Regional interdependence and the nexus between culture and growth

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Abstract

Does regional interdependence influence the nexus between culture and growth? We augment the framework set out in Tabellini (2010) to account for spatial correlation in technology and culture across European regions. We find that regional interdependence contributes to growth mainly through technology. We also find that when regional interdependence is taken into account, the cultural trait that enhances growth is tolerance and respect for others in the community.

JEL: C21, E02,

Keywords: Culture, Development, Spatial Econometrics

Very preliminary: Do not quote

1. Introduction

Tabellini (2010) studies the links between institutions, culture and development in Europe, analysing the effect that some specific cultural traits have on economic growth. His findings suggest that culture is a relevant factor in growth. To give an idea of the magnitude of this effect in Europe, he concludes that "if southern Italy had the same culture as Lombardy, the average yearly growth rate would have been higher by almost 0.5" percentage points (Tabellini 2010:702-704). Simple calculation shows that if this were so, the gap in average gross value added per capita between Southern Italian regions and Greater London would have been closed in 2000. Put it differently, according to this prediction, the question on why poor European regions are poor are entirely explained by the absence of culture and adequate institutions.

Is growth clusterd or randomly distributed? Is the impact of culture and institutions upon growth that Tabellini (2010) proposes net of the role of technological and cultural interdependence? Apart from culture and institutions, location and geography are indeed listed among the so-called fundamental determinants of growth, as they make it depending upon the neighbors' economic development because of, among other things, technological and cultural interdependence (Tabellini, 2008, Ertur and Koch, 2011).

The importance of spatial dependence has been recently raised in growth empirics (Anselin, 2003; Ertur and Koch, 2007). Various articles point out the necessity to account for spatial interdependence across both countries (Ertur and Koch, 2007) and regions (Corrado, Martin and Weeks, 2005; Ertur et al., 2007; Basile, 2008; LeSage and Fisher, 2008) to explain differences in growth rates. For instance, Ertur and Koch (2007) build a growth model that takes into account technological interdependence across a sample of worldwide economies allowing for the presence of spatial spillovers. They find that technological interdependence has to be taken into account to explain the conditional convergence process. There is also some empirical work analyzing the importance of spatial interdependences across European regions (Ertur, Le Gallo and LeSage, 2007; Basile, 2008; LeSage and Fischer, 2008). Indeed, Ertur et

al. (2007) estimate a spatial autoregressive model (SAR) under the assumption of both homoskedasticity and heteroskedasticity. Using a sample of 138 European regions along the time span 1980-1995, they estimate a locally linear Bayesian model to allow for heterogeneity and to account for the hypothesis that regions with similar institutions and fundamentals are likely to converge to similar steady-states (the conditional convergence hypothesis). Their results support the presence of variation in the β-convergence parameter across countries as well as substantial variation within countries. Basile (2008) estimates a semiparametric Spatial Durbin Model (SDM) to analyze convergence across a sample of 155 regions of Europe over the period 1988-2000. LeSage and Fischer (2008) describe the suitability of the SDM, among the available spatial econometric models, to estimate growth regressions. They apply the model to a sample of 255 European regions during a 8-year time period and use a Bayesian Model Averaging (BMA) procedure in order to allow for model uncertainty (Durlauf, 2001; Fernandez et al., 2001a,b). They find strong significance of spatial interdependence and spillover effects in determining regional income. Some other work analyses regional convergence across both space and time: Corrado, Martin and Weeks (2005), for instance, use a methodology that allows for the formation of endogenous clusters identified by means of pairwise tests for stationarity of differences in per capita GVA to assess convergence across European regions over the period 1975-1999. Their results show that clusters are small and that both geographic and socio-demographic factors are important to explain such clusters. Overall, their findings suggest that convergence paths across European regions are complex and they vary over both space and time. In the cultural economics literature, Beugelsdijk and van Schaik (2005) use the approach suggested by Quah (1996) to control for spatial correlation across regions when investigating the impact of culture and social capital on growth.

Other work acknowledges the importance of geographical dependence in both cultural and social norms for the determination of economic outcomes. Durlauf (2004) remarks that regional differences in contracting and policies may be explained by differences in social attitudes across

regions. Bisin and Verdier (2011) point out that culture may have a geographical spread. Brenlich et al. (2014) underline the relevance of social capital and the nonpecuniary externalities it may generate when analyzing regional growth dynamics and related issues.

This evidence is supportive of our attempt to link economic growth, culture and spatial econometrics. However, as far as we can ascertain, no paper has used so far spatial econometric techniques in order to account for spatial interdependence across economies when assessing the impact of culture on growth. Therefore, the aim of our work is to show that spatial autocorrelation should be taken into account in regressions analyzing the impact of culture on growth. In this paper we build on Tabellini's work, factoring in the effect of regional interdependence on the nexus between culture and economic growth, and test whether spatial autocorrelation in the dependent variables should be included in the analysis to avoid biased and inconsistent estimates (Anselin, 1988; Anselin and Bera, 1998; Arbia, 2006).

To answer these questions, we test residuals of each of the two stages in Tabellini (2010) for spatial autocorrelation. Should the evidence support the hypothesis that residuals are spatially correlated, we generalize the corresponding estimating equation to account for the potential presence of spatial correlation. Grounding on recent advances of both cultural economics and spatial econometrics literature, we use Tabellini's (2010) work investigating the causal impact of culture on growth as a benchmark framework for the study of the relationship between culture, growth and spatial interdependences. Our aim is not questioning the results obtained by the author, but rather looking for evidence about the nexus between culture, growth and spatial econometrics on already established empirical findings to open a fertile ground for future research.

We obtain four main results. First, interdependence across EU regions affects growth through technology. Second, controlling for the set of regressors in Tabellini (2010), cultural interdependence across regions is not likely to affect growth. Third, taking technological interdependence into account reduces the impact of culture on growth considerably. Last, the

most relevant cultural trait for growth is emphasis on the importance of encouraging children to tolerate and respect others in the community.

The paper is organised as follows. Section 2 analyses the channels through which regional interdependence affects growth, Section 3 studies the impact of regional interdependence on the nexus between growth and culture in Europe, and Section 4 concludes.

2. Data and motivation

2.1 Data

The data used in our analysis are taken from Tabellini (2010). The data are drawn from various sources. Information for the cultural indicators is collected from the World Values Surveys database (WVS). Tabellini assembles indicators that capture the effect of "social capital" through *trust* and *respect* for others, as well as indicators that capture "individual virtues" through an individual's *control* over his own life and *obedience*. The level of individual *trust* is measured by referring to the following WVS question: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?". The indicator is constructed using the regional percentage of respondents who answer that "Most people can be trusted" to the above question (the other possible answers being "Can't be too careful" and "Don't know"). The variable *respect* is obtained on the basis of the respondents' answer to the following WVS question: "Here is a list of qualities that children can be encouraged to learn at home. Which, if any, do you consider to be especially important? Please choose up to five". To construct the indicator Tabellini takes the regional percentage of respondents that mentioned the quality "tolerance and respect for other people" as being important (the other qualities in the list being: "good manners; independence; obedience; hard work; feeling of responsibility; imagination; thrift, saving money and things; determination and perseverance; religious faith; unselfishness").

The other two variables refer to individual virtues. *Obedience*, captures the difference

between hierarchical and modern democratic societies and is constructed on the basis of respondents' answers to the following WVS question: "Here is a list of qualities that children can be encouraged to learn at home. Which, if any, do you consider to be especially important? Please choose up to five". Tabellini takes the percentage of respondents that mention "obedience" as being important to the aforementioned question. It is important to note obedience is negatively correlated with economic growth. Finally, the variable *control* measures individual freedom and self-esteem and is constructed on the basis of the regional average responses (multiplied by 10) to the following WVS question: "Some people feel they have completely free choice and control over their lives, while other people feel that what we do has no real effect on what happens to them. Please use this scale (from 1 to 10) where 1 means "none at all" and 10 means "a great deal" to indicate how much freedom of choice and control in life you have over the way your life turns out".

We also use *pc-culture* and *pc_culture_pos*. The former is the regional average (multiplied by 100) of the first principal component extracted from the four cultural variables mentioned earlier: *control*, *obedience*, *respect* and *trust*. The latter is the regional average (multiplied by 100) of the first principal component extracted from those cultural variables that are positively correlated with economic growth: *control*, *respect* and *trust*.

The two indicators used to measure economic development and growth are the followings. *Growth* represents the average yearly growth, defined as the log difference of per capita GVA over the period 1977-2000; *yp9500* is the variable defining the average of per capita GVA over the period 1995-2000. In the growth regression we control also for school enrollment in 1960, *school*, urbanization in 1850, *urban*, and the log of per capita GVA in 1977, *lyp77*. The two instruments for cultural indicators are the literacy rate measured by the percentage of people that could read and write around 1880, *literacy*, and constraints on the executives in the years 1600-1850, *pc_institutions*. For a more detailed definition of the variables used in the empirical analysis, their sources and the way they have been constructed, the reader should refer to

Tabellini (2010).

2.2. Motivation

In Table 1 we report some preliminary evidence from the test for autocorrelation, where evidence of spatial autocorrelation should be taken as evidence of interdependence across regions. In the test, which is based on the Moran (1948) I statistic, we adopt the distance-based spatial weighting matrix, *W*, built on the geographical coordinates and the inverse of the squared distance, as in Ertur and Koch (2007).

Columns (1) and (2) report the analysis for the variables used to measure economic development in Tabellini (2010), namely GVA per capita, *yp9500*, and the growth rate of EU regions between 1977 and 2000, *growth*. The statistics that measure the global degree of similarity in the sample (global autocorrelation) and similarity among neighbouring regions (local autocorrelation) support the hypothesis of spatial autocorrelation (for local autocorrelation we present results at quintiles of the distribution of the statistic). Columns (3) to (7) suggest that the cultural traits considered in Tabellini (2010) are spatially correlated to a similar extent. These traits are the degree of trust individuals have in others, *trust*; the importance of encouraging children to tolerate and respect others, *respect*; the importance of teaching children obedience at home, *obedience*; the strength of the perception that individual effort will pay in life, *control*; and, finally, the regional average of the first principal component extracted after performing the principal component analysis on these traits, *pc_culture* (see data appendix for description and sources of the variables).

The results reported in Table 1 are not surprising. Tabellini (2010) exploits cross-sectional variation across European regions, and given the level of aggregation, regional interdependence is very likely to influence economic development. Looking more closely, therefore, the question is not whether interdependence matters, but the extent to which it influences the nexus between growth and culture across Europe, and the channels through which this influence is exerted. What is the main channel by which regional interdependence affects growth?

Table 1. Test for global and local spatial autocorrelation in variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variable:	*yp9500*	*growth*	*pc_culture*	*control*	*trust*	*obedience*	*respect*
Test for global spatial correlation							
	0.120	0.176	0.131	0.067	0.086	0.138	0.105
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Test for local spatial correlation							
Test value at:							
100%	0.663	0.991	0.894	0.640	1.106	1.114	0.726
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
80%	0.271	0.336	0.315	0.148	0.166	0.238	0.272
	(0.000)***	(0.000)***	(0.003)***	(0.026)**	(0.042)***	(0.053)*	(0.002)***
60%	0.134	0.126	0.091	0.041	0.058	0.095	0.117
	(0.023)**	(0.064)*	(0.191)	(0.305)	(0.236)	(0.233)	(0.184)
40%	0.004	0.04	0.016	0.001	0.002	0.048	0.005
	(0.462)	(0.284)	(0.378)	(0.457)	(0.423)	(0.258)	(0.428)
20%	-0.024	-0.004	-0.031	-0.028	-0.029	-0.012	-0.002
	(0.463)	(0.434)	(0.459)	(0.386)	(0.445)	(0.491)	(0.470)

Note: The Table reports the Moran (1948) I statistic. Columns (1) and (2) report the tests for spatial autocorrelation in the variables measuring economic development. Columns (3) to (7) report the tests for spatial autocorrelation in the variables measuring culture. *** (**) [*] stands for statistical significance at the 1%, (5%) [10%] level. *p* -values are in parenthesis.

3. Empirical framework

To answer, we test for spatial autocorrelation of the residuals in each of the two stages in Tabellini (2010). If we found evidence in support of the hypothesis of spatial autocorrelation, we could generalize the corresponding estimating equation to account for the potential presence of spatial autocorrelation.

We follow Tabellini (2010) and assume that:

(1) $$Y = \alpha + \delta C + \beta Y_0 + \gamma X + e,$$

where Y denotes either average per capita output or the growth rate; C denotes one of the

cultural traits under consideration; Y_0 indicates past economic development, proxied by degree of urbanization in 1850; X denotes the other regressors, such as school enrolment in 1960 and country dummies to capture current institutions; e is the unobserved error term. Because C and e are likely to be correlated, Tabellini (2010) postulates the following stochastic process:

$$(2) \qquad C = \lambda_1 + \lambda_2 X_0 + \lambda_3 Y_0 + \lambda_4 X + \upsilon \,,$$

where λ_i are parameters, υ is an unobserved error term, and X_0 is the set of instruments measuring past education (literacy rate around 1880) and early political institutions (constraints on the executive between 1600 and 1850). Equation (2) is the first stage equation to identify the coefficient of interest, δ, in equation (1). As in Ertur and Koch (2007), we test for spatial autocorrelation in the residuals of both equation (1) and equation (2), applying Moran's I test. **The evidence of spatial autocorrelation in residuals from these two equations indicates respectively technological and cultural interdependence across European regions.**

This would allow us to answer the second of the questions we are interested in: what is the impact of regional interdependence on the nexus between culture and growth?

Given the foregoing results, we generalize equation (1) allowing for spatial correlation in the error term as follows:

$$(3) \qquad Y = \phi + \varphi C + \eta Y_0 + \mu X + (I - \rho W)^{-1} \varepsilon \,.$$

Equation (3) allows for technological interdependence in the error term, which is captured by the parameter ρ. If the hypothesis $\rho=0$ is not rejected, the model reduces to that in Tabellini (2010).

4. Results

4.1. Does regional interdependence impact growth and culture in the EU?

The results are reported in Table 2. We estimate the model by the Bayesian Spatial Error model based on the Markov chain Monte Carlo, which allows for both technological

interdependence and heteroskedasticity (Geweeke, 1993; LeSage and Pace, 2009).

We set the prior of the hyperparameter equal to 4, thus allowing for heteroskedasticity and making the estimated parameters robust to outliers. First we run 1,000 draws with 100 burn-in, then 10,000 draws with 2,500 burn-in. We prefer the Bayesian Spatial Error approach to the Bayesian Spatial Durbin approach to estimate the models (LeSage and Fischer, 2009) because the presence of the individual dummies that Tabellini (2010) adds to the set of regressors to control for regional institutions is likely to lead to over-parametrization. In addition, the evidence (not reported) shows that the explanatory power of the models estimated via the Bayesian SEM is always greater than via the SDM.

We estimate the model using the unconditional (observed) value of culture. The associated test statistics are reported in Column (1). The results in all the other Columns are obtained using the conditional values of culture (Tabellini, 2010). The conditional value of culture is calculated by controlling the cultural variables for the potential effect of age, marital status, gender, self-reported social class, years of education, regional dummies and two categorical variables for health conditions.

The null hypothesis of no spatial correlation is not rejected in the case of the model estimated for culture, *C*, independently of the proxy used. This suggests that spatial correlation in cultural variables is in fact captured by our set of regressors. However, the null hypothesis is rejected in the case of the residuals from all the models for the variable *growth*. All in all, the evidence supports the hypothesis that technological interdependence affects economic development in Europe.

Table 3 shows the empirical results. The results from the first stage equation are not reported, as they are the same as in Tabellini (2010).

To ease comparison with Tabellini (2010), we always control for country dummies, school enrolment and past urbanization. Columns (1) and (2) display the results when the *pc_culture* regressor is unconditional and conditional value, respectively. The evidence supports

conditional convergence and technological interdependence. The results consistently show that the estimated parameter for technological interdependence is large and statistically significant in both specifications.

Table 2. Test for spatial autocorrelation of the residuals from the first and second stage equations

Model:	(1)	(2)	(3)	(4)	(5)	(6)
Moran's I test on residuals from $Y = \alpha + \delta C + \beta Y_0 + \gamma X + e$						
growth	2.792 (0.005)***	2.812 (0.005)***	2.880 (0.004)***	2.759 (0.006)***	2.756 (0.006)***	3.270 (0.001)***
Moran's I test on residuals from $C = \lambda_1 + \lambda_2 X_0 + \lambda_3 Y_0 + \lambda_4 X + \upsilon$						
pc_culture	1.163 (0.245)	1.268 (0.205)				
control			-0.986 (0.324)			
trust				-0.761 (0.447)		
obedience					-0.935 (0.350)	
respect						-0.927 (0.354)
Conditional values of culture						
	No	Yes	Yes	Yes	Yes	Yes

Note: Moran's I statistics are reported. Alle the models include country dummies. *** (**) [*] stands for statistical significance at the 1%, (5%) [10%] level. *p* -values are in parenthesis.

The impact of culture on growth is statistically significant, but substantially reduced by comparison with Tabellini (2010). These conclusions also hold if we remove the negative cultural indicator, *obedience*, from the principal component analysis, and obtain *pc_culture_pos* (Column 3). Columns (4) to (7) show the results for the variables *control*, *trust*, *obedience* and *respect*. Again we note that controlling for technological interdependence the

parameter estimates for culture are reduced considerably. The results suggest that culture works through tolerance and respect for other individuals in the community, transmitted by parents to children. The other proxies of culture are not statistically significant. As further support for, Columns (8) and (9) report results showing that when the variable *respect* is removed from the principal component analysis, the impact of culture on growth becomes not significant.

Table 3. Results from the second stage equation augmented for tecnological interdependence

Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
lyp_77	-0.930	-0.448	-0.415	-0.541	-0.504	-0.511	-0.346	-0.512	-0.563
	(0.407)**	(0.308)*	(0.329)*	(0.349)**	(0.316)*	(0.316)*	(0.325)	(0.342)*	(0.340)**
pc_culture	0.014	0.001							
	(0.008)**	(0.001)*							
pc_culture_pos			0.001						
			(0.001)*						
control				-0.001					
				(0.001)					
trust					-0.000				
					(0.002)				
obedience						0.001			
						(0.001)			
respect							0.002		
							(0.001)**		
pc_culture_no_respect								0.074	
								(0.087)	
pc_culture_pos_no_respect									0.075
									(0.096)
ρ	0.525	0.563	0.562	0.513	0.551	0.560	0.607	0.544	0.587
	(0.199)***	(0.161)***	(0.198)***	(0.191)***	(0.180)***	(0.200)***	(0.178)***	(0.192)***	(0.172)***
Cond. Val.	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# obs.	1000	1000	1000	1000	1000	1000	1000	1000	1000
Adj R^2	0.74	0.74	0.73	0.72	0.72	0.73	0.74	0.73	0.73

Notes: Estimation method: SEM. All the models include country dummies. *** (**) [*] stands for statistical significance at the 1%, (5%) [10%] level. *p* -values are in parenthesis.

3. Conclusions

Building on Tabellini (2010), we account for regional interdependence in the relationship between culture and growth in Europe. Our results do not question the direction of causality posited by Tabellini (2010), but they do suggest that interdependence affects growth through

technology; that accounting for technological interdependence substantially attenuates the effect of culture on growth; and finally that culture plays a role in growth through a specific cultural trait, namely *respect*.

Compared with the findings on the effect of culture on economic growth set out in Tabellini (2010), our own findings suggest that if parents in Southern Italy had encouraged their children to tolerate and respect others in the same way as parents in Lombardy did, the average yearly growth rate in the South would have been 0.2 percentage points higher, and the gap with the North would have been more than a fourth narrower in 2000. Our results raise questions concerning which variable, if any, captures the role that technological interdependence plays for growth across Europe. This question is left for further research.

Although empirically this could imply a reduction in size of the estimated cultural parameters, estimating spatial models allows to bring further improvements to the recent literature of cultural economics on both economic and econometric perspective. While we provide evidence on the importance of both collective cultural values and individual virtues to explain cross-regional growth dynamics, by testing for spatial dependence of cultural values it is also possible to check for the presence of spatial externalities and spillover effects of cultural values across the regions of Europe and assess if and the extent to which such externalities increase the importance of culture for economic growth.

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