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Kevin S. Nell

Centro de Economia e Finanças da UP
www.fep.up.pt

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Abstract

This paper shows that conditional convergence in per capita income, as a robust empirical regularity across countries, may have dissipated in the post-1989 globalisation era. There is evidence of conditional *divergence* over the period 1990-2016, with growth-reducing structural change emanating from greater trade openness and a slower rate of technology catch-up in developing countries identified as potential explanations. The results further show that conditional divergence can only be ceased subject to some initial, efficiency-adjusted level of educational attainment. One implication of conditional divergence is that the growth accelerations observed in many developing economies since the late-1990s may not be sustainable.

JEL Classification: O11; O15; O33; O47

Keywords: conditional convergence; conditional divergence; education; structural change; technology catch-up

Institutional Affiliations: College of Business and Economics, School of Economics, University of Johannesburg, Auckland Park 2006, Johannesburg, South Africa

E-mail: knell@uj.ac.za
Tel: +27-(0)11-559-7459

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1. Introduction

Most studies that test for convergence in aggregate per capita income between rich and poor countries across the world find evidence of *conditional* rather than unconditional convergence (Mankiw *et al*., 1992; Rodrik, 2013; Barro, 1998, 2015). Barro (2015) provides evidence of a combined conditional convergence rate over the periods 1870-2010 and 1960-2010 that is close to the 'iron-law' of 2% per annum, and refers to this rate as a 'robust empirical regularity'. Holding all the other explanatory variables constant, conditional convergence means that there is a relative advantage of being 'underdeveloped'. From a neoclassical perspective (Mankiw *et al.,* 1992; Barro, 1991, 1998), a negative and significant sign on the initial per capita income variable captures diminishing returns to capital; poor countries with low capital-labour ratios grow faster relative to rich countries with high capital-labour ratios. A negative sign, however, could also be the result of technology catch-up or faster structural change between low- and high-productivity sectors in poor countries and not necessarily diminishing returns to capital (Nell and Thirlwall, 2018).

This paper hypothesises that conditional convergence, as a robust empirical regularity, may not necessarily hold in the post-1989 globalisation period. There is widespread agreement that the pace of globalisation has picked up significantly since the early 1990s, and that the world economy has entered a new age of globalisation compared with the period 1820-1990 (McMillan *et al.*, 2014; Baldwin, 2016; Rodrik, 2016). Several studies provide evidence of growth-reducing structural change since 1990, with labour shifting out of high-productivity sectors into low-productivity sectors in developing countries (McMillan *et al*., 2014; de Vries, *et al*., 2015; Rodrik, 2018). In a conventional Barro-type regression, growth-reducing structural change may imply conditional divergence instead of convergence.

Moreover, greater trade openness in the post-1989 globalisation period is often identified as the main cause of growth-reducing structural change out of high-productivity

manufacturing activities into low-productivity agricultural and service activities which, in turn, may partly explain the 'premature deindustrialisation' phenomenon observed in many developing countries (McMillan *et al*., 2014; Rodrik, 2016).[2] Accordingly, this paper re-examines the growth effect of Sachs and Warner's (1995, 2001) trade openness index constructed between 1970-1990, and whether countries that were more open during this period grew slower in the post-1989 globalisation period.

Conditional divergence could further be exacerbated by the nature and faster pace of technological progress in the new globalisation era. In contrast to the pre-1990 period, the ability of developing economies to absorb advanced technologies in this new era may crucially depend on the quality of their human capital.

Lastly, the rapid pace of globalisation and technological progress may perhaps be associated with higher rates of return on capital in advanced economies, which would offset rates of return differences between rich and poor countries and speed up the rate of conditional divergence.

This paper formally tests the conditional *divergence* hypothesis in a cross-country sample of 84 rich and poor countries over the period 1990-2016. Twenty-five potential growth determinants are considered, using the general-to-specific (Gets) model selection algorithm incorporated in the software programme Autometrics (Owen, 2003; Hendry and Krolzig, 2005; Doornik, 2009; Castle *et al*., 2013; Doornik and Hendry; 2013).

2. Conditional Convergence and Divergence in a Barro-type Regression

As a benchmark specification, consider a summary of the regression results in Nell and Thirlwall (2018) across 84 rich and poor countries (absolute *t*-statistics in parentheses):

$$\left(g_{y/p}\right)_i = \underset{(2.54)}{-0.2045}\ln\text{RGDP80}_i - \underset{(3.12)}{0.0976}\left(\text{TOTED80}\times\ln\text{RGDP80}\right)_i + \hat{\boldsymbol{\alpha}}\boldsymbol{X}_{\boldsymbol{i}} + \hat{u}_{1i} \qquad (1)$$

[2] Also see Felipe *et al.* (2018) who find evidence of premature employment deindustrialisation.

where $\left(g_{y/p}\right)_i$ is the average real GDP per capita income growth rate during 1980-2011 in country *i*; lnRGDP80_i is the initial level of per capita income in 1980; TOTED80_i is average years of primary, secondary and tertiary education in 1980 obtained from the Barro and Lee (2013) dataset; and $\boldsymbol{X}_i$ is a vector of other (conditional) growth determinants.

The initial per capita income variable contains a negative sign and is statistically significant at the 2.5% level. The rate of conditional convergence (λ) implied by the estimate on initial per capita income is 0.74% per annum, and much slower than the combined rate of 2% over the periods 1870-2010 and 1960-2010 reported in Barro (2015).[3]

A negative and significant sign on the initial per capita income variable implies that there is a *relative* advantage of being poor. From a neoclassical perspective (Mankiw *et al*., 1992; Barro, 1991, 1998), capital-scarce developing countries have higher marginal productivities of capital than rich countries and therefore grow faster, holding constant all the other growth determinants in the vector of $\boldsymbol{X}$ variables. On the other hand, the negative sign on the initial per capita income variable may capture large productivity gaps between sectors in poor countries relative to rich countries and the scope for productivity-enhancing structural change, or the negative sign could pick up technology catch-up; poor countries might be expected to growth faster than rich countries because they have a backlog of technology to absorb which they have not had to pay for themselves (Nell and Thirlwall, 2018).

The rate of conditional convergence in equation (1) increases when educational attainment is taken into account. The sum of the coefficients on initial per capita income and the interactive term, TOTED80 × lnRGDP80, gives a derived conditional convergence rate of around 1.2% per annum. The increase in the conditional convergence rate from 0.74% to 1.2% shows that an extra year of schooling allows a poor country with a backlog of

[3] Following Mankiw *et al.* (1992), the conditional convergence rate (λ) in equation (1) can be derived from the following formula: $-(1-e^{-\lambda t}) = -0.2045$, where $t = 31$.

technology to catch-up at a faster rate. In effect, education imposes an *extra* condition on the conditional convergence (initial per capita income) term; *some* technologies imported from abroad can only be absorbed conditional on the initial level of education. Earlier work by Barro (1998) reports an unadjusted convergence rate of 2.5% percent per annum and an adjusted rate (adjusted for educational attainment) of 3.2% per annum during 1960-1990.

It is apparent that the unadjusted and adjusted conditional convergence rates in equation (1) are significantly slower than those derived in Barro (1998, 2015). An interesting hypothesis is that these differential results may perhaps be attributed to the different time periods under analysis in each study. Much larger fractions of Barro's sample periods fall outside the post-1989 globalisation era compared with equation (1), which covers the period 1980-2011. The next sections examine whether the relative advantages of being underdeveloped have dissipated when the sample period only includes post-1989 data.

3. Methodology and Data

The empirical analysis considers a representative sample of 84 rich and poor countries and twenty-five potential determinants of per capita income growth over the period 1990-2016. The sample of countries is the same as in equation (1) (see Nell and Thirlwall, 2018), except for war-torn Syria, which is excluded and replaced by Poland. Table A1 in Appendix A lists the countries and Table A2 describes all the variables together with their expected signs and data sources. To select the parsimonious model from a long list of potential regressors, requires an appropriate model selection strategy. This paper employs the general-to-specific (Gets) methodology incorporated in the software programme Autometrics (Owen, 2003; Doornik, 2009; Castle *et al*., 2013; Doornik and Hendry, 2013). Autometrics performs a multiple-path tree search from an initial general unrestricted model (GUM) that is congruent with the data. To obtain a simpler, specific model that encompasses rival models, insignificant variables are eliminated at a pre-selected significance level. The simplified

models further need to satisfy a set of pre-specified diagnostic and structural stability tests, while encompassing tests are used to resolve terminal models.

The battery of diagnostic and structural stability tests that underlies the Gets methodology can go some way to ensure that the final selected model is well specified. In addition, the list of variables in Table A2 includes a strictly exogenous variable (geography measured by absolute latitude) as a potential control, and a wide range of stock variables that are measured as close as possible to the starting date of the sample (1990). In this way, it is possible to estimate the effect on per capita income growth (1990-2016) *after* an initial shock to the stock variables, which should mitigate simultaneity problems (see Nell and Thirlwall, 2018).

4. Empirical Results

Consider the GUM with per capita income growth averaged over the period 1990-2016 as the dependent variable and the twenty-five potential growth determinants in Table A2. Similar to equation (1), the average years of education ($\mathrm{TOTED90}_i$) in 1990 and its interactive term (TOTED90 $\times$ lnRGDP90) are considered in the initial GUM rather than the returns-adjusted average years of education index listed as variables 19 and 20 in Table A2.

To select the final parsimonious model, a significance level of 5% is pre-specified to retain the relevant regressors. The parsimonious model chosen by Autometrics, denoted as Model 1, is reported in Table 1 below. The model is well determined and comfortably passes all the required diagnostic, structural stability (Chow-test) and outlier detection tests.[4]

[4] The Chow-test is useful to examine whether the regression model is structurally stable across rich and poor countries. To perform this test on cross-country data, it is necessary to order the initial 1990 levels of per capita income of the 84 countries in ascending order. Two structural stability tests, denoted as Chow (n), are reported in Table 1. The first one tests for a break at the sample mid-point ($n = 0.5N$, where N is the number of countries), and the other for a break at the 75$^{\text{th}}$ percentile of the sample ($n = 0.75N$). For more on the settings that underlie the Gets methodology, see Appendix B in Nell and Thirlwall (2018: pp. 193-194).

Table 1: Cross-country Growth Regressions, 1990-2016[a]

Independent variable	Model 1	Model 2
Constant	0	–8.3418*** (3.36)
Initial GDP per capita income, 1990 (lnRGDP90)	0	0.9926*** (3.64)
Average years of education, 1990 (TOTED90)	1.0792*** (3.60)	–
TOTED90 × lnRGDP90	–0.1120*** (3.73)	–
Returns-adjusted average years of education, 1990 index (RTOTED90)	–	7.3184*** (5.13)
RTOTED90 × lnRGDP90	–	–0.7411*** (5.05)
Trade openness; proportion of years open during 1970-1990 (YRSOPEN)	–0.9779** (2.54)	–1.0239*** (2.69)
Fixed investment ratio (INVRATE)	0.0814*** (3.96)	0.0918*** (4.31)
Government consumption ratio (GCON)	–0.0995*** (5.17)	–0.0929*** (4.40)
Export growth (GEX)	0.0839*** (3.63)	0.0904*** (3.64)
Foreign direct investment ratio (FDI)	0.0220** (2.13)	0.0223** (2.14)
Inflation rate of GDP deflator (INFLDEF)	–0.0018*** (3.28)	–0.0017*** (3.16)
Population growth (GPO)	–0.3538*** (3.36)	–0.3311*** (3.05)
Life expectancy at birth, 1990 (LIFE90)	0.0270*** (2.75)	0
Government effectiveness index, 1996 (GEI96)	0.6732*** (3.26)	0.6904*** (3.31)
R^2	–	0.66
Standard error ($\hat{\sigma}$)	0.79	0.78
Ramsey's Reset (omitted variables) test: F-test	[0.38]	[0.61]
Normality test: χ^2 [2]	[0.53]	[0.50]
Heteroscedasticity: F-test	[0.53]	[0.21]
Chow (42): F-test	[0.36]	[0.31]
Chow (63): F-test	[0.40]	[0.40]
Autometrics outlier detection test (large residuals)[c]	None detected	None detected
Number of observations (*N*)	84	84

Notes:

a. The figures in parentheses (·) are absolute t-statistics and the figures in brackets [·] *p*-values. *** denotes significance at the 1% level and ** at the 5% level.

b. The null hypotheses of the diagnostic tests are the following: i) no omitted variables or functional form misspecification (using squares and cubes), ii) the residuals are normally distributed, iii) homoscedasticity (using squares), iv) structural stability based on Chow tests, and v) outliers (large residuals) against the alternative of no outliers. For more details, see Doornik and Hendry (2013).

c. No outliers (large residuals) are detected at the one-tailed 2.5% significance level.

Most of the growth determinants in Model 1 carry their expected sign. The initial level of per capita income in 1990 (lnRGDP90), however, is eliminated in the model reduction process and, in effect, is not significantly different from zero. When entered individually in Model 1, it contains a coefficient of –0.12 (*t*-value: –0.70) that is statistically insignificant at conventional levels.

In contrast to equation (1) and the other studies reviewed in section 2, there is no evidence of conditional convergence in the post-1989 globalisation period when the initial level of per capita income is considered on its own. This changes when educational attainment is taken into account. The sum of the coefficients on the initial level of per capita income and interactive term, TOTED90 × lnRGDP90, gives a derived conditional convergence rate of 0.4% (*t*-value: 3.94) per annum.[5] The conditional convergence rate is not only very slow but shows that the relative 'advantages' of being poor are subject to an *extra* condition in the post-1989 globalisation period. The significant interactive term suggests that new technologies imported from abroad since 1990 can only be absorbed conditional on some initial level of educational attainment.

It is informative to examine what happens when the returns-adjusted average years of education index (RTOTED90) from PWT 9.0 and its interactive term are included in the initial GUM of twenty-five variables instead of the unadjusted variables in Model 1 (see Table A2 in Appendix A for a detailed description of the returns-adjusted educational indicator). The specific model chosen by Autometrics, denoted as Model 2 in Table 1, indicates that RTOTED90 and its interactive term are significant at the 1% level.

[5] The conditional convergence rate is obtained by setting the equation in footnote 1 equal to –0.11, and then solving for λ with $t = 26$.

All the non-nested tests in Table 2 show that Model 2 parsimoniously encompasses Model 1 at the 5% and 10% significance levels. The results imply that Model 2, which includes the efficiency-adjusted educational indicator, outperforms Model 1 with the unadjusted educational variable.

Table 2: Non-nested tests[a]

Test procedure[b]	Model 2 versus Model 1	Model 1 versus Model 2
Cox (1961)	[0.96]	[0.05]**
Ericsson (1983), IV-test	[0.96]	[0.08]*
Sargan (1959), IV-test	[0.14]	[0.09]*
Joint model, F-test	[0.14]	[0.08]*

Notes:

a. The figures in brackets [·] are *p*-values. ** denotes significance at the 5% level and * at the 10% level.
b. For more details on the Cox, instrumental variable (IV) and joint model tests, see Doornik and Hendry (2013).

A striking feature of the Model 2 results in Table 1 is that the initial level of per capita income becomes positive and statistically significant at the 1% level. The derived conditional *divergence* rate is $\lambda = -2.65\%$ (*t*-value: –5.04) per annum, which shows that being poor has become a relative disadvantage in the post-1989 globalisation period. Even when educational attainment is taken into account, the sum of the coefficients on the initial level of per capita income and the returns-adjusted interactive term, RTOTED90 × lnRGDP90, gives a derived conditional divergence rate of –0.25% (*t*-value: –1.42) per annum, albeit with an estimate that is not significantly different from zero.

The combined estimate of zero shows that conditional divergence can only be ceased subject to some initial (efficiency-adjusted) level of educational attainment. The extra condition imposed by the returns-adjusted interactive term suggests that it has become more challenging for developing countries to absorb cutting-edge technologies in the post-1989 globalisation era, such as robotics, artificial intelligence and biomanufacturing. This, in turn,

may partly explain the premature deindustrialisation phenomenon observed in many developing countries (Rodrik, 2016: pp. 19-20). Whereas in the past it was relatively easy for developing countries to absorb industrial machinery from abroad, the skill-intensive nature of new technologies in the post-1989 globalisation era has effectively put a squeeze on manufacturing development in developing countries.

The conditional divergence rate of −2.65% may not only pick up the difficulty of poor countries to absorb new technologies from abroad for a *given* level of educational attainment, but also growth-reducing structural change (McMillan *et al.*, 2014; Rodrik, 2016). As observed in McMillan *et al.* (2014), evidence of large productivity gaps across different sectors in developing countries relative to more advanced economies provides ample scope for growth-enhancing structural change as labour moves out of low-productivity sectors into high-productivity sectors. In many developing countries, however, there is evidence of growth-reducing structural change since 1990 (McMillan *et al.*, 2014; Rodrik, 2018).[6] Greater import competition, resulting from extensive trade liberalisation measures in developing countries during the globalisation era, may have caused a shift of labour out of high-productivity manufacturing activities into low-productivity services and other informal activities (see McMillan *et al.*, 2014; Rodrik, 2016).

The effect of trade liberalisation is captured in Model 2 of Table 1. The trade openness index (YRSOPEN) measures the proportion of years a country was deemed to be open to international trade between 1970 and 1990 (Sachs and Warner, 1995, 2001). Although the Sachs and Warner index has been subjected to various criticisms (Rodríguez and Rodrik, 2000; Wacziarg and Welch, 2008), the result in Table 1 presents a striking anomaly compared with the original findings in Sachs and Warner (1995, 2001) and many other cross-

[6] Since around 2000 there is evidence of growth-enhancing structural change in some African countries (McMillan *et al.*, 2014; Diao *et al.*, 2017). However, because labour predominantly moved into non-agricultural activities with relatively high levels of productivity but slow or negative growth rates (de Vries *et al.*, 2015; Diao *et al.*, 2017), the sustainability of Africa's improved growth performance is questionable.

section studies (see, for example, Sala-i-Martin, 1997). Instead of showing a positive impact of trade openness on growth, YRSOPEN is negative and statistically significant at the 1% level. The estimate shows that a country completely open/closed to trade in the interval 1970-1990, on average, grew one percentage point slower/faster over the period 1990-2016. This result predicts that trade liberalisation measures in the post-1989 era may have slowed down growth. Holding constant the direct effect of trade openness on growth, the conditional divergence coefficient may also be picking up an indirect effect, such as growth-reducing structural change when developing countries re-adjusted their economies to greater competition from abroad.

Finally, the conditional divergence coefficient could also capture higher rates of return on capital in more advanced countries relative to poor countries in the post-1989 period. However, this potential source of divergence is not supported by Jordà *et al.'s* (2017) historical dataset over the period 1870-2015, which provides no clear evidence of higher rates of return on capital in advanced countries since 1990.

5. Conclusion

This paper shows that conditional convergence, as a robust empirical regularity, may have dissipated in the post-1989 globalisation era. Instead, there is evidence of conditional *divergence*, with growth-reducing structural change and a slower rate of technology catch-up in developing countries identified as potential explanations. Sachs and Warner's (1995, 2001) trade openness index in the interval 1970-1990 has a negative effect on post-1989 growth, which supports the contention that the conditional divergence coefficient may partially pick up growth-reducing structural change from greater import competition. Moreover, the results show that conditional divergence can only be ceased subject to some initial, efficiency-adjusted level of education. These findings imply that it has become more challenging for

developing countries to industrialise via technology catch-up from abroad, and are consistent with the premature deindustrialisation phenomenon observed in Rodrik (2016).

Conditional divergence does not mean absolute divergence. This will depend on all the growth determinants in Table 1. Although many developing countries experienced growth accelerations since the late-1990s, these episodes were for most part not driven by rapid industrialisation (de Vries, 2015; Diao *et al*., 2017). Since industrialisation has historically been a salient feature of long-run growth transitions, it is uncertain whether the recent growth spurts are sustainable (McMillan *et al.* 2014; Diao *et al*., 2017; Rodrik, 2016, 2018).

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APPENDIX A, Table A1 – List of Countries

Number	Country	Number	Country
1	Argentina	43	Malawi
2	Australia	44	Malaysia
3	Austria	45	Mali
4	Bangladesh	46	Malta
5	Belgium	47	Mauritania
6	Benin	48	Mauritius
7	Bolivia	49	Mexico
8	Botswana	50	Morocco
9	Brazil	51	Mozambique
10	Cameroon	52	Netherlands
11	Canada	53	New Zealand
12	Chile	54	Nicaragua
13	Colombia	55	Norway
14	Congo, Democratic Republic	56	Pakistan
15	Congo, Republic	57	Panama
16	Costa Rica	58	Paraguay
17	Cote d'Ivoire	59	Peru
18	Cyprus	60	Philippines
19	Denmark	61	Poland
20	Dominican Republic	62	Portugal
21	Ecuador	63	Rwanda
22	Egypt	64	Senegal
23	El Salvador	65	Sierra Leone
24	Finland	66	Singapore
25	France	67	South Africa
26	Gambia	68	Spain
27	Germany	69	Sri Lanka
28	Ghana	70	Sudan
29	Greece	71	Swaziland
30	Guatemala	72	Sweden
31	Honduras	73	Switzerland
32	Hong Kong	74	Tanzania
33	Iceland	75	Thailand
34	India	76	Togo
35	Indonesia	77	Trinidad & Tobago
36	Israel	78	Tunisia
37	Italy	79	Turkey
38	Japan	80	Uganda
39	Jordan	81	United Kingdom
40	Kenya	82	United States
41	Korea	83	Uruguay
42	Luxembourg	84	Zambia

Note: The sample excludes the following oil-producing countries: Algeria, Gabon Iran, Iraq, Kuwait, Nigeria, Oman, Saudi Arabia, and Venezuela. Following Nell and Thirlwall (2018), several countries listed in World Development Indicators (2017) are omitted from the sample due to missing or incomplete data. Lastly, based on the outlier detection test of Autometrics (Doornik, 2009; Doornik and Hendry, 2013), China and Lesotho are also excluded from the sample.

APPENDIX A, Table A2 – List of Variables

Variable (Expected Sign)	Description	Comments	Source
Dependent Variable:			
$g_{y/p}$	Growth rate of real GDP per capita income in national prices.	Average: 1990-2016.	World Development Indicators (WDI), 2017.
Independent Variables:			
1) ABLAT (+)	Absolute latitude from the equator.	Measures the effect of geography on economic development. See Gallup *et al*. (1999).	Sala-i-Martin (1997).
2) FDEV90 (+)	Ratio of liquid liabilities to GDP. The ratio is a measure of financial development, as discussed in Levine (1997).	Following King and Levine (1993), an initial value is used. Data are for the year 1990 or the closest possible year.	The latest version of the dataset (September 2015) described in Beck *et al*. (2000).
3) FDI (+)	Net foreign direct investment inflows as a ratio of GDP.	Average: 1990-2016.	WDI, 2017.
4) GCON (–)	Ratio of general government consumption expenditure to GDP.	Average: 1990-2016.	WDI, 2017.
5) GEI96 (+)	Government effectiveness index; initial value in 1996.	Index ranges from -2.5 (weak governance) to +2.5 (strong governance).	Latest version of Worldwide governance indicators (1996-2016) described in Kaufmann *et al.* (2011).
6) GEX (+)	Growth rate of real exports of goods and services.	Average: 1990-2016.	WDI, 2017.
7) GPO (–) or (+)	Growth rate of population.	Average: 1990-2016. Scale effects (+) or resource depletion (-).	WDI, 2017.
8) INFLCON (–) or (+)	Inflation rate derived from the consumer price index (CPI).	Average: 1990-2016.	WDI, 2017.
9) INFLCONSTDV (–)	Standard deviation of the inflation rate derived from the CPI.	1990-2016.	WDI, 2017.
10) INFLDEF (–) or (+)	Inflation rate derived from the GDP deflator.	Average: 1990-2016.	WDI, 2017.
11) INFLDEFSTDV (–)	Standard deviation of the inflation rate derived from the GDP deflator.	1990-2016.	WDI, 2017.
12) INVRATE (+)	Investment rate: fixed investment as a ratio of GDP.	Average: 1990-2016.	WDI, 2017.
13) LIFE90 (+)	Life expectancy at birth in 1990.	Initial value in 1990.	WDI, 2017.

APPENDIX A, Table A2 – List of Variables (Continued)

Variable (Expected Sign)	Description	Comments	Source
14) lnPOP90 (+)	Natural logarithm (ln) of the population size in 1990.	Measures scale effects associated with market size.	WDI, 2017.
15) lnRGDP90 (–)	Natural logarithm (ln) of the initial level of purchasing-power-parity adjusted real GDP per capita income in 1990 (constant 2011 dollars).	Initial value in 1990.	WDI, 2017.
16) MINING (+)	The share of mining and quarrying in GDP.	Data are for the year 1988 or the closest possible year.	Hall and Jones (1999).
17) REGQUAL96 (+)	Regulatory quality; initial value in 1996.	Index ranges from -2.5 (weak governance) to +2.5 (strong governance).	Latest version of Worldwide governance indicators (1996-2016) described in Kaufmann *et al.* (2011).
18) REVCOUP (–)	Revolutions and Coups.	Number of military coups and revolutions	Barro (1991).
19) RTOTED90 (+)	Initial 1990 returns-adjusted average years of primary, secondary and tertiary education of total population.	Combined data from Barro and Lee (2013), Cohen and Soto (2007), and Cohen and Leker (2014). Adjusted for rates of return obtained from Psacharopoulos's (1994) Mincerian wage equation estimates across different regions of the world, using the standard method in Caselli (2005).	Penn World Table (PWT) 9.0 (Feenstra *et al.*, 2015). For more details visit: https://www.rug.nl/ggdc/docs/human_capital_in_pwt_90.pdf
20) [RTOTED90×lnRGDP90] (–)	Interactive (product) term, with variables defined above.	Initial values in 1990.	PWT 9.0; WDI, 2017.
21) RULELAW96 (+)	Rule of law index; initial value in 1996.	Index ranges from -2.5 (weak governance) to +2.5 (strong governance).	Latest version of Worldwide governance indicators (1996-2016) described in Kaufmann *et al.* (2011).
22) SRATE (+)	Saving rate: gross domestic saving as a ratio of GDP.	Average: 1990-2016.	WDI, 2017.

APPENDIX A, Table A2 – List of Variables (Continued)

Variable (Expected Sign)	Description	Comments	Source
23) TOTED90 (+)	Unadjusted average years of primary, secondary and tertiary education of total population.	Initial value in 1990.	Barro and Lee (2013).
24) [TOTED90×lnRGDP90] (–)	Interactive (product) term, with variables defined above.	Initial values in 1990.	Barro and Lee (2013); WDI, 2017.
25) TOPEN (+)	Measures trade openness: the ratio of total trade (imports + exports) to GDP.	Average: 1990-2016.	WDI, 2017.
26) VCAI96 (+)	Voice and accountability index; initial value in 1996.	Index ranges from -2.5 (weak governance) to +2.5 (strong governance).	Latest version of Worldwide governance indicators (1996-2016) described in Kaufmann *et al.* (2011).
27) YRSOPEN (+)	Trade openness index: measures the proportion of years in the interval 1970-1990 in which an economy is open to international trade according to the criteria in Sachs and Warner (1995).	The binary index in Sachs and Warner (1995) takes the value of 1 or 0, where 1 indicates open and 0 closed.	Sachs and Warner (1995, 2001).