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The Role of Ex-Colonizer's Effect in Long-Run Economic Growth

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Abstract:

Purpose: *This paper aims to explore the relationship of the rate of long-run economic growth expressed through GDP per capita average growth rate during the specified period (dependent variable) to colonizer's past of the states. The ultimate goal of the study is to draw conclusions on significance of the colonizer's past on long-run economic growth among the set of the chosen factors.*
Design/ Methodology/Approach: *For this purpose, econometric regression is estimated with inclusion of variables chosen by Sala-i-Martin, Doppelhofer and Miller (2004) methodology of Bayesian Averaging of Classical Estimates (BACE).*
Findings: *The model specification indicates that there exists no statistically significant effect of past colonial possessions in 1945 on 1960-1996 average rate of growth.*
Practical Implementation: *Results give birth to several potentially promising directions for analysis. Such as improvement and further sophistication of methodology, accounting for Jointness measures from BMA theory and creating joint proxies and/or instrumental variables to address the issue of multicollinearity.*
Originality/Value: *Examination of historical processes, even though not purely economic in nature, does provide an invaluable insight for growth economists, allowing them to account for differences and similarities in states' development paths, assessing properly their relative characteristics, or even serving as an object of the study itself. To the best knowledge of the author, there are a few papers discussing the phenomenon.*

Keywords: *Colonizer effect, determinants of long-run economic growth, economic impact of colonialism.*

JEL Classification: *E02, O47, F19.*

Paper type: *Research Paper.*

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1. Introduction

It could be argued that the theory of long-run economic growth presents the essence and the goal of macroeconomics discipline if not economics in general. After all, determination of factors that make states, nations, regions (or economies on various levels in general) to grow plays one of the most important if not defining role in guiding humanity to sustainable and beneficial development.

While the first and, thus, crucial stage of analysis in search for such factors is attributed to theoretical approach, it is the empirical investigations that allow to draw conclusions about what and how influences the path of state's economic development. In turn, "empirics" in the field of long-run growth analysis refers to historical macro level data, at least from a very general point of view. That is being given, the analysis of long-run economic growth one way or another enters the field of cross-countries and cross-time comparisons, creating the necessity for isolation of numerous influences of various historical phenomena. Author would cautionary argue, that underestimation of the significance of the latter could potentially flaw the conclusions drawn on comparative effectiveness and weakness of different economies.

The above-presented reasoning can be argued with and perhaps, even rejected on some grounds. However, the conclusions drawn from it can be hardly doubted. Examination of historical processes, even though not purely economic in nature, does provide an invaluable insight for growth economists, allowing them to account for differences and similarities in states' development paths, assessing properly their relative characteristics, or even serving as an object of the study itself. Considering this, the author finds it interesting how one-sided the available economic literature discusses the topic of colonization, which can potentially be stated as one of the main driving forces in history of economic growth and modern societies development in general. While vast variety of works about the effects of such process on former colonies could be found, the same issue with respect to colonizer states received remarkably low attention.

This paper aims to partially feel this niche a little further, exploring the relationship of the rate of long-run economic growth expressed through GDP per capita average growth rate during the specified period (dependent variable) to colonizer's past of the states. For this purpose, econometric regression is estimated with inclusion of variables chosen by Sala-i-Martin, Doppelhofer, and Miller (2004) methodology of Bayesian Averaging of Classical Estimates (BACE). The ultimate goal of the study is to draw conclusions on significance of the colonizer's past on long-run economic growth among the set of the chosen factors.

The paper is organized as follows: Next section provides a brief overview of the relevant literature on the topic and is followed by theoretical background and model specification. Consecutive section discusses the data and its sources, while the next

one presents the analysis of the results of regression. The final section concludes with addressing the goals presented above and suggesting the options for future research.

2. Literature Review

As it was mentioned in the end of the previous section, there exist significant disproportion in the amount of literature linking the fact of being a colony and being a colonizer in the past to growth. Describing, however, the same process from different perspective, the methodological approaches used in one type could be potentially applied to the other. The effect of colonial heritage on long-run growth of African nations is, perhaps, most widely quoted and most developed area of the topic. The most pronounced works in this field are several. One of Bertocci and Canova (2003), for instance, employs set of different econometric approaches (namely bivariate and multivariate frameworks) to cross-sectional growth regressions in order to prove correlation among such variables as colonizer identity and the degree of economic penetration on one side and investment-output ratio, various human capital measures and the degree of political distortions on the other. Author especially emphasizes the role of educational and institutional links for post-independence growth of African colonies. However, the expansion of the selection to include colonies in other parts of the world does not indicate the validity of such relationships outside of the African continent.

The work of Grier (1999) also finds the importance of colonizers' educational policies for successive growth performance among African nations. On broader scale, analyzing the sample of 63 post-colonial countries around the world under the framework of new growth theory author finds the significant positive effect of the length of colonial period on post-independence growth. Agbor, Fedderke and Viegi (2010) alongside with Bertocchi (2011), applying different methodologies reach the same conclusions on the role of education and colonizer's identity.

The separate class of works, by Easterly and Levine (2012) and Acemoglu, Johnson and Robinson (2001) among others, employ newly introduced datasets regarding early stages of colonization and including such variables as European settlers' mortality rates and share of Europeans in population after certain period of time. Both works also argue for crucial role of colonizers' activity in latter economic growth. As it can be clearly noticed, even such a narrow sample of works on the topic already develops the evidence to such extent that one could draw a rather empirically grounded conclusion on the existence of colonial heritage effect on the consequent growth of former colonies. A curious reader would easily find many more relevant literatures on the topic, which author leaves out of the scope of this paper.

On the other hand, the degree of development of the same evidence regarding colonizers is rather limited. In fact, there exist hardly any paper employing

econometric methods or any other type of empirical analysis to establish direct links among ex-colonizer status and economic growth. The search of the economic literature discussing the effects of subjects on metropolis in colonial empires of the past reveals works discussing the latter with at best to some specific factor related to growth and mostly with respect to a particular colonizer only.

One of the most significant works of this kind belongs to van der Eng (1998), who estimates the amount of "colonial surplus" received by the Netherlands from its Indonesian holdings, stating that both of the parties has gained from their colonial relationships. Similar exercise was performed by Foreman-Peck (1989), reconstructing the balance of payments between Britain and India during their colonial relationship. Reached conclusion is like one of van der Eng (1998), which is contradictory to common believe for existence of excessive returns from colonial holdings. One other work of this type discusses Portuguese colonial empire and belongs to Costa, Palma and Reis (2013).

The topic is to some degree also covered by the works, which examine both former colonies and colonizers as a part of one system of states, while studying for some phenomenon not necessarily causally linked to growth. Just a couple examples of this are Ferguson and Schularick (2011) alongside with Accominotti, Flandreau, and Rezzik (2011), discussing the relatively easy access to financing for British Empire members, and Frankel and Rose (2001), who include ex-colonizer dummy in their analysis of the effects of common currencies on trade. To summarize, there exist an obvious underdevelopment of literature on the topic, both on qualitative and quantitative measures, which creates a vast field for future research.

Methodology employed in scope of this paper relies on Bayesian Model Averaging (BMA) theory, which general path of development can be traced by works of Jefreys (1961) and Leamer (1978; 1983; 1985). The complete overviews of theoretical background on this issue could be found in Beck (2017). The criterion of inclusion of the variables in growth regression are outlined in Sala-i-Martin, Doppelhofer, and Miller (2004), which also serves as theoretical basis for this paper.

3. Theoretical Background and Model Specification

The theoretical justification for analyzing the significance of ex-colonizer dummy in growth regression is provided by the same kind of reasoning presented at the beginning of this paper. That is, to draw proper and realistic conclusions about the pattern of growth of an ex-colonizer country one should test for what is mentioned as "crude exploitation hypothesis" in Grier (1999) or, in other words, the assumption that colonies bring excessive returns to colonizer's economy. Initial judgements on such pattern should then be corrected if necessary. After all, the proper form of the latter implies comparison of the national economy to other regarding size, regime, experienced shocks etc. Would it be correct to state that economies of the colonial country with access to overseas territories and resources and its non-colonial

neighbor having the same GDP per capita size are also of the same efficiency? The ultimate judgement is left to the reader, but author would suggest that such significant kind of positive shock as colonies' attainment should be properly studied and accounted for.

Thus, the hypothesis of this paper is that countries with ex-colonizer experience have experienced positive impact on rate of growth of their economies from their colonial possessions. Also, another assumption is that there exists a "colonizer's bias", that is those nations with ex-colonizer's experience have experienced relatively higher rate of growth in comparison to economies of similar size and historical past. The choice of the variables and their form is based on the findings of Sala-i-Martin, Doppelhofer, and Miller (2004), who employ Bayesian theory for determination of the factors having the highest probability of entering true growth regression. As it was already mentioned above, detailed overview of BMA methods could be found in Beck (2019). For the reader unaware with the topic, it would be enough to know that this theoretical approach is built on the grounds of Bayesian probability concept and employs extensively famous Bayes Theorem. Each of the variables specified prior by the author is studied for the probability of belonging in true model, which is referred to as Posterior Inclusion Probability (PIP). Such approach lowers the probability of model misspecification and omitted variable bias in comparison to classical econometrics approach where inclusion of variables is usually made according to prior judgement on their relevance introduced by the author, which can potentially be a subject to theory misinterpretation.

Table 1 depicts the results of PIP estimation (Column 1) for 67 variables carried out by Sala-i-martin, Doppelhofer, and Miller (2004) with dependent variable defined as average growth of GDP per capita at purchasing power parities between 1960 and 1996. Top 18 defined by the author as "significant" in true model, while 19 to 21 as "marginally significant". The rest of the variables investigated are stated as having "little or no support for inclusion" (Sala-i-Martin, Doppelhofer, and Miller, 2004).

In scope of this paper author would rely on conclusions reached in the above-mentioned paper, taking 21 defined as "significant" and "marginally significant" variables as independent ones, keeping the same dependent variable in place. Additionally, the model will be augmented with dummies for European continent (=1 if country is situated in Europe, = 0 otherwise), which is already included in Sala-i-Martin, Doppelhofer, and Miller (2004) and ex-colonizer's experience (=1 if country had colonies in 1945, = 0 otherwise), as well as the product of these two. The purpose of such augmentation is to assess the difference among European nations which did and did not have colonies (second part of paper's hypothesis), as this represents the most homogenous group of economies including both colonial and non-colonial countries. Ex-colonizer's dummy defined in 1945 as the last year before the start of post-WWII decolonization processes. The final specification of the model is represented by the following equation:

$$growth_i = a_0 + a_1 * east_i + a_2 * p60_i + a_3 * iprice1_i + a_4 * gdpch60l_i + a_5 * tropicar_i + a_6 * dens65c_i + a_7 * malfal66_i + a_8 * life060_i + a_9 * confuc_i + a_{10} * safrica_i + a_{11} * laam_i + a_{12} * mining_i + a_{13} * spain_i + a_{14} * yrsopen_i + a_{15} * muslim00_i + a_{16} * budha_i + a_{17} * avelf_i + a_{18} * gvr61_i + a_{19} * dens60_i + a_{20} * rerd_i + a_{21} * othfrac_i + a_{22} * europe_i + a_{23} * col_i + a_{24} * eurcol_i + e_i \quad (1)$$

Last 4 terms are European dummy, ex-colonizer dummy, their product and error term respectively, defined as mentioned above. Expected signs for each of 3 variables' coefficients signs are positive in line with earlier presented theory. The description of the rest of variables are presented by Table 2, with their expected coefficient's sign the same as defined by Column 2 in Table 1. The model is cross-sectional, and no time dimension is present, that is all variables are taking as averages or as observations is single point of time. Subscript i refers to 1, …, i countries included into the dataset.

To preserve consistency of the methodologies, time frames for all the variables are the same as those in the original paper, with 1960-1996 for dependent one and 1960 or the earliest available for independent. Detailed characteristics of these is presented by Table 1. The data on all the variables is accessed from technical appendix to Doppelhofer and Weeks (2009), which includes updated measures for variables presented in Sala-i-Martin, Doppelhofer, and Miller (2004). Data on ex-colonizer's dummy is sourced from CEPII database, using its dummy of col45 in dist_cepii dataset on geographic distances (CEPII n.d.).

4. The Analysis and Interpretation of the Results

The run of the linear regression with only those 21 variables specified as "significant" and "marginally significant" in Sala-i-martin, Doppelhofer, and Miller (2004) corrected for heteroscedasticity provides the output presented by Table 3. Out of 139 countries only 94 had observations for all the specified variables. The results are highly in line with Bayesian Theory expectations and results presented by Sala-i-Martin, Doppelhofer, and Miller (2004). Model explains approximately 81.58% of variation in endogenous variable, with explanatory power of the model significant at 1% level. Also, it is characterized by rather small value of the standard error of the regression. The signs of the coefficients are also completely in line with Column 2 of Table 1, except for malaria fatality rate, which is statistically insignificant, however. The largest disparity in these and Sala-i-Martin, Doppelhofer, and Miller (2004) results lies in significance of the coefficients. As it can be seen at Table 4, only Fraction of population Confucian and Logarithm of GDP per capita in 1960 are significant at 1% level. Primary Schooling Enrollment, Investment Price, Population Coastal Density, Life Expectancy and Real Exchange Rate Distortions are significant at 5% level, while Mining Share of GDP and Fraction Speaking Foreign

Language are significant at 10% level. The rest of the variables are statistically insignificant.

Table 1. *Significant and marginal significant variables for growth of GDP based on PIP estimation.*

	Posterior inclusion probability	Posterior mean conditional on inclusion	Posterior s.d. conditional on inclusion	BACE sign certainty probability	OLS p-value	OLS sign certainty probability	Fraction of regressions with |tstat| > 2
East Asian dummy	0.823	0.021805	0.006118	0.999	0.505	0.999	0.99
Primary schooling 1960	0.796	0.026852	0.007977	0.999	0.155	0.999	0.96
Investment price	0.774	-0.000084	0.000025	0.999	0.032	0.999	0.99
GDP 1960 (log)	0.685	-0.008538	0.002888	0.999	0.387	0.999	0.30
Fraction of tropical	0.563	-0.014757	0.004227	0.997	0.466	0.997	0.59
Population density coastal 1960's	0.428	0.000009	0.000003	0.996	0.767	0.996	0.85
Malaria prevalence in 1960's	0.252	-0.015702	0.006177	0.990	0.515	0.010	0.84
Life expectancy in 1960	0.209	0.000808	0.000354	0.986	0.761	0.014	0.79
Fraction Confucian	0.206	0.054429	0.022426	0.988	0.377	0.988	0.97
African dummy	0.154	-0.014706	0.006866	0.980	0.589	0.980	0.90
Latin American dummy	0.149	-0.012758	0.005834	0.969	0.652	0.969	0.30
Fraction GDP in mining	0.124	0.038823	0.019255	0.978	0.305	0.978	0.07
Spanish colony	0.123	-0.010720	0.005041	0.972	0.507	0.028	0.24
Years open	0.119	0.012209	0.006287	0.977	0.826	0.023	0.98
Fraction Muslim	0.114	0.012629	0.006257	0.973	0.478	0.973	0.11
Fraction Buddhist	0.108	0.021667	0.010722	0.974	0.460	0.974	0.90
Ethnolinguistic	0.105	-0.011281	0.005835	0.974	0.991	0.974	0.52
Government consumption share 1960's	0.104	-0.044171	0.025383	0.975	0.344	0.025	0.77
Population density 1960	0.086	0.000013	0.000007	0.965	0.815	0.965	0.01
Real exchange rate distortions	0.082	-0.000079	0.000043	0.966	0.835	0.034	0.92
Fraction speaking foreign language	0.080	0.007006	0.003960	0.962	0.474	0.962	0.43

Source: *Sala-i-Martin, Doppelhofer, and Miller, 2004,*

Table 2. *Data description and sources*

Variable	Variable Name	Variable Description
GROWTH	Average Growth Rate of PPP-adjusted GDP per Capita 1960-1996	Growth of GDP per capita at purchasing power parities between 1960 and 1996.
EAST	East Asian Dummy	Dummy for East Asian countries.
P60	Primary Schooling Enrollment	Enrolment rate in primary education in 1960.
IPRICE1	Investment Price	Average investment price level between 1960 and 1964 on purchasing power parity basis.
GDPCH60L	Initial Income (Log GDP in 1960)	Logarithm of GDP per capita in 1960.
TROPICAR	Fraction of Tropical Area	Proportion of country's land area within geographical tropics.
DENS65C	Population Coastal Density	Coastal (within 100km of coastline) population per coastal area in 1965.
MALFAL66	Malaria Prevalence	Index of malaria prevalence in 1966.
LIFE060	Life Expectancy	Life expectancy in 1960.
CONFUC	Fraction Confucian	Fraction of population Confucian.
SAFRICA	Sub-Saharan Africa Dummy	Dummy for Sub-Saharan African countries.
LAAM	Latin America Dummy	Dummy for Latin American countries.
SPAIN	Spanish Colony	Dummy variable for former Spanish colonies.
MINING	Mining Share of GDP	Fraction of GDP in mining.
GVR61	Government Consumption Share of GDP	Share of expenditures on government consumption to GDP in 1961.
MUSLIM00	Fraction Muslim	Fraction of population Muslim in 1960.
YRSOPEN	Years Open 1950-94	Number of years economy has been open between 1950 and 1994.
AVELF	Ethnolinguistic Fractionalization	Average of five different indices of ethnolinguistic fractionalization
BUDDHA	Fraction Buddhist	Fraction of population Buddhist in 1960.
DENS60	Population Density	Population per area in 1960.
RERD	Real Exchange Rate Distortions	Real exchange rate distortions.
OTHFRAC	Fraction Speaking Foreign Language	Fraction of population speaking foreign language.
EUROPE	European Dummy	Dummy for European economies.

Source: *Self-constructed based on Sala-i-Martin, Doppelhofer, and Miller (2004).*

This, in author's opinion, should not raise any major concerns, however, as actual value of PIP in Sala-i-martin, Doppelhofer, and Miller (2004) is subject to prior model size specification, and what is more important, indicates the necessity of inclusion of the variable into the regression, as the opposite would cause omitted variable bias. This, however, does not imply that this variable would prove to be statistically significant, the confirmation of which can be found at Column 7 of Table 1. While not all of author's variables corresponds to this statistical significance/insignificance pattern, the latter still indicates that such results are not anomalous.

Table 4 presents the results of the same regression with the inclusion of European and ex-colonizer's dummies as well as their products. The characteristics of regression from Table 4 are generally preserved, except for minor (0.0001) increase

in standard error of the regression, minor increase in R squared (0.004) due to the inclusion of additional variables and the change of Latin American dummy sign, which is highly statistically insignificant. Also, Investment Price and Life Expectancy are now significant at 10% level.

Table 3. *Regression output with "significant" and "marginal significant" independent variables.*

Dependent variable: growth	Coefficient	Robust standard error	P>|t|
east	0.0073346	0.0066674	0.275
p60	0.0175087	0.0083589	0.040
ipricel	-0.0000684	0.0000341	0.049
gdpch601	-0.0112527	0.0022734	0.000
Tropicar	-0.0064367	0.0043814	0.146
dens65c	4.11e-06	2.06e-06	0.050
malfal66	0.0012173	0.0053052	0.819
life060	0.0006089	0.0002818	0.034
Confuc	0.0361033	0.011903	0.003
Safrica	-0.0049287	0.0046642	0.294
Laam	-0.0020687	0.0071785	0.774
Mining	0.0305913	0.017641	0.087
Spain	-0.0054591	0.0056807	0.340
Yrsopen	0.0039567	0.0052512	0.454
muslim00	0.0065058	0.0041632	0.123
Buddha	0.0119793	0.0084759	0.162
Avelf	-0.0012419	0.0047705	0.795
gvr61	-0.023252	0.0208651	0.269
dens60	9.13e-06	6.30e-06	0.151
Rerd	-0.0000631	0.0000282	0.029
Othfrac	0.0041269	0.0024263	0.093
Cons	0.0700294	0.0145611	0.000
R^2	0.8158		

Source: *Own calculations on Doppelhofer and Weeks (2009) dataset in Stata13.*

None of the European, ex-colonizer dummy or their product are statistically significant. In light of the hypothesis stated above this can be interpreted as follows: "Neither the situation on the European continent nor the fact of having colonies in 1945 have the effect on Average Growth Rate of PPP-adjusted GDP in the period of 1960-1996. What is more, there is no evidence that European nations that possessed colonies in 1945 have experienced higher or lower rate of growth in comparison to other European nations in the period of 1960-1996". While these results are in clear contradiction to "exploitation hypothesis" and author's prior assumption, they present a significant interest in themselves. The fact that those countries with access to overseas resources and colonies have not experienced any positive impact on growth from them can indicate for significant inefficiencies of these resources' utilization or no less significant comparative advantages of the unknown source on the side of non-colonizer nations, or both. Either way, such results contradict the

common picture of colonial empires being the wealthiest and most economically powerful nations, provoking for further thought and inquiry.

Table 4. *Regression output with additional independent variables*.*

Dependent variable: growth	Coefficient	Robust standard error	P>|t|
east	0.007331	0.0070405	0.301
p60	0.018249	0.0087956	0.042
ipricel	-	0.0000363	0.072
gdpch601	-0.012307	0.0025418	0.000
tropicar	-	0.0044247	0.223
dens65c	4.80e-06	2.24e-06	0.036
malfal66	0.0018457	0.0057067	0.747
life060	0.0005883	0.0003024	0.056
confuc	0.0437314	0.0135234	0.002
safrica	-0.004396	0.0048451	0.367
laam	0.0001615	0.0080571	0.984
mining	0.0360837	0.0193113	0.066
spain	-	0.0059519	0.499
yrsopen	0.0004947	0.0071703	0.945
muslim00	0.0087705	0.0055549	0.119
buddha	0.0162359	0.0098263	0.103
avelf	-	0.0049605	0.880
gvr61	-0.022417	0.022285	0.318
dens60	8.44e-06	6.59e-06	0.204
rerd	-	0.0000297	0.023
othfrac	0.0046634	0.0023839	0.054
europe	0.0094209	0.0094181	0.321
col	0.004575	0.0040511	0.263
eurcol	-	0.004876	0.152
cons	0.0750827	0.0159279	0.000
R^2	0.8198		

Note: **This model will be referred as original in this paper.*
Source: *Own calculations on Doppelhofer & Weeks (2009) dataset in Stata13.*

There exists one purely theoretical explanation, which, from the author's point of view, best fit this phenomenon. By 1945, in fast growing and globalizing world economies, with easier access to foreign markets and beginning of the shift from production of goods (which is highly resource-demanding) to production of resources in developed countries, the "colonial effect" of overseas territories might have simply lost its prior significance, potentially present during earlier centuries. To accept or reject such proposition, however, one would have to obtain much older macroeconomic data, which is available for very limited set of countries. The latter is, in fact, confirmed in Sala-i-Martin, Doppelhofer, and Miller (2004), serving as justification to choose 1960 as a starting point for the analysis.

Table 5. *Regression output after correction for multicollinearity.*

Dependent variable: growth	Coefficient	Robust standard error	P>|t|
Ipricel	-0.000051	0.0000352	0.150
gdpch601	-0.0053506	0.0020813	0.012
dens65c	0.0000104	2.47e-06	0.000
Mining	0.0441521	0.0179621	0.016
Yrsopen	0.0214241	0.0064695	0.001
Avelf	-0.0117587	0.0063949	0.070
gvr61	-0.019305	0.0227056	0.398
dens60	-1.18e-06	5.85e-06	0.841
Rerd	-0.0001135	0.0000307	0.000
Othfrac	0.0016667	0.0040468	0.682
Europe	0.004621	0.0062866	0.464
Col	0.0112692	0.0040596	0.007
Eurcol	-0.0135699	0.0051967	0.011
Cons	0.0690175	0.0168931	0.000
R^2	0.6171		

Source: *Own calculations on Doppelhofer and Weeks (2009) dataset in Stata13.*

To fully interpret the results, series of tests for various problems was considered. The potential presence of heteroscedasticity was dealt with by estimating both above regressions with robust standard errors. Due to the absence of time dimension one can also exclude the possibility of autocorrelation, as none of the variables has its own past values present in the regression. The results of Jargue-Berra test for Normal distribution of residuals, Ramsey RESET test for model misspecification (non-linear functional form) and summary statistics for expected value (mean) of error term (e) could be found in the Table 6 in Appendices. Each of the results reject the null of the presence of the respective bias.

The omitted variable bias presence can be rejected on the grounds of both Ramsey RESET test and results of Sala-i-martin, Doppelhofer, and Miller (2004), as the whole BACE procedure is essentially designed to address such an issue. Problem of endogeneity was not spotted by neither examination of independent variables' correlation with error term nor the J-test. The results of corresponding tests can be seen in Table 7 and Table 8 in Appendices. Given the fact of low explanatory power of these methods, the possibility of such problem existence cannot be completely excluded, however. Endogeneity could be possibly present among the independent and dependent variables. Just a couple of examples of the former are Primary Schooling Enrollment and Life Expectancy.

Cautious reader has, perhaps, already spotted the main problem of the specified model, that is multicollinearity among independent variables. This can be identified on purely theoretical grounds, as the strongest pairwise correlations are present among regional and religious dummies as well as regional dummies and such

variables as, for instance, Life Expectancy, Malaria Fatality Rate, Fraction of Tropical Area etc. Estimation of auxiliary regressions, taking each of such variables as dependent one and the remaining as independent reveals that multicollinearity is a serious problem in case of significant part of such regressions. Such inference can be drawn from the fact that the value of R^2 of such regressions are higher than of the original one. [2]

In order to address such a problem, author decided to exclude the above-mentioned sets of highly correlated variables (that is regional, religious dummies and "quality of life" indexes), leaving only such variables as Investment Price, Initial Income, Population Coastal Density, Mining Share of GDP, Years Open 1950-94, Ethnolinguistic Fractionalization, Government Consumption Share of GDP, Population Density, Real Exchange Rate Distortions, Fraction Speaking Foreign Language alongside with European, ex-colonizer dummies and their product. The results of the estimation of such modified regression are presented by Table 5. The correlation coefficient (Table 10 in Appendices) matrix shows that the significant correlations are present only between European and ex-colonizer's dummies as well as their product. These comes from obvious reasons, as overwhelming majority of colonizer countries are among European ones. Correlations among the rest of variables are, at most, marginally above the value of 0.5, which could be interpreted as an absence of strong multicollinearity. This is also confirmed by estimation of auxiliary regressions for the modified model, employing the same as previously methodology.

The main problem of such an approach is that the price of treating multicollinearity is the decrease in the explanatory power of the model. The latter is still statistically significant at 1% level, however, while the number of observations has increased to 97. The share of the variance in endogenous variable explained by the model is decreased significantly to 61.71%, while the standard error of regression increases to approximately 0.013. Major changes in comparison to original model presented by Table 4. have also occurred with respect to coefficients' significance, with general increase of the latter for variables specified as significant at original model. The exceptions are Investment Price and Fraction Speaking Foreign Language, which are now statistically insignificant, while Ethnolinguistic Fractionalization became significant at 10% level.

Most importantly, ex-colonizer dummy and the product of European and ex-colonizer's dummy are now significant at 1% and 5% level respectively. This can be interpreted as follows: "The fact of having colonies in 1945 increases the Average Growth Rate of PPP-adjusted GDP in the period of 1960-1996 by approximately 1.13%. What is more, there exist evidence that European nations that possessed colonies in 1945 have experienced lower by approximately 1.36% rate of growth in comparison to other European nations in the period of 1960-1996".

Such results imply that even though colonizers have benefited from their colonial possessions on the global scope, in Europe their non-colonizer neighbors have more than compensated for such an effect on relative terms. This makes us to state the same theoretical hypothesizes discussed above one more time and regret the lack of empirical material to test them.

The main caveat of this research, thus, depends on the choice of the specification of the model. While the reader is encouraged to draw his/her own conclusions, the author would suggest the prevalence of the initial form. Reasons for this are several. Firstly, as far as author's understanding of Bayesian theory takes them, the issue of multicollinearity is natural for BMA and BACE approaches. After all, the value of PIP indicates ultimately not the probability of variable inclusion into the true model, but of the information it encompasses. Obviously, variables expressing the same or similar information (i.e., Spanish Colonies and Latin America dummies) will both find their way into the model. The preservation of the statistical significance of such variables even in the presence of multicollinearity works only in favor of their inclusion to the regression.

It is worth noting that further and more sophisticated analysis on the matter of simultaneous inclusion of different variables into the model can be obtained employing Jointness Measures procedure, which allows to explore the relationships of independent variables under Bayesian framework conditional on their inclusion. For further insight to such approach one can consult Beck (n.d.) once again.

Another justification of the preferability of the initial model specification comes from the analysis for potential problems. The same test for modified model as those run for original one (Table 11, 12 and 13 in Appendices). The result indicates two additional problems. First one is marginal non-normality of residuals distribution regarding Kurtosis (at 10%, but not 5% level). Another is a model misspecification at 1% significance level according to Ramsey RESET test. The most logical reason for this to assume is the omitted variable bias, coming from exclusion of variables experiencing multicollinearity.

Finally, the dominance of the initial model is confirmed by both Akaike and Bayesian information criteria (see Appendix 2, Table 14.). The values of both are lower for original regression in comparison to modified one.
Basing on the evidence presented above, author would argue that acceptance of initial model multicollinearity is justified and preferred to the choice of modified regression, as the latter would lead to greater distortion of information carried by coefficients.

5. Conclusions and Proposals for Future Research

This work has intended to address the issue of underrepresentation of the studies on the effects of ex-colonizer's past on long-run economic growth. Utilizing the results

of BACE approach developed by Sala-i-Martin, Doppelhofer, and Miller (2004), author have run and analyzed the set of regressions including those variables determined as "significant" and "marginally significant" in the above-mentioned paper. To test for ex-colonizer's effect in absolute and relative terms, dummies for European continent, ex-colonizer's past and their product were added to the original regression.

The results of the work provide illustration on how examination of historical processes can lead to reassessment of perceptions on the relative efficiency of different economies. The model specification chosen by the author as prevalent indicates that there exists no statistically significant effect of past colonial possessions in 1945 on 1960-1996 average rate of growth. Moreover, European nations with ex-colonizer past have experienced no statistically significant effect from the latter in comparison to European non-colonizer nations.

In scope of methodology employed and data availability, author considers that goals of the research are met and its outcomes being contradictory to the hypothesis of the paper can be used as a starting point for future endeavors. Results reject the hypothesis of existence of excessive returns from colonial holdings and give birth to a few potentially promising directions for analysis. First and most obvious is the improvement and further sophistication of methodology, accounting for Jointness measures from BMA theory and creating joint proxies and/or instrumental variables to address the issue of multicollinearity. Another one lies around data gathering, as sufficiently developed regarding time and number of covered nations dataset could be used to test for hypothesis discussed by the author in previous section. A significant improvement in quality of the result could potentially come from introduction of the following measures into the regression:

1. Size of colonial holdings.
2. Average distance from metropolis to colonies.
3. Colonies' abundance with various kinds of resources.
4. Duration of colonial relationship.

In general, any kind of information allowing for greater differentiation among the properties of different colonial systems is expected to improve the results of the analysis.

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Appendices:
Appendix 1. Tests for possible econometric problems. Original model

Table 6. *Jargue-Bera, Ramsey Reset and test for expected value of error term.*

Jargue-Bera Skewness/Kurtosis test for Normality				
Variable	Pr(Skewness)	Pr(Kurtosis)	Adjusted chi^2 (2)	Prob>chi2
e	34	0.2356	0.4233	2.10
Ramsey RESET Test for Non-linear functional Form				
F (3,66)	Prob>F	-	-	-
1.44	0.2405	-	-	-
Expected value of error terms equals to 0				
Variable	Mean	Standard Deviation	Min	Max
e	$3.79e^{-12}$	0.008019	-0.020653	0.0189969

Source: *own calculations on Doppelhofer & Weeks (2009) dataset in Stata13.*

Table 7. *J-test.*

east - p60 = 0
east - ipricel = 0
east - gdpch601 = 0
east - tropicar = 0
east - dens65c = 0
east - malfa166 = 0
east - life060 = 0
east - confuc = 0
east - safrica = 0
east - laam = 0
east - mining = 0
east - spain = 0
east - yrsopen = 0
east - muslim00 = 0
east - buddha = 0
east - avelf = 0
east - gvr61 = 0
east - dens60 = 0
east - rerd = 0
east - othfrac = 0
east - europe = 0
east - col = 0
east - eurcol = 0
east = 0
F(24,69)=0.00
Prob>F=1.0000

Source: *Own calculations on Doppelhofer and Weeks (2009) dataset in Stata13.*

Table 8. *Examination of independent variables correlation with error term*

	e	east	p60	ipricel	gdpch601	tropicar	dens65c	malfal66	life060	confuc	safrica	laam	mining
	1												
east	-0	1.00											
p60	-0	0.17	1.00										
ipricel	0	-0.17	-0.24	1.00									
gdpch60	-0	-0.06	0.72	-0.29	1.00								
tropicar	0	0.12	-0.45	0.19	-0.56	1.00							
dens65c	0	0.47	0.15	-0.07	0.08	0.08	1.00						
malfa166	0	-0.04	-0.64	0.36	-0.64	0.66	-0.16	1.00					
life060	-0	0.08	0.84	-0.27	0.86	-0.61	0.20	-0.70	1.00				
confuc	-0	0.55	0.14	-0.09	-0.04	-0.07	0.48	-0.15	0.11	1.00			
safrica	0	-0.27	-0.64	0.40	-0.62	0.49	-0.17	0.79	-0.67	-0.13	1.00		
laam	-0	-0.19	0.23	-0.17	0.15	0.27	-0.10	-0.25	0.09	-0.10	-0.37	1.00	
mining	0	-0.01	-0.10	-0.04	-0.14	0.19	-0.13	0.22	-0.23	-0.10	0.24	-0.02	1.00
spain	-0	-0.16	0.19	-0.16	0.14	0.18	-0.10	-0.31	0.07	-0.09	-0.31	0.84	-0.04
yrsopen	0	0.33	0.61	-0.35	0.60	-0.44	0.32	-0.59	0.71	0.22	-0.56	-0.09	-0.18
muslim0	0	-0.05	-0.39	0.08	-0.25	-0.14	-0.03	0.01	-0.34	-0.08	0.03	-0.28	-0.01
buddha	0	0.62	0.19	-0.07	-0.10	0.06	0.34	-0.10	0.16	0.25	-0.18	-0.14	-0.12
avelf	0	0.06	-0.51	0.23	-0.54	0.48	-0.08	0.62	-0.59	-0.12	0.63	-0.30	0.24
gvr61	0	-0.05	-0.52	0.18	-0.46	0.35	-0.19	0.47	-0.50	-0.14	0.37	-0.14	0.13
dens60	0	-0.13	-0.22	0.01	-0.08	0.15	-0.14	0.14	-0.20	-0.10	0.30	-0.07	0.57
rerd	0	-0.21	-0.45	0.41	-0.40	0.39	-0.12	0.53	-0.44	-0.07	0.62	-0.15	0.25
othfrac	-0	-0.01	0.32	-0.11	0.28	-0.17	0.19	-0.48	0.25	0.09	-0.48	0.45	-0.09
europe	-0	-0.18	0.49	-0.20	0.73	-0.63	-0.04	-0.43	0.73	-0.10	-0.36	-0.28	-0.22
col	0	0.01	0.35	-0.20	0.46	-0.52	-0.01	-0.37	0.46	-0.09	-0.28	-0.26	-0.14
eurcol	-0	-0.14	0.38	-0.18	0.54	-0.47	0.01	-0.33	0.55	-0.08	-0.27	-0.21	-0.18

Source: *Own calculations on Doppelhofer and Weeks (2009) dataset in Stata13.*

Table 9. *Correlation coefficient matrix. Test for multicollinearity*

	growth	east	P60	ipricel	gdpch601	tropicar	dens65c	malfa166	life060	confuc	safrica	laam	Mining
growth	1.00												
east	0.53	1.00											
p60	0.57	0.17	1.00										
ipricel	-0.14	-0.17	-0.24	1.00									
gdpch60	0.31	-0.06	0.72	-0.29	1.00								
tropicar	-0.43	0.12	-0.47	0.19	-0.56	1.00							
dens65c	0.43	0.47	0.15	-0.07	0.08	0.08	1.00						
malfa166	-0.54	-0.04	-0.64	0.36	-0.64	0.66	-0.16	1.00					
life060	0.54	0.08	0.84	-0.27	0.86	-0.61	0.20	-0.70	1.00				
confuc	0.47	0.55	0.14	-0.09	-0.04	-0.07	0.48	-0.15	0.11	1.00			
safrica	-0.55	-0.24	-0.64	0.40	-0.62	0.49	-0.17	0.79	-0.67	-0.13	1.00		
laam	-0.12	-0.19	0.23	-0.17	0.15	0.27	-0.10	-0.25	0.09	-0.10	-0.37	1.00	
mining	-0.03	-0.00	-0.10	-0.04	-0.17	0.19	-0.13	0.22	-0.23	-0.10	0.24	-0.02	1.00
spain	-0.12	-0.16	0.19	-0.16	0.14	0.18	-0.10	-0.31	0.07	-0.09	-0.31	0.84	-0.04
yrsopen	0.60	0.33	0.61	-0.35	0.60	-0.44	0.32	-0.59	0.71	0.23	-0.56	-0.09	-0.18

muslim0	-0.01	-0.05	-0.39	0.08	-0.25	-0.14	-0.03	0.01	-0.34	-0.08	0.03	-0.28	-0.01
buddha	0.45	0.62	0.19	-0.07	-0.01	0.06	0.34	-0.10	0.16	0.25	-0.18	-0.14	-0.12
avelf	-0.40	0.06	-0.51	0.23	-0.54	0.48	-0.08	0.62	-0.59	-0.12	0.63	-0.30	0.24
gvr61	-0.41	-0.05	-0.52	0.18	-0.46	0.35	-0.19	0.47	-0.51	-0.14	0.37	-0.14	0.13
dens60	-0.12	-0.13	-0.22	0.01	-0.08	0.15	-0.14	0.14	-0.20	-0.10	0.30	-0.07	0.57
rerd	-0.47	-0.21	-0.45	0.41	-0.40	0.39	-0.12	0.53	-0.44	-0.07	0.62	-0.15	0.25
othfrac	0.25	-0.01	0.32	-0.11	0.28	-0.17	0.19	-0.48	0.25	0.09	-0.48	0.45	-0.09
europe	0.25	-0.18	0.47	-0.20	0.73	-0.63	-0.04	-0.43	0.72	-0.10	-0.36	-0.28	-0.22
col	0.28	0.01	0.36	-0.20	0.46	-0.52	-0.01	-0.37	0.46	-0.09	-0.28	-0.26	-0.14
eurcol	0.19	-0.14	0.38	-0.18	0.54	-0.47	0.01	-0.33	0.55	-0.08	-0.27	-0.21	-0.18
	spain	yrsopen	muslim00	buddha	Avelf	gvr61	dens60	Rerd	Othfrac	europe	col	eurcol	
spain	1.00												
yrsopen	0.01	1.00											
muslim0	-0.24	-0.23	1.00										
buddha	-0.22	0.34	-0.08	1.00									
avelf	-0.21	-0.39	0.01	-0.07	1.00								
gvr61	-0.10	-0.51	0.08	-0.08	0.50	1.00							
dens60	-0.03	-0.14	0.08	-0.14	0.17	0.20	1.00						
rerd	-0.13	-0.38	0.09	-0.23	0.41	0.25	0.29	1.00					
othfrac	0.47	0.23	0.12	-0.04	-0.46	-0.27	-0.08	-0.21	1.00				
europe	-0.24	0.64	-0.27	-0.14	-0.37	-0.32	-0.05	-0.23	-0.01	1.00			
col	-0.22	0.43	-0.06	0.02	-0.23	-0.31	-0.11	-0.27	-0.05	0.61	1.00		
eurcol	-0.18	0.47	-0.20	-0.11	-0.30	-0.26	-0.07	-0.22	0.01	0.77	0.82	1.00	

Source: *Own calculations on Doppelhofer and Weeks (2009) dataset.*

Appendix 2. Tests for possible econometric problems. Model after correction for multicollinearity.

Table 10. *Correlation coefficient matrix. Checking for multicollinearity.*

	ipricel	gdpch601	dens65c	mining	yrsopen	avelf	gvr61	dens60	rerd	othfrac	europe	col
ipricel	1.00											
gdpch6	-0.30	1.0										
dens65c	-0.07	0.08	1.00									
mining	-0.04	-0.13	-0.13	1.00								
yrsopen	-0.36	0.60	0.32	-0.18	1.00							
avelf	0.22	-0.53	-0.08	0.21	-0.38	1.00						
gvr61	0.22	-0.46	-0.19	0.12	-0.51	0.48	1.00					
dens60	0.05	-0.09	-0.15	0.55	-0.16	0.17	0.23	1.00				
rerd	0.40	-0.38	-0.13	0.24	-0.38	0.42	0.24	0.29	1.00			
othfrac	-0.11	0.28	0.19	-0.08	0.24	-0.45	-0.26	-0.08	-0.22	1.00		
europe	-0.19	0.72	-0.04	-0.21	0.62	-0.38	-0.32	-0.06	-0.24	-0.01	1.00	
col	-0.20	0.45	-0.01	-0.14	0.42	-0.24	-0.30	-0.11	-0.27	-0.05	0.61	1.00
eurcol	-0.17	0.53	0.01	-0.17	0.46	-0.30	-0.25	-0.07	-0.22	0.00	0.77	0.82

Source: *Own calculations on Doppelhofer and Weeks (2009) dataset in Stata13.*

Table 11. *Jargue-Bera, Ramsey Reset and test for expected value of error term.*

Jargue-Bera Skewness/Kurtosis test for Normality				
Variable	Pr(Skewness)	Pr(Kurtosis)	Adjusted chi^2 (2)	Prob>chi2
e	0.4016	0.0810	3.86	0.1453
Ramsey RESET Test for Non-linear functional Form				
F (3,66)	Prob>F	-	-	-
4.69	0.0045	-	-	-
Expected value of error terms equals to 0				
Variable	Mean	Standard Deviation	Min	Max
e	3.79e⁻12	0.008019	-0.020653	0.0189969

Source: *Own calculations on Doppelhofer and Weeks (2009) dataset in Stata13.*

Table 12. *J-test.*

ipricel - gdpch601 = 0
ipricel - dens65c = 0
ipricel - mining = 0
ipricel - yrsopen = 0
ipricel - aveif = 0
ipricel - gvr61 = 0
ipricel - dens60 = 0
ipricel - rerd = 0
ipricel - othfrac = 0
ipricel - europe = 0
ipricel - col = 0
ipricel - eurcol = 0
ipricel = 0
F (13,80) =0.00
Prob>F=1.0000

Source: *Own calculations on Doppelhofer and Weeks (2009) dataset in Stata13.*

Table 13. *Examination of independent variables correlation with error term*

	e	ipricel	gdpch601	dens65c	mining	yrsopen	avelf	gvr61	dens60	rerd	othfrac	europe	col
	1.00												
ipricel	0.00	1.00											
gdpch601	-0.00	-0.29	1.00										
dens65c	0.00	-0.07	0.08	1.00									
minin	0.00	-0.04	-0.14	-0.13	1.00								
yrsopen	0.00	-0.35	0.60	0.32	-0.18	1.00							
avelf	0.00	0.23	-0.54	-0.08	0.24	-0.39	1.00						
gvr61	0.00	0.18	-0.46	-0.19	0.13	-0.51	0.50	1.00					

dens6	0.00	0.01	-0.08	-0.14	0.57	-0.14	0.17	0.20	1.00				
rerd	0.00	0.41	-0.39	-0.12	0.25	-0.38	0.41	0.25	0.29	1.00			
othfra	-0.00	-0.11	0.28	0.19	-0.09	0.23	-0.46	-0.27	-0.08	-0.21	1.00		
europ	-0.00	-0.20	0.73	-0.04	-0.22	0.64	-0.37	-0.32	-0.05	-0.23	-0.01	1.00	
col	0.00	-0.20	0.46	-0.01	-0.14	0.43	-0.23	-0.31	-0.11	-0.27	-0.05	0.61	1.00
eurcol	-0.00	-0.18	0.54	0.01	-0.18	0.47	-0.30	-0.26	-0.07	-0.22	0.01	0.77	0.82

Source: *own calculations on Doppelhofer & Weeks (2009) dataset in Stata13*

Table 14. *Akaike and Bayesian Information criteria.*

	Original model	Modified model
AIC	-591.5224	-560.8368
BIC	-527.94	-524.7909

Source: *Own calculations on Doppelhofer and Weeks (2009) dataset in Stata13.*