions as major drivers for the cultural complexity in our world, which cannot be safely and easily wedged out from the analysis of the basic operation of any socio-economic mechanism of interest.

In order to empirically illustrate the remaining cultural interactions and their complexity in the presence of the use of country fixed effects, the current chapter uses the example of religion as a cultural factor which is renowned in economics and is of prominent socio-economic significance. Using data on religion from the World Value Survey, and employing a variety of statistical and econometric techniques (including detailed decomposition analysis and logistic regressions), the current chapter shows that even in the presence of use of 'cultural' fixed effects (regarding the national identity), there are still: (1) statistically and economically significant

cultural interactions to account for in the model (H01); (2) the cultural hysteresis over time (H02) and (3) the cultural relativity and path-dependence across space (H03) always exist and are present conditions that cannot be safely ruled out on a *ceteris paribus* principle through the use of linear empirical methods.

The findings in the current chapter clearly support the existing contributions by some of the leading cultural economists demonstrating with extraordinary precision the difference between national fixed effects and cultural and context dependencies in their analysis (see Neumayer 2003a, b; Tabellini 2010). The current study generalizes them into the insight, inspired by and offered through the lens of Nijkamp (2007), explicating that the use of FE is intended as a *ceteris paribus* in empirical work, especially regarding cultural interactions. This, however, is an unhealthy bias-generating practice, just as *ceteris paribus* is in theoretical work, because as claimed by Nijkamp (2007), complexity and nonlinearity exist in the cultural context. Moreover, we show empirical evidence that the bias that FE causes with regard to ignoring the complexity and nonlinearity of the cultural interactions has the same roots as the bias that *ceteris paribus* generates in theoretical modelling.

The main policy implication from this chapter is that econometric modelling cannot be taken for granted as a reliable and easily transferable across place and time analytical tool for evidence-based policy making. Firstly, in order for an econometric estimation to avoid omitted variable bias, every model needs to contain cultural variables reflecting the impact of the context. Second, fixed effects assume that the cultural influence is not correlated with the rest of the factors for the economic outcome and is captured in the error term. But clearly the complexity of our socio-economic reality is embedded in a cultural context, where culture affects most of the inputs and outputs in a Toblerian manner. Moreover, this context varies over time and place and this requires further careful modelling. Only hierarchical models and Bayesian probability models could be eventually trustworthy. Yet, that is true only if their precise and flexible technique is used to estimate an accurately defined and fully specified culture-based economic model. Put differently, mathematical and statistical simplification can do miracles to enlighten policy making, but only if simplification does not lead to over-simplification and loss of touch with reality and meaning. First step towards ensuring this is through requiring the model on which evidence-based policy making is made to always account for the cultural context. Second, accounting for the cultural context has to be done in a precise and well-calibrated manner, and not through an abrupt over-simplified severing of the cultural question through reliance on the statistically unreliable for this purpose fixed effects.

In summary, the current work demonstrates one of the wider, empirical applications of the theoretical insight on the *ceteris paribus* condition in economic modelling offered by Nijkamp (2007). This is one of the numerous examples of the far-reaching, lateral thinking endowed and important synthesis generating scientific genius of Peter Nijkamp. His wealth of contribution to the regional science library of ideas, and to socio-economic sciences more broadly, will keep shedding light on new pathways ahead, which we still need to revisit, comprehend and integrate in our practice.

Appendix: Descriptive Statistics: WVS Individual Level Data

Variable	Obs	Mean	Std. Dev.	Min	Max
<i>Wage</i>	314,846	4.62	2.337	1	10
<i>Age</i>	344,279	40.72	16.135	13	102
<i>age_sq</i>	344,279	1918.43	1487.046	169	10,404
<i>Edu</i>	299,295	4.71	2.229	1	8
<i>Female</i>	343,808	0.52	0.500	0	1
<i>City</i>	229,132	0.58	0.494	0	1
<i>religion_important</i>	348,532	0.67	0.472	0	1
<i>Waves</i>	348,532	4.27	1.432	1	6
<i>wave1</i>	348,532	0.04	0.194	0	1
<i>wave2</i>	348,532	0.07	0.256	0	1
<i>wave3</i>	348,532	0.22	0.416	0	1
<i>wave4</i>	348,532	0.17	0.375	0	1
<i>wave5</i>	348,532	0.24	0.428	0	1
<i>Country</i>	348,532			1	100

Notes: The table presents the main descriptive statistics for the variables from the WVS used on individual level in this chapter

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