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Tolerance and growth: modeling the empirical relationship

Abstract We showed, in Berggren and Elinder (2012), that tolerance toward homosexuals is negatively and quite robustly related to economic growth. In a comment, Bornhoff and Lee (201X) question this finding on model-specification grounds. By undertaking three changes, they purport to show that our main result does not hold. In this article, we demonstrate that one of these changes is inconsequential (replacing GDP per capita by its logarithm in controlling for conditional convergence) and argue that two of them are questionable. First, the removal of certain central control variable risks introducing omitted variable bias and inconsistent estimates. Second, regional dummy variables are added on arbitrary grounds. For example, by using regional dummy variables that are just as reasonable as the Baltic dummy used by Bornhoff and Lee, we find that significance for tolerance toward homosexuals reappears in our empirical model. In all, this implies that there are good grounds for considering the negative relationship between tolerance towards homosexuals and growth valid, Bornhoff and Lee's claims notwithstanding.

Keywords Tolerance · Growth · Diversity

JEL codes O40 · Z13

1 Introduction

In Berggren and Elinder (2012), we offered, for the first time, a cross-country analysis of how tolerance affects economic growth. We looked at two types of tolerance, toward homosexuals and toward people of a different race, and found a quite robust *negative* effect of tolerance toward homosexuals on growth. This result was almost without exception statistically significant, both in cross-sectional and in panel-data regressions, and it withstood several sensitivity tests. The estimated coefficients indicated that an increase in tolerance toward homosexuals of 10 percentage points entails a decrease in the growth rate by 0.3–0.4 percentage points.[1] As for tolerance toward people of a different race, we did not find as robust results. The sign of the estimated coefficient was, however, positive throughout.

In a comment, Bornhoff and Lee (201X: XX), henceforth denoted BL, state the following:

> Our results, however, explain growth better with more attention to initial conditions. We conclude that the concern in BE [Berggren and Elinder 2012] is unwarranted. … Overall, our results do not provide any evidence that tolerance towards homosexuals would have any effect on economic growth.

Their main claim is that they, unlike us, properly account for conditional convergence by "replacing the dollar level of GDP by its natural logarithm" (ibid.: XX), and on this basis they assert that the relationship we identified disappears.

Here, we identify several shortcomings in BL's analysis. More specifically, we show that it does not matter whether one uses GDP per capita or its logarithm to control for initial conditions; we argue that their model specification, by excluding important variables, violates both theoretical and empirically verified findings and that this risks introducing omitted variable bias; and we consider their country-dummy strategy arbitrary, showing that when we add other country dummies (that are as reasonable as their dummy for the Baltic countries) to our model, a negative and statistically significant relationship between tolerance and growth reappears.

We take all of this to imply that BL's attempt to establish that our initial finding does not hold is unconvincing. This is not to say that the analysis we performed is without its weaknesses (as no cross-sectional regression analysis is), but to challenge our findings, other and more systematic methods are needed.

[1] The tolerance measures are based on a survey in which respondents were asked if they would like to have homosexuals or people of a different race as neighbors. The fraction in each country that did not answer no is our basic measure of tolerance.

2 The BL argumentation and our reply

In this section, we explain why we find the BL argumentation, in its various parts and as a whole, wanting.[2]

2.1 Modeling conditional convergence

The first issue is how to account for initial economic conditions. BL (201X: XX) write:

> One of the principal causes for the contrast between the findings of BE and our results with their dataset lies in the modeling of "conditional convergence". … All of BE's regression equations have growth over some period as the dependent variable and the level of GDP per capita as one of the explanatory variables. We replace that level by the logarithm of initial GDP per person, in line with the literature …

Our reply to this critique consists of three parts. (i) Their Table 1 shows that exchanging GDP per capita by its logarithm does not change either the sign or the statistical significance of the coefficient for tolerance toward homosexuals: compare columns (2) and (3). Hence, whether one uses the one or the other does not matter in a qualitative sense for the empirical results of interest. (ii) In our new Table 1, the same finding appears with regard to our own model: when comparing columns (1) and (2) it is clear that the coefficient for tolerance toward homosexuals in both cases has the same negative sign, similar size and the same significance levels. Oddly, in spite of the framing of their paper as a critique of how we model conditional convergence, BL admit that "[a]ll of our results below, however, hold also for BE's level of GDP" (ibid.: XX). (iii) Lastly, BL claim that one should use the logarithm "in line with the literature" (ibid.: XX). We do not object to using the logarithm – many do; however, there are quite a few published studies that, in addition to ours, use the untransformed level (Barro 1991 and Hanushek and Woessmann 2008, to take two prominent examples). Ultimately, BL's view that our choice of measure here matters greatly seems wholly unfounded.

[2] BL have added two countries to our sample of 54 without identifying them, which in itself could affect the results. In any case, in order to clarify the validity of our original contribution, we retain the original sample here.

Table 1 Cross-sectional regression results

Dependent variable: Average annual growth in real GDP per capita 1998 to 2007						
	(1)	(2)	(3) Change 1	(4) Change 2	(5) Change 3	(6) Changes 1–3
Model:	Our model (4)	Our model (4) with GDP (log)	Drop controls	Drop Tol. race	Arbitrary regions	
Tolerance homosexuals	-3.034*	-2.68*	-0.83	-1.06	-0.62	0.83
	(1.62)	(1.47)	(1.98)	(1.43)	(1.27)	(0.83)
Tolerance race	12.45***	11.90***	6.03		4.33	
	(4.09)	(4.15)	(4.25)		(2.73)	
GDP	-0.01					
	(0.05)					
GDP (log)		-0.89	-0.59*	-0.97	-0.87*	-0.52*
		(0.54)	(0.30)	(0.59)	(0.46)	(0.28)
Schooling	0.01	0.09		0.21	0.02	
	(0.18)	(0.16)		(0.15)	(0.11)	
Investment share	0.09*	0.11**		0.09	0.01	
	(0.05)	(0.05)		(0.06)	(0.04)	
Trust	5.33**	5.65**		4.61*	2.27	
	(2.16)	(2.27)		(2.60)	(1.53)	
Legal	-0.42	-0.40		-0.20	-0.02	
	(0.37)	(0.33)		(0.31)	(0.22)	
Gini	0.05	0.04	-0.01	0.04	-0.02	-0.02
	(0.04)	(0.04)	(0.03)	(0.04)	(0.03)	(0.02)
Government	-0.09**	-0.07		0.01	-0.04	
	(0.04)	(0.05)		(0.05)	(0.04)	
Political rights	-0.24	-0.35		-0.16	-0.48	
	(0.36)	(0.36)		(0.37)	(0.30)	
Civil liberties	0.35	0.32		0.28	0.25	
	(0.49)	(0.46)		(0.45)	(0.28)	
Asia	2.04	1.61	1.79	0.22		
	(1.37)	(1.33)	(1.88)	(1.16)		
Latin America	-1.81*	-1.49	-0.48	-1.14		
	(0.94)	(0.96)	(0.67)	(0.89)		
Transition	2.15***	1.714**	2.26***	1.86**	2.06***	2.27***
	(0.79)	(0.63)	(0.55)	(0.77)	(0.59)	(0.46)
EU	0.95	0.96	0.69	0.47		
	(0.61)	(0.58)	(0.49)	(0.56)		
North America	0.04	0.20	0.49	-0.42		
	(0.81)	(0.71)	(0.45)	(0.84)		
Baltic					2.03**	2.58***
					(0.78)	(0.55)
China					7.22***	6.76***
					(0.849)	(0.420)
Ireland					2.88***	3.02***
					(0.32)	(0.21)
Constant	-8.19	-6.83	-0.60	-0.27	2.23	4.11***
	(5.57)	(5.19)	(3.34)	(4.66)	(2.43)	(1.15)
Observations	54	54	54	54	54	54

Notes: Column (1) reproduces column (4) from Table 1 in Berggren and Elinder (2012). In column (2) we change one thing: GDP/capita is replaced by its natural logarithm. In columns (3)-(5) we change the model in column (2) in three different ways, following the approach of BL: in column (3) we remove certain control variables; in column (4) we remove *Tolerance race*; and in column (5) we change the set of regional dummies used. In column (6) we, like BL, put all these changes together. Robust standard errors in parentheses. *Significant at 10%,**Significant at 5%, ***Significant at 1%.

2.2 Model specification: control variables

A central problem in all cross-country growth regressions is how to avoid omitted variable bias in the estimates of interest. Of first-order importance is to control for the most relevant growth factors. BL exclude the standard explanatory variables of growth, an action we consider dubious. Both investments and human capital have been shown to be important determinants of growth, in addition to initial income. The theoretical basis for inclusion is Solow's growth model, and the empirical basis is numerous findings that these variables are of particular importance (see, e.g., Mankiw et al. 1991; Temple 1999; Zak and Knack 2001; Sala-i-Martín et al. 2004; Durlauf et al. 2005; and Hanushek and Woessmann 2008).[3] We hold that these variables should be included in the regressions even if they do not turn out statistically significant in each individual regression. We cannot reject that they are different from zero, and if they have an effect, which we have good reason to expect, their exclusion is likely to render the estimates of the tolerance coefficients biased.

BL not only remove the core variables of investments and human capital; they also reject most of the other control variables in our preferred model (4) in Table (1) in Berggren and Elinder (2012). They do so on the grounds that the total number of variables becomes too large. We disagree and think that the more important problem is a risk of omitted variable bias in the parsimonious specification used by BL, not least since *Tolerance race*, *Trust*, *Government* and *Latin America* are statistically significant. Nevertheless, they are removed by BL, who, on the other hand, arbitrarily, it seems to us, retain *Gini*, which is *not* significant in our old model (4).[4] Hence, we continue to hold that the rich set of control variables used by us should be included.

We are interested to see what BL's exercise here entails (because they report only the results of making many changes at the same time). We therefore ask what the effect on *Tolerance homosexuals* is of changing the model in column (2) of Table 1 above by dropping all of the control variables except *Gini* and *Tolerance race* (for reasons explained in the next paragraph). We find, as reported in column (3), that statistical significance goes away but that the negative sign is retained.

A serious omission, in our view, is BL's exclusion of *Tolerance race*, which is apt to cause omitted variable bias. More specifically, since the correlation coefficient between the two tolerance measures is 0.52, it is likely that this omission will result in *Tolerance homosexuals* also picking up large parts of the effect of *Tolerance race*. Since the estimated coefficient of the latter is of the

[3] In particular, Glaeser (2005) argues that in studies including tolerance, it is key to control for education and that failing to do so could generate misleading results.

[4] Notably, in our Table 1 above *Gini* never attains statistical significance. One can add that columns (2) and (3) in BL's Table 1 illustrate the perils of deleting variables because they do not attain statistical significance: *Gini* is not deleted by BL from (2) although being statistically insignificant; and simply by changing a variable in (3), significance is obtained.

opposite sign and generally not statistically significant, this could in itself be a major reason to expect the estimated coefficient of *Tolerance homosexuals* to be biased toward zero. In column (4) in Table 1 above, we see the effect of dropping *Tolerance race* from the model in column (2). Again, and not surprisingly, the estimate of *Tolerance homosexuals* becomes statistically insignificant, but the sign is still negative.

2.3 Model specification: regional dummy variables

We cannot control for all possible growth factors. The standard approach to dealing with this issue is to add regional dummy variables to control for growth factors that are similar within but different between regions. BL remove most of the regional dummies that we use (in the old model (4), reproduced here as column (1) in Table 1) and instead add new ones – but, we believe, on arbitrary grounds. We explain our strategy and present weaknesses in theirs with three arguments, including some new empirical findings.

(i) It is a common procedure in cross-sectional growth regressions to include dummies for the major regions of the world, the countries of which are plausibly related to each other in systematic ways – e.g., culturally, institutionally and policy-wise (see, e.g., Hanushek and Woessman 2008; Latin America and Africa are controlled for frequently – see Durlauf et al. 2005). With the exception of one, our regional dummies are all dropped by BL. Even if one would accept that all statistically insignificant variables should be dropped, it is still the case that the Latin America dummy attains statistical significance in our old model (4). If the argument is that this dummy becomes insignificant when further regional dummies are added, and that it therefore should be dropped, the methodological question becomes one of clarifying when to stop adding new countries and regions. If one adds new ones, the ones that are significant in the BL specification could well turn insignificant. Not least, the order in which one adds and removes these dummies becomes important. We do not consider such an approach satisfactory; and we continue to think that the major regional dummies should be included.

(ii) Instead of the major regional dummies, with the exception of *Transition*, BL add three others: *Baltic*, *China* and *Ireland*. In column (5) in Table 1 above, we see that this exercise yields a statistically insignificant estimate of *Tolerance homosexuals*, but the sign is still negative.[5]

However, using *Baltic* in addition to *Transition* seems to us arbitrary. We do not find the theoretical arguments convincing for singling out the Baltic states: what is said to hold for them historically, in terms of institutional quality and a pick-up of growth following the fall of communism,

[5] We discuss the inclusion of China and Ireland in the next point, as they are supposedly included because of being outliers.

seems to us to hold equally well for many other transition countries (such as Poland, the Czech Republic, Slovakia and Hungary) – and quite possibly for many non-transition countries – that are not included as dummies. Clear theoretical reasons and systematic empirical analysis are lacking for the inclusion of the Baltic dummy.

In fact, if one looks more closely at the Baltic countries, one notices that they combine high growth rates and low tolerance levels. It is therefore hardly surprising that including them as a dummy weakens the relationship between tolerance and growth. If one instead systematically looks at the effect of including as dummies other culturally and institutionally similar country groups that stand out in the overall sample by combining, respectively, low growth with low tolerance (some Muslim countries around the Mediterranean), low growth with high tolerance (the Benelux countries) and high growth with high tolerance (not found), the resulting pattern lends support to the conclusion of our original paper and indicates that BL's findings are not robust, neither in estimated signs nor magnitudes. This is shown in Table 2. Indeed, *Tolerance homosexuals* turns out negative and, except in one case (the one picked by BL), statistically significant in model (2) from Table 1 above. Also note that the sign of *Tolerance homosexuals* becomes negative in BL's model as well as several other specifications.[6]

This exercise demonstrates that estimates of *Tolerance homosexuals* are sensitive to the particular choice of regional dummies, but the fact that we perform and report it should not be taken to indicate that we consider it a good way of picking regional dummies. We include it to illustrate that the method chosen by BL is arbitrary. Again, we prefer the standard way of including dummies – for the major regions of the world, our original strategy.

[6] Furthermore, in Berggren and Elinder (2012), panel-data results showed statistical significance (and a negative sign) for *Tolerance homosexuals – without the panel sample containing the Baltic countries*. This provides further grounds for being careful about rejecting, in any categorical way, the presence of a negative effect of tolerance toward homosexuals on growth. BL provide no panel-data analysis.

Table 2 Estimates of *Tolerance homosexuals* when varying regional dummies

	Baseline	+Baltic	+MedMus	+Benelux	+All
Our model (2)	-2.68**	-1.22	-5.29***	-2.84*	-3.92*
BL	0.02	0.69	-2.91	-0.01	-1.92

Notes: Our model (2) is the one of column (2) in Table 1 above. BL refers to the model of column (3) in their Table 1, excluding the Baltic dummy and the dummies for China and Ireland (but the results remain qualitatively the same if the latter two dummies are retained). Also note that we use our original sample of 54 countries here rather than that of 56 countries used by BL. *Baltic*: Estonia, Latvia and Lithuania. *MedMus*: Morocco, Turkey and Jordan. *Benelux*: Belgium, the Netherlands and Luxembourg. The dummies are added separately except in the case of *All*.

*Significant at 10%, **Significant at 5%, ***Significant at 1%

(iii) We made an important point in our paper of carrying out a robust outlier analysis, using the estimation technique of least trimmed squares (see Temple 1999: 127). BL do not seem to have used it but simply look at individual standardized residuals and single out China and Ireland (China was an outlier in our analysis as well, but Ireland was not; instead, India and Luxembourg were). We do not consider BL's outlier analysis reliable, for reasons outlined in our first paper. Furthermore, it seems to us odd to create dummies for outliers instead of seeing what happens when one removes them from the sample (which we did in our paper, indicating robustness for tolerance toward homosexuals in its effect on growth).

To summarize our assessment, BL engage in one action that is inconsequential (changing GDP per capita to its logarithm) and other actions that are dubious (drops standard control variables; drops Tolerance race; and introduces regional dummies in an arbitrary manner). Even if one accepts all of BL's actions it bears noting that, in each case, as shown in Table 1, the sign of *Tolerance homosexuals* remains negative. It is only when they are all combined together that the sign changes to positive. Add to this the findings of Table 2, which demonstrate that the arbitrary inclusion of the Baltic dummy generates the particular result stressed by BL. When one adds other regional dummies to our baseline model that are just as reasonable, statistical significance and a negative sign for the estimates of *Tolerance homosexuals* reappear.

3 Conclusion

We closed our previous article by stating that "[w]e do not consider this study to be definitive in providing an answer to the role of tolerance for economic growth. Rather we view it as a first attempt to look into the economic effects of tolerance across countries" (Berggren and Elinder 2012: 301). In that spirit, we certainly welcome new studies of the tolerance-growth relationship. However, we do not think that BL constitutes a particularly enlightening attempt in this regard. We stand by our published results – but certainly welcome new extensions. Not least, it is well known that cross-

country analysis alone can hardly be relied upon for definitive conclusions about causality, and we think and hope that future research designed to credibly address causality can shed more light on this issue.

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