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PITFALLS IN ESTIMATING β-CONVERGENCE BY MEANS OF PANEL DATA: AN EMPIRICAL TEST

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Abstract. This paper aims to test the conjecture advanced in a recent work by Bianchi and Menegatti (2007) that usual β–convergence panel regressions may produce biased evidence, due to their inability to distinguish between actual catching-up across countries and decreasing growth rates over time within countries. The test considers different sub-groups in a dataset of 72 countries for the period 1970-2000 and introduces both human capital and proxies for technological differences into the analysis. The results confirm the conjecture that traditional evidence about β-convergence may be misleading; they also show that catching-up across countries is weaker than usually claimed and that this process occurred only in some sub-groups of countries.

JEL Classification: C2, O11, O5.
Keywords: Catching-up, Convergence, Economic Growth, Panel Estimation Techniques.

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1. Introduction

The conjecture that poor countries should exhibit higher growth rates than richer ones, based on the conclusions of the neoclassical growth model, is one of the most debated issues in growth empirics. After the seminal contributions by Baumol (1986) and Abramovitz (1986), the so-called convergence hypothesis has been intensively discussed and tested in a series of papers by means of different econometric methodologies. Among these techniques the simplest and most commonly used is the so-called β-convergence test, which consists in examining the relationship between the initial level of GDP per capita (or per worker) and its subsequent growth in a group of countries. If this relationship is negative and significant, then it can be claimed that initially poorer countries tend, on average, to grow faster than richer ones, generating a phenomenon of catching-up.[1]

Empirical studies investigating the likely occurrence of β-convergence can be divided into two groups according to the specific model used for analysing actual data. An early group of papers (e.g. Barro, 1991; Mankiw, Romer and Weil, 1992 and Barro and Sala-i-Martin, 1995) tested the convergence hypothesis by using cross-country and cross-region data. However, this approach was shown to have two possible shortcomings: the first is related to the usually small number of observations available for estimation; the second, initially emphasised by Islam (1995), concerns the possible presence of country-specific effects (typically related to technological differences) and, in some cases, of time-specific effects, which are neglected in cross-section studies. In order to avoid these potential problems, a second group of papers (e.g. Islam 1995, Caselli et al., 1996; Evans, 1997; Dowrick and Rogers, 2002) performed the β-convergence analysis using panel data techniques.[2]

In a recent contribution, Bianchi and Menegatti (2007) (henceforth BM) claim that the traditional panel data techniques used in estimating β-convergence across countries may lead to potential pitfalls since they are unable to unravel the possible occurrence of two different phenomena:

a) the tendency for poor countries to grow faster than richer ones;

b) the contingency of a decreasing growth rate over time within countries.

In order to understand this potential problem, consider the case where richer countries grow faster than poorer ones but all (or most) economies experience a decreasing growth rate over time. Given

[1] It must be emphasised that, starting from Quah (1993), the use of this β-convergence technique to test for the existence of catching-up processes was criticised in different studies since it can suffer from problems related to the so-called Galton's fallacy. As in the original BM paper, we do not deal with this problem, focusing our analysis on alternative and potential pitfalls which can specifically affect this methodology when it is applied to panel data.

[2] A third minor group of studies (e.g. Barro and Lee, 1994) used a pooling technique in analysing convergence. This model is somehow intermediate between the cross-section and the panel models since it increases the number of observations but does not consider country-specific and time-specific effects.

these assumptions, although there is divergence across countries, the β-coefficient estimated using panel techniques may be negative, suggesting the counterfactual evidence of a convergence process.[3] This false result can occur because in the traditional panel approach the estimated β-coefficient reflects both the existence of different growth rates across countries in each period of time and the dynamics of the growth rates of each country over time. In this case, then, the estimated β-coefficient is the result of a mix of two effects of initial GDP per capita: a positive cross-country effect and a negative time effect.

BM also suggest a possible solution for these potential pitfalls. Since the potential bias in estimating β-convergence is due to the possible tendency of a decreasing growth rate over time within countries, BM suggest to overcome this problem by using a model that sterilizes the effect of time. This can be obtained by estimating a panel equation where *"the relevant variables to be used in the regressions are, for each sub-period, the deviations from their averages between countries."* (BM, p. 966).[4]

Given these premises, the aim of this paper is twofold. On one hand, from a methodological standpoint, we aim to test the BM conjecture by using empirical data about different groups of countries, rather than a hypothetical numerical example as in the original BM paper. On the other hand, from an empirical standpoint, we aim to verify whether the convergence results obtained in many empirical tests in the literature using panel data techniques are confirmed or somehow biased by the potential pitfalls implicit in the methodology used.

The analysis is performed by comparing the traditional results obtained using panel data techniques with the results obtained applying the technique proposed by BM to different sets of countries (OECD, Europe, Low-income, Middle-income and High-income countries). In addition, we test the robustness of the previous results by introducing a measure of human capital accumulation and a vector of proxies for technological differences.

The paper is organised as follows. Section 2 describes the methodological framework and the database used. Section 3 presents the results of the estimates made using the traditional set of control variables. Section 4 expands this set by introducing human capital and some proxies for technological differences. Section 5 outlines the conclusions to be drawn from previous analysis.

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[3] To prove this, BM produce a numerical example where the usual panel data techniques, applied to a specifically-constructed dataset, suggest the presence of convergence, while the growth rates of GDP per worker in the simulated economies actually diverge.

[4] BM implemented this model on the generated dataset, described in Footnote 3. The estimated regression unambiguously confirms the post-hoc divergence across simulated economies and thus the inadequacy of panel data techniques to distinguish between convergence and a declining growth rate over time.

2. The empirical test and the data

Traditional panel estimates may use two alternative specifications: a panel data regression with country-specific effects and a panel data regression with both country-specific and time-specific effects. The proposed specification for the regressions to be estimated is the most commonly used one in β-convergence analysis (cf. Durlauf and Quah, 1999; Temple, 1999 and Islam, 2003), founded on the seminal paper by Mankiw et al. (1992). Using this specification, the two alternative standard panel models used in the empirical literature correspond to the following equations respectively:

$$\log\left[\frac{y_{it+1}}{y_{it}}\right] = \alpha_i + \beta\log(y_{it}) + \gamma\log(s_{it}) + \delta\log(n_{it} + d + g) + \varepsilon_{it} \qquad [1]$$

$$\log\left[\frac{y_{it+1}}{y_{it}}\right] = \alpha_i + \eta_t + \beta\log(y_{it}) + \gamma\log(s_{it}) + \delta\log(n_{it} + d + g) + \varepsilon_{it} \qquad [2]$$

where i=*1,2,…, N* is the country index; t=*1,2,…, T* is the time index; y_{it} is the level of GDP per worker (or per capita)[5] in country *i* at the beginning of period *t*; s_{it} is the average saving rate in country *i* in period *t*; n_{it} is the average population growth in country *i* in period *t*; *d* is the average depreciation rate; *g* is the average rate of technological progress; and ε_{it} is the random error term for the *i*th country and *t*th time period, which is assumed to have zero mean and constant variance and to be independently distributed over time and countries. The parameters *d* and *g* are assumed to be equal across countries and over time. The usual conclusion of econometric analyses is that the convergence hypothesis is verified if the β-coefficient is negative.

By contrast, starting from the same theoretical growth model, the BM conjecture requires estimating the following equation:

$$\log\left(\frac{y_{it+1}}{y_{it}}\right) - av\left[\log\left(\frac{y_{it+1}}{y_{it}}\right)\right] = \beta\left[\log(y_{it}) - av(\log(y_{it}))\right] + \gamma\left[\log(s_{it}) - av(\log(s_{it}))\right] + \delta\left[\log(n_{it} + d + g) - av(\log(n_{it} + d + g))\right] + \varepsilon_{it} \qquad [3]$$

[5] The alternative between GDP per worker and GDP per capita does not lead to a unanimous choice in the catching-up literature. Convergence in GDP per worker is more accurate from a theoretical standpoint and more robust from an empirical one.

where $av(z_{it})$ represents the average of variable z_{it} between countries at time t. Also in this case the convergence hypothesis is verified if the β-coefficient is found to be negative.

It is worthwhile to notice that checking whether β is negative in equation [3] implies testing a different null hypothesis from equations [1] and [2]. In particular, in equation [3] the underlying assumption is that countries whose initial income is higher than average grow less than average, while equations [1] and [2] simply assume that higher initial income generates lower subsequent growth (with reference not only to different countries in each time period, but also to the same country in different periods of time). This difference in the underlying hypotheses to be tested leads to the claim that only estimating equation [3] enables to unravel the original convergence issue posed by Baumol (1986) and Abramovitz (1986) (i.e. whether richer countries grow less than poorer ones), while the estimates made through equations [1] and [2] may imply analysing a mix of different phenomena.[6]

The data used for the empirical analysis are mainly drawn from Summers and Heston's *Penn World Tables 6.1* and refer to the time period 1970 - 2000.[7] The rate of growth of population (n_j) is drawn from the World Bank World Development Indicators database, 2001 edition. The level of the initial real GDP per worker (or per capita) y_j at constant Laspeyres prices (with base year 1996) is obtained by adding up consumption, investment, Government expenditure and exports and subtracting imports in any given year. The saving rate s_j is measured by the investment share in real GDP per worker (per capita), estimated using the level of the investment share in real GDP per worker (per capita) available in the *Penn World Tables 6.1*, where the component shares of real GDP are obtained directly from a multilateral Geary aggregation over all countries. As usually done in this literature, the depreciation rate (d) and the rate of technological progress (g) are assumed to be equal across countries and set respectively to 0.05 and 0.02. In the panel estimates made, the overall sample period is divided into sub-periods of five years each.

The *Penn World Tables 6.1* sample includes 72 countries and since this study investigates the potential convergence either across all countries or across homogeneous sub-groups, countries were classified into five partially overlapping sets. This classification is shown in Table 1.

TABLE 1 HERE

[6] In order to better understand the point at issue, consider the case where all countries have equal starting conditions in each time period (also implying that they grow at the same rate in each period of time). Under this hypothesis, obviously, we would have $\log(y_{it}) - av(\log(y_{it})) = 0$, so that the estimated β–coefficient in equation [3] would be zero, while the same estimated coefficient in equations [1] and [2] might be negative. This latter result, however, would be misleading in the analysis of convergence across countries, since it would suggest that richer countries grow less than poorer ones while, by assumption in this case, all countries follow exactly the same growth pattern.

[7] A description of the *Penn World Tables* can be found in Heston and Summers (1996).

3. Testing the BM conjecture

We now compare the estimates for equations [1] and [2] with those for equation [3]. Two comparisons are undertaken: the first one uses observations from all 72 countries; the second one uses observations from the different sub-groups outlined in the previous Section. Table 2 summarises the estimates of the relevant β-coefficient.[8] In both Part I and Part II of the Table, the first two columns show the estimates derived from the traditional panel models, while the third column shows the estimates obtained using the BM technique.

The results reported in the Table show that both traditional panel models support the claim of the existence of a convergence process across the 72 countries in the whole sample. Furthermore, a negative and significant β-coefficient is obtained in both models for all sub-groups of countries except for the case of European countries in model [2]. We can thus conclude that the traditional panel estimation *clearly hints at a convergence process in all samples of countries*.

TABLE 2 HERE

However, when we use the BM technique, the outcomes are quite different. Examining the results in the third column of Part I and Part II of Table 2, we clearly see that, while the β–coefficient for the sample of all 72 countries is negative and significant, the coefficients estimated for sub-groups of countries are all not significant, except for the case of Middle-income countries. Hence, the BM model suggests that a clear process of *convergence seems to exist only for the sample of all 72 countries and for the sub-group of Middle-income countries*, while no significant catching-up process can be found in all other sub-groups of countries.

These results have some relevant implications for the convergence debate. First, from a methodological standpoint, the coefficients in Table 2 confirm that the use of traditional panel data techniques may lead to biased results about the existence of a catching-up process. In particular, the BM technique shows that in some cases (such as for the European economies, OECD countries, High-income and Low-income countries) the β-coefficients are not significant, as claimed by traditional estimates.

This conclusion is consistent with the accepted evidence about the dynamics of the growth process in these economies. Most of these countries experienced high growth rates in the initial time periods

[8] The estimates of the other coefficients appearing in eqs. [1]-[3], omitted to save space, can be provided by the authors.

considered in our sample, while afterwards they recorded declining growth rates over time. Hence, as BM claim, the traditional convergence tests based on panel data techniques may fail to disentangle the actual catching-up effect and the effect of a declining growth rate over time.

Second, from an empirical standpoint, the BM estimates reported in Table 2 suggest that a revision of some usual conclusions about convergence may be necessary. Indeed many papers analysing β-convergence by means of traditional panel techniques found that a strong process of catching-up occurred among High-income and/or OECD countries (e.g. Islam, 1995 and Dowrick and Rogers, 2002).[9] This conclusion is clearly challenged by the results derived using the BM technique, which suggests that an unambiguous catching-up process occurred only across Middle-income countries, while it did not concern the sub-groups of High-income and OECD countries.[10]

4. The introduction of human capital and technological differences

In Section Three we tested β-convergence by using the simplest equations derived from the basic neoclassical growth model. In order to verify the robustness of our results, we consider two possible extensions of this framework, by expanding the original set of control variables. This supplementary exercise is appropriate in order to reduce the risk that the conclusions obtained in the previous Section using the BM approach may be biased because of the omission of some relevant variables affecting growth.

First, in line with Mankiw-Romer-Weil's (1992, p. 421) argument that *"adding human capital to the Solow model improves its performance"* when testing for conditional convergence, we introduce this regressor in the set of control variables. Following a broad body of literature starting with Barro (1991), we choose the school-enrolment rate as the appropriate proxy for human capital. The variable used in the regressions is, in particular, the logarithm of "Gross Percentage of Secondary School Enrolment" at the beginning of each 5-year sub-period, retrieved from the World Bank Development Indicators database, 2001 edition.

Second, as emphasised by BM, a further problem in estimating equation [3] is its potential inability to consider technological differences across countries. However, as mentioned in the introduction, panel data analyses were introduced in β-convergence studies just for this purpose. BM suggest that

[9] It should be noticed that, obviously, these works consider time periods different from each other and also different from the time period studied in this work.

[10] It should be emphasised that the absence of a catching-up process in these sub-groups of countries is confirmed by other works using different methodologies for estimating convergence, such as cointegration or joint-stationarity techniques (cf. Bernard and Durlauf (1995) and Su (2003)).

this potential problem can be solved *"either by modelling the country-specific technology as a function of other observable variables or by introducing some proxies for it"* (BM 2007, p. 966). The number of proxies for technology in our large samples of countries is unfortunately rather limited. Hence the set of proxies for technological differences was actively restricted to the following four variables: electric power consumption (Kwh per capita), electric power transmission and distribution (as a percentage of output), number of personal computers (per thousand of people), number of telephone mainlines (per thousand of people). Variables are taken in logarithms at the beginning of each 5-year sub-period and are retrieved from the usual World Bank Development Indicators database, 2001 edition.

The estimates of the β-coefficients obtained from the regressions including human capital and technological differences are reported in Tables 3 and 4.[11] As the tables show, the introduction of human capital confirms the results previously derived from the basic specification: in the extended model, too, the β-coefficient is significant only for the sample of all 72 countries and for the sub-group of Middle-income countries.

A different conclusion is obtained when technological proxies are introduced. In this case, indeed, the catching-up result previously found for the whole sample disappears, so that only the group of Middle-income countries exhibits convergence. It should be noticed, however, that the sample of all countries in this case does not include Low-income countries, since technological data are not available for them. Obviously this difference, which implies the exclusion of poorer countries, could be the cause of the weaker convergence process found in the whole sample.

In conclusion, the extensions of the basic model studied in this Section provide further support for the BM conjecture, confirming that standard panel data techniques may fail to distinguish between actual convergence across countries and the effect of declining growth rates within countries over time. These results also confirm the conclusions obtained in Section Three according to which the convergence process experienced across countries in the period 1970-2000 is weaker than usually claimed by means of traditional techniques and seems to concern the Middle-income sub-group of countries only.

TABLE 3 HERE

TABLE 4 HERE

[11] Human capital is significant in all regressions both in the whole sample and in all sub-groups. Technological variables, instead, because of the typology of available proxies, are significant only in some regressions. However we choose to use them anyway in order to test the robustness of our results.

5. Conclusions

Bianchi and Menegatti (2007) claim that the β coefficients derived from traditional panel data regressions may be biased because they may capture both the tendency for poor countries to grow faster than richer ones and the possible tendency within countries to grow at a decreasing rate over time. These techniques could therefore be misleading and indicate the presence of convergence even in cases where there is none. As a consequence, BM suggest getting rid of the second effect by considering the difference between the actual observation in every country and the average between countries for each regressor in each sub-period of time considered in the panel.

This work performed an empirical test of the BM conjecture, by estimating the basic equation proposed by the authors for different samples of countries (OECD, Europe, High, Middle and Low-income countries) and comparing the results with those obtained by using the standard panel data techniques. The estimates made for the time period 1970-2000 provide strong support in favour of the BM conjecture.

Furthermore, the results also show that the convergence process experienced across countries is weaker than usually claimed in the literature. Indeed an inspection of the estimated β-coefficients provides clear evidence of a catching-up effect occurring only with reference to the whole sample of the 72 countries analysed and to the group of Middle-income countries. On the contrary, no convergence can be claimed in the other sub-groups of economies (OECD countries, European countries, High-income, and Low-income countries). This conclusion seems to clearly narrow the cases of a convergence process experienced in past years.

Finally, the paper shows that these results are robust to the inclusion of a measure of human capital accumulation and a vector of proxies for technological differences in the set of regressors. Indeed the estimates obtained introducing these additional control variables in the BM model confirm the conclusions reached in the basic specification.

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Table 1. Groups of countries used in the empirical estimates

OECD	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Portugal, Spain, Switzerland, Turkey, UK, USA
EUROPE	Austria, Belgium, Denmark, Finland, France, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Switzerland, UK
HIGH INCOME	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Republic of Korea, Spain, Sweden, Switzerland, United Kingdom, USA
MIDDLE INCOME	Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Algeria, Ecuador, Egypt, Gabon, Greece, Guatemala, Indonesia, Iran, Jamaica, Jordan, Malaysia, Panama, Peru, Philippines, Paraguay, Romania, Syria, Thailand, Trinidad and Tobago, Turkey, Uruguay, Venezuela
LOW INCOME	Benin, Bangladesh, China, Cameroon, Ghana, Ethiopia Honduras, India, Kenya, Mozambique, Nigeria, Nicaragua, Nepal Pakistan, Senegal, Tanzania, Zambia, Zimbabwe

Note: Countries are grouped according to the World Bank classification. For OECD countries data availability restricts the OECD sample to only 22 countries of the group (out of 30).

Table 2 . Estimation of the β coefficient in different samples according to different techniques

Sample	*Obs.*	*I. GDP per capita*			*II. GDP per worker*		
		Country *[1]*	***Country & Time*** *[2]*	***BM*** *[3]*	***Country*** *[1]*	***Country & Time*** *[2]*	***BM*** *[3]*
ALL	***432***	*-0.259* *-7.581*	*-0.319* *-7.839*	*-0.037* *-3.385*	*-0.510* *-8.415*	*-0.561* *-8.702*	*-0.072* *-3.354*
Adj. R-squared		*0.382*	*0.408*	*0.411*	*0.332*	*0.406*	*0.407*
OECD	***132***	*-0.071* *-5.079*	*-0.064* *-2.686*	*-0.010* *-1.130*	*-0.290* *-10.191*	*-0.312* *-10.487*	*-0.022* *-1.961*
Adj. R-squared		*0.404*	*0.346*	*0.401*	*0.402*	*0.326*	*0.405*
EUROPE	***90***	*-0.051* *-3.041*	*-0.022* *-0.799*	*0.004* *0.583*	*-0.321* *-9.164*	*-0.365* *-8.990*	*-0.022* *-1.356*
Adj. R-squared		*0.320*	*0.372*	*0.412*	*0.318*	*0.376*	*0.410*
HIGH INCOME	***138***	*-0.212* *-3.701*	*-0.318* *-3.771*	*-0.033* *-1.833*	*-0.288* *-8.198*	*-0.284* *-8.443*	*-0.019* *-1.544*
Adj. R-squared		*0.404*	*0.438*	*0.473*	*0.402*	*0.426*	*0.455*
MIDDLE INCOME	***174***	*-0.381* *-6.912*	*-0.460* *-7.210*	*-0.107* *-4.107*	*-0.706* *-7.615*	*-0.881* *-8.842*	*-0.059* *-2.367*
Adj. R-squared		*0.396*	*0.404*	*0.567*	*0.392*	*0.406*	*0.567*
LOW INCOME	***108***	*-0.156* *-2.336*	*-0.140* *-2.138*	*-0.036* *-1.501*	*-0.640* *-4.101*	*-0.588* *-3.443*	*-0.140* *-1.678*
Adj. R-squared		*0.302*	*0.414*	*0.494*	*0.302*	*0.416*	*0.497*

Note: For each regression the first number represents the β-coefficient and the second one its associated *t-statistics* value. With regards to panel data regressions with fixed effect we report only the overall adjusted R-squared. The appropriate standard econometric tests confirm that all error terms satisfy the usual required assumptions reported on page 4.

Table 3. Estimation of the β coefficient according to the basic BM model and the extended model including human capital and technological differences in the set of control variables and using GDP per capita as an independent variable

Sample	*Obs.*	*GDP per capita*			
		Standard model	***Human capital***	***Technology***	***Technology and human capital***
		BM	**BM**	**BM**	**BM**
ALL	***432 (324)***	*-0.037* *-3.385*	*-0.007* *-3.005*	*-0.017* *-1.003*	*-0.021* *-0.778*
Adj. R-squared		*0.411*	*0.612*	*0.571*	*0.705*
OECD	***132***	*-0.010* *-1.130*	*-0.004* *-0.593*	*-0.009* *-0.701*	*-0.004* *-0.677*
Adj. R-squared		*0.401*	*0.446*	*0.331*	*0.321*
EUROPE	***90***	*0.004* *0.583*	*0.003* *0.315*	*0.010* *0.467*	*0.004* *0.519*
Adj. R-squared		*0.412*	*0.447*	*0.458*	*0.467*
HIGH INCOME	***138***	*-0.033* *-1.833*	*-0.020* *-1.077*	*-0.020* *-1.066*	*-0.021* *-1.090*
Adj. R-squared		*0.473*	*0.280*	*0.326*	*0.326*
MIDDLE INCOME	***174***	*-0.107* *-4.107*	*-0.101* *-3.968*	*-0.115* *-4.073*	*-0.119* *-4.101*
Adj. R-squared		*0.567*	*0.430*	*0.326*	*0.340*
LOW INCOME	***108***	*-0.036* *-1.501*	*-0.031* *-1.290*	-	-
Adj. R-squared		*0.494*	*0.338*	-	-

Notes: For each regression the first number represents the β-coefficient and the second one its associated *t-statistics* value. With regards to panel data regressions with fixed effect we report only the overall adjusted R-squared. The appropriate standard econometric tests confirm that all error terms satisfy the usual required assumptions reported on page 4. When proxies for technology are included as regressors, Low-income countries are not considered in the regressions because of the lack of technological data; this implies that in this case the number of observations for the whole sample is reduced to 324.

Table 4. Estimation of the β coefficient according to the basic BM model and the extended model including human capital and technological differences in the set of control variables and using GDP per worker as an independent variable

Sample	*Obs.*	*GDP per worker*			
		Standard model	*Human capital*	*Technology*	*Technology and human capital*
		BM	**BM**	**BM**	**BM**
ALL	***432 (324)***	*-0.072* *-3.354*	*-0.004* *-2.989*	*-0.009* *-1.001*	*-0.019* *-0.667*
Adj. R-squared		*0.407*	*0.611*	*0.571*	*0.578*
OECD	***132***	*-0.022* *-1.961*	*-0.008* *-0.601*	*-0.012* *-0.772*	*-0.001* *-0.701*
Adj. R-squared		*0.405*	*0.454*	*0.331*	*0.402*
EUROPE	***90***	*-0.022* *-1.356*	*0.003* *0.315*	*0.009* *0.498*	*0.001* *0.500*
Adj. R-squared		*0.410*	*0.432*	*0.458*	*0.398*
HIGH INCOME	***138***	*-0.019* *-1.544*	*-0.012* *-1.109*	*-0.022* *-0.123*	*-0.109* *-1.000*
Adj. R-squared		*0.455*	*0.283*	*0.401*	*0.320*
MIDDLE INCOME	***174***	*-0.059* *-2.367*	*-0.091* *-4.898*	*-0.056* *-3.037*	*-0.101* *-3.002*
Adj. R-squared		*0.567*	*0.391*	*0.445*	*0.430*
LOW INCOME	***108***	*-0.140* *-1.678*	*-0.097* *-1.310*	-	-
Adj. R-squared		*0.497*	*0.385*	-	-

Notes: For each regression the first number represents the β-coefficient and the second one its associated *t-statistics* value. With regards to panel data regressions with fixed effect we report only the overall adjusted R-squared. The appropriate standard econometric tests confirm that all error terms satisfy the usual required assumptions reported on page 4. When proxies for technology are included as regressors, Low-income countries are not considered in the regressions because of the lack of technological data; this implies that in this case the number of observations for the whole sample is reduced to 324.