Should education and military expenditures be combined for government economic policy?

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Abstract

This article examines the impact of EDUMILEX, namely the ratio between investment in education and military expenditure, on economic performance. It uses panel data estimation methods for 60 countries over the period 2000–2018. The findings suggest the existence of a non-linear, cubic relationship between EDUMILEX and economic performance. In particular, EDUMILEX is positively associated with both GDP per capita and labor productivity. The results also show that the effect of EDUMILEX is heterogeneous across countries, with lower values of EDUMILEX required to increase economic performance in developed countries than developing ones.

This article considers the appropriate economic policies to build peace in the long run—taking the conceptual insights of Caruso (2017) as point of departure, in which a workable definition of peace took inspiration from the balance between productive and destructive activities as envisioned in Baumol (1990). Defining peace as "an integrative institutional setting that favors productive at the expense of unproductive activities due to democratic governance, balanced economic interdependence, and long-lasting productivity growth in the long-run", the ratio of public education investment to military expenditure (hereafter EDUMILEX) is considered a relevant variable for a peaceful economic policy. The choice of this ratio appears to be reasonable in the light of the existing literature. On the one hand, almost all economists agree on the positive impact of education on economic growth in the long run[1]. On the other hand, prevailing literature shows the negative impact of military expenditures on growth[2]. Thus, it seems reasonable to consider military expenditures and investment in education as countervailing forces for economic growth. Keller *et al*. (2009) investigated the relationship between the military draft and economic growth in OECD countries, finding that countries with military draft exhibited poorer economic performance compared to countries with an all-volunteer recruitment of military personnel. Military conscription seems to have a negative impact on human capital accumulation because it diverts younger people from studying. Indirect confirmation of this is found in the study of the earthquake that hit Southern Italy in 1980, by Cipollone and Rosolia (2007). Young men were exempted from compulsory military service after the earthquake, and this eventually led to high-school-graduation rates of boys increasing by more than 2 percentage points. Moreover, due to peer-effect, graduation rates of young women also increased. In addition, there is more recent empirical evidence of a negative relationship between conscription and labor market outcomes[3].

This article considers the impact of EDUMILEX on economic performance. It takes GDP per capita and labor productivity as dependent variables and regresses them against the EDUMILEX ratio for a panel of countries over

1 See among others: Hanushek and Woessmann (2020); Marconi (2018); Benos and Zotou (2014); Krueger and Lindhal (2001).
2 See among others: Dunne and Tian (2020, 2016), D'Agostino *et al.* (2019), Awaworyi Churchill and Yew (2018).
3 See among others: Bingley *et al.* (2020); Torun (2019), Jaworski (2014), and Bauer *et al.* (2012).

the period 2000 to 2018. In the next section, the relevant variables are presented, and the data sources given. Long-run correlations have been considered by means of several plots and cross-section analyses. This article then presents panel data estimation results and draws some conclusions.

Given that education and military expenditures are countervailing factors in securing long-run growth, the ratio between public investment in education and military expenditure (EDUMILEX) is proposed as a target variable for a peaceful economic policy. EDUMILEX has a non-linear, cubic relationship with economic performance, being positively associated with both GDP per capita and labor productivity. Lower income countries are found to need higher levels of EDUMILEX to improve economic performance.

Data and variables

The analysis focuses on the impact of the EDUMILEX ratio on per capita GDP and labor productivity. The main explanatory variable, EDUMILEX, is defined as the ratio of public investment in education over military expenditure.

$$EDUMILEX = \frac{Public\ investment\ in\ education\ (constant\ dollars)}{Military\ expenditures\ (constant\ dollars)}$$

Public investment in education is from the UNESCO[4] dataset. Unfortunately, data for some relevant countries, such as China, France and the Republic of Korea are not available. Data on military expenditure are provided by the Stockholm International Peace Research Institute (SIPRI). We compute labor productivity as the ratio between GDP (gathered from UNCTAD) and the number of employed persons in line with the definition provided by the International Labor Organization[5]. The number of employed persons has been computed by using the employment rate of 15+ populations and working age populations (15–64) and total population figures from the World Bank. GDP per capita is computed as the ratio of GDP to total population. All data sources quoted in current dollars are converted to constant dollars (base year 2015) using the Consumer Price Index from the Bureau of Labor Statistics.

Table 1 shows the EDUMILEX ratio for some selected countries. At first glance, two stylized facts emerge. First, it seems that the EDUMILEX ratio has grown over time for most countries. Second, it appears that countries with the lowest EDUMILEX ratio (Colombia, Israel, the Russian Federation, the United States, and Iran) are frequently involved in armed conflicts. This suggests a hypothesis that the greater the EDUMILEX ratio is at a certain point in time, the greater the level of GDP per capita and labor productivity will be in the long run. Put differently, the aim is to test whether the EDUMILEX ratio at time t can be expected to have a positive impact on growth measures at $t+n$.

The plots in Figure 1 depict a long-run relationship between the EDUMILEX ratio and the development measures used (GDP per capita and Labor Productivity). Data for 60 countries[6] are used for the period 2000–2018, including 28 current high-income countries and 32 current middle- and low-income countries, according to the World Bank classification. The first graph in Figure 1 shows the relationship between GDP per capita in 2018 and the EDUMILEX ratio in 2000; the second illustrates the relationship between labor productivity in 2018 and the EDUMILEX ratio in 2000. It would appear that a positive correlation does exist.

4 Germany data are from OECD. (Accessed: 10 January 2022).
5 https://ilostat.ilo.org/resources/concepts-and-definitions/description-labour-productivity/ .
6 Countries included in the panel are: Argentina, Armenia, Australia, Austria, Azerbaijan, Benin, Brazil, Cameroon, Chile, Colombia, Côte d'Ivoire, Cyprus, Czech Republic, Denmark, El Salvador, Estonia, Finland, The Gambia, Georgia, Germany, Ghana, Guyana, Hungary, Iran, Ireland, Israel, Italy, Jamaica, Japan, Kenya, Kyrgyz Republic, Latvia, Lithuania, Madagascar, Malaysia, Mali, Mauritius, Mexico, Moldova, Nepal, Netherlands, New Zealand, Norway, Pakistan, Peru, Poland, Portugal, Romania, Russian Federation, Senegal, Sierra Leone, Slovakia, South Africa, Spain, Sweden, Switzerland, United Kingdom, Ukraine, United States.

This positive relationship between the EDUMILEX ratio and GDP per capita or labor productivity is supported by the results of the cross-section regression analysis. Estimating:

$$y_{i,2018} = \beta_0 + \beta_1 EDUMILEX_{i,2000} + \epsilon$$

$$y_{i,2018} = \beta_0 + \beta_1 EDUCATION_{i,2000} + \beta_2 MILEX_{i,2000} + \epsilon$$

gave the results in Table 2, with the coefficients on EDUMILEX all positive and significant at 10%.

Both the plots and the cross-section analysis suggest the higher the current value of EDUMILEX, the higher will be GDP per capita and labor productivity in the long run. In addition, Table 2 columns (2) and (4) confirm a hypothesis drawn from previous literature—that in the long run investment in education is positively associated both to GDP per capita and labor productivity, while a negative association exists between military expenditure and GDP per capita and labor productivity in the long run. There is, however, also the possibility that this pattern represents an underlying non-linear relationship, as suggested by the recent empirical works by Tiwari and Shahbaz (2013) and Dunne and Tian (2015) for military expenditure, and Krueger and Lindhal (2001) and Marquez-Ramos and Mourelle (2019) for education. Figures 2 and 3 show the relationship between the EDUMILEX ratio and GDP per capita and labor productivity respectively at t-5 and t-8, distinguishing high-, middle- and low-income countries and showing clear differences. We choose 5-year time lags as they have been already used in previous empirical works on education and growth[7]. Furthermore, an 8-year lag is also used, inspired by the recurring political cycle of the US (being the main spender regarding military expenditures). The heterogeneity is also apparent in the cross-section results in columns (3) and (6) of Table 2. High Income$_{2000}$ is a dummy variable which is equal to 1 if, in 2000, the World Bank classified the country as high-income and 0 otherwise and is positive and significant. These cross-section results reveal that, all other things being equal, countries that were classified as high-income countries in 2000 show higher GDP per capita and labor productivity in 2018.

Table 1: EDUMILEX ratio for some selected countries

Country	*2000*	*2010*	*2018*
United States	1.93	1.36	-
United Kingdom	1.72	2.15	2.50
Russian Federation	0.83	-	1.26
France	-	-	2.93
China	-	-	-
Argentina	3.98	6.12	6.66
Brazil	2.28	3.67	4.14
Colombia	1.16	1.33	1.47
Germany	2.98	3.45	-
Ireland	5.94	10.52	11.79
Israel	0.97	0.93	1.15
Italy	2.47	2.88	3.13
Iran	0.55	1.14	1.57
Japan	3.52	3.48	3.25
Kenya	4.04	3.27	3.76
Mexico	9.32	11.39	8.90
New Zealand	-	4.40	4.96
Spain	2.42	3.50	3.33

7 See among others: Barro (2013); Marconi (2018).

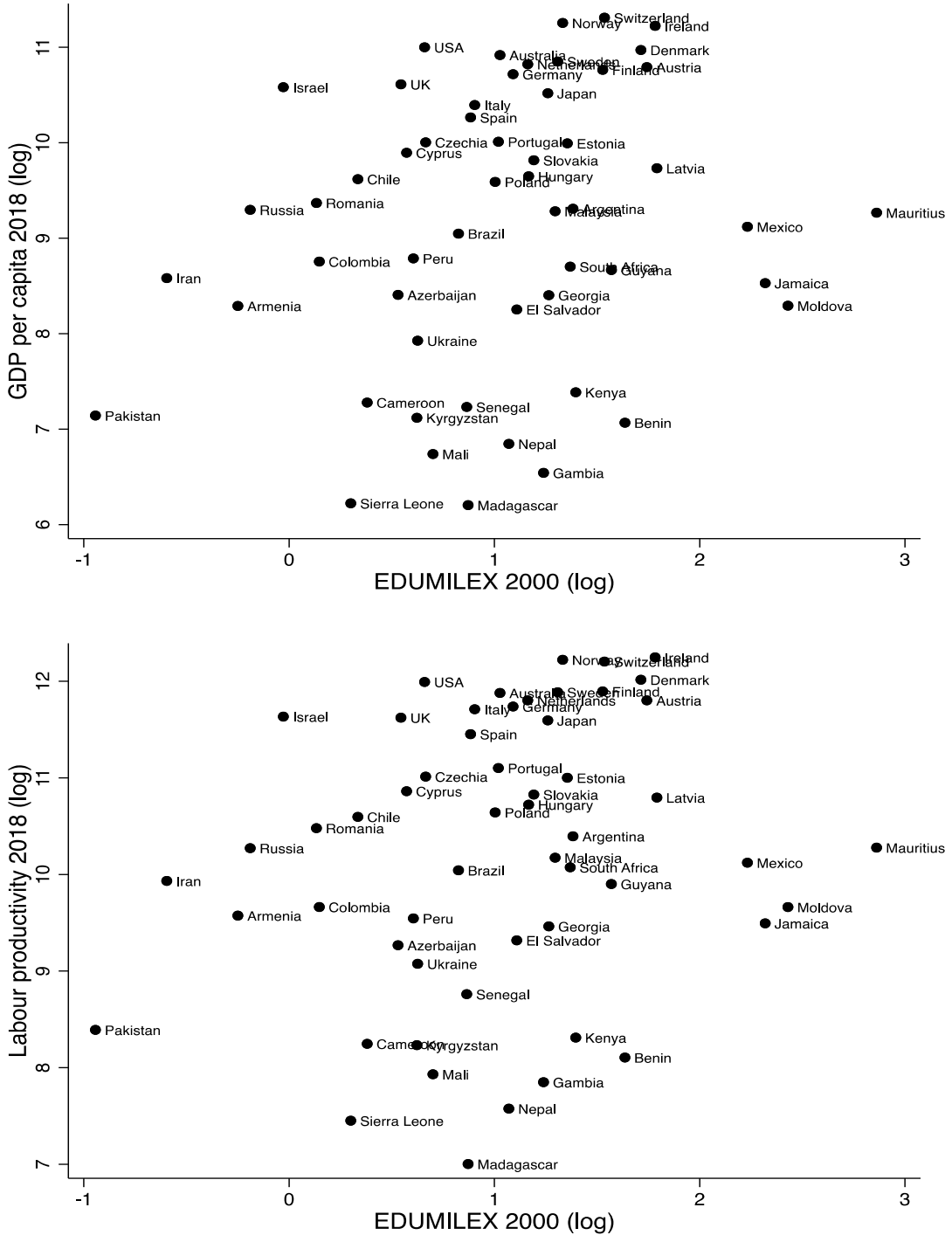

Figure 1: Productivity 2018 and GDP per capita 2018 against the EDUMILEX ratio

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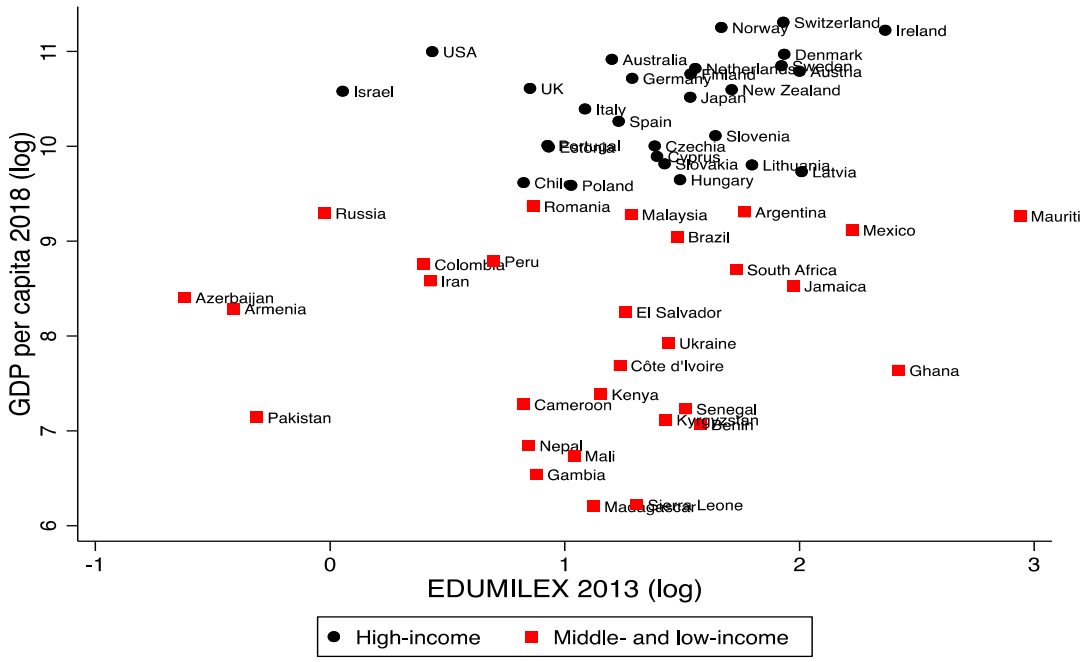
Table 2: Cross-section analysis

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Dependent variables	*GDP per capita 2018 (log)*	*GDP per capita 2018 (log)*	*GDP per capita 2018 (log)*	*Labor Productivity 2018 (log)*	*Labor Productivity 2018 (log)*	*Labor Productivity 2018 (log)*
$EDUMILEX_{2000}$ (log)	**0.430*** (0.218)		**0.274*** (0.140)	**0.406*** (0.208)		**0.252*** (0.069)
$EDUEX_{2000}$ (log)		**0.920***** (0.185)			**0.883***** (0.185)	
$MILEX_{2000}$ (log)		**-0.464***** (0.165)			**-0.440***** (0.164)	
$High\ Income_{2000}$			**2.282***** (0.201)			**2.255***** (0.196)
Constant	**8.719***** (0.287)	**5.117***** (0.456)	**8.129***** (0.246)	**9.807***** (0.278)	**6.297***** (0.468)	**9.224***** (0.240)
Obs.	55	55	55	55	55	55
R-squared	0.046	0.654	0.592	0.042	0.638	0.592
F statistic	**3.88***	**52.36*****	**65.92*****	**3.82***	**47.42*****	**67.57*****

Notes: Robust standard error in parentheses. *** significant at 1%, **significant at 5%, *significant at 10%. For sake of readability statistically significant coefficients are in bold.

We hypothesize that the relationship between EDUMILEX and economic growth is N-shaped. The poorest countries usually exhibit very low literacy rates and higher levels of military expenditure compared to investment in education. In such countries, when government policies divert resources from the military sector to education, slight increases in literacy rates result in higher levels of productivity and GDP per capita in the short run. In addition, military expenditure might cause an increase of GDP per capita in the short run through the government spending multiplier. In the medium term, as long as a country's level of development increases, investment in education switches from primary to secondary and tertiary education. Later investment might cause a drop in GDP per capita and labor productivity for two reasons. First, returns on these investments need time to take shape. A second explanation relies on the concept of firms' absorptive capacity expounded by Cohen and Levinthal (1990), which is the ability of firms to internalize and exploit external knowledge. In the developmental path there might be a time in which workers' level of education is too high compared to the absorptive capacity of firms. As a result, since firms are not able to exploit workers' high skills, public investment in education does not result in higher GDP per capita and labor productivity. On the other hand, as Tiwari and Shahbaz (2013) show, any positive effect of military expenditure on economic growth rapidly vanishes. In the long run, as long as a country keeps following a developmental path, the economic framework will adapt to highly skilled workers. Public investment in education is increasingly devoted to tertiary education, which eventually results in higher economic performance in the long run. The next section provides an empirical analysis of this assumption by using longitudinal data for 60 countries over the period 2000–2018.



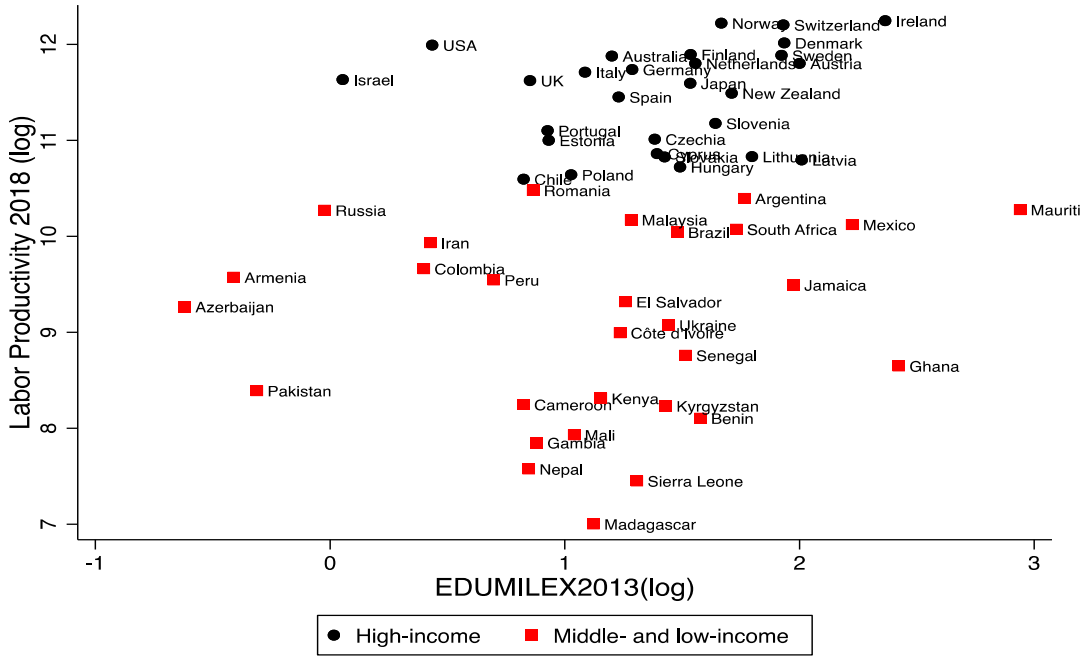


Figure 2: the relationship between EDUMILEX ratio and GDP per capita and labor productivity at t-5

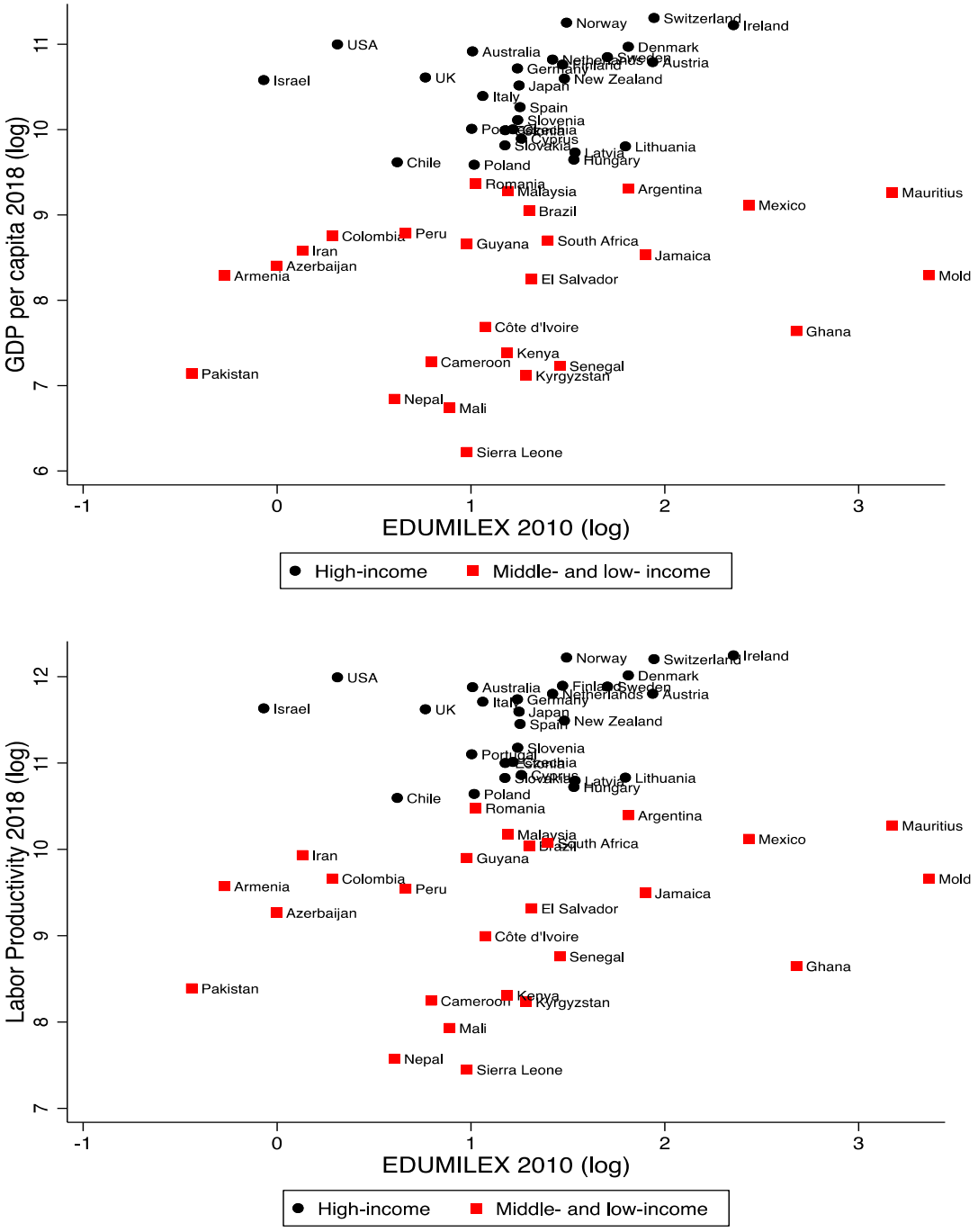


Figure 3: the relationship between EDUMILEX ratio and GDP per capita and labor productivity at t-8

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The panel data analysis

To take the analysis further, a parsimonious panel data analysis is applied using the simple econometric model:

$$y_{i,t} = \beta_0 + \beta_1 y_{i,t-1} + \beta_2 EDUMILEX_{i,t-n} + \beta_3 EDUMILEX^2_{i,t-n} + \beta_4 EDUMILEX^3_{i,t-n} + X_{it} + \epsilon_{i,t}$$

Where y denotes alternatively the GDP per capita and the labor productivity. The number of lags n is equal to 5 and 8 alternatively[8]. X_{it} is the vector of the control variables. Control variables are military conscription and the Electoral Democracy Index (EDI)[9]. The first is a dummy which is equal to 1 if military draft is in force in country *i* at time *t*. Information are drawn from the CIA World Factbook[10]. Most countries (75% of the sample) show no change in their military recruitment policies during the relevant period. The US enduringly relies on all-volunteer recruitment of military personnel, while the Russian Federation, conversely, has the military draft as a permanent recruitment strategy. In Europe, there have been changes in the military recruitment strategy. Countries such as Italy, Portugal, and Spain abolished conscription in the early 2000s, while Sweden and Ukraine abolished conscription respectively in 2010 and 2012 and then reinstated it in 2018 and 2014 (to counter deteriorating security situations). The Electoral Democracy Index (EDI) provided by V-Dem measures to what extent country *i* at time *t* accomplish electoral democracy features of polyarchies as defined by Dahl (1971). It ranges from 0 (low) to high (1). The quality of political and economic institutions (Acemoglu and Robinson, 2012; Monteforte and Temple, 2020) has a clear-cut impact on developmental paths. In particular, Acemoglu *et al*. (2019) highlighted that democracy is pivotal for economic growth because democracies tend to invest more in human capital compared to autocratic regimes. Moreover, several studies show that democracies tend to exhibit lower levels of military expenditure compared to autocratic regimes (Mulligan, Gil and Sala-i-Martin, 2004; Albalate, Bel and Elias, 2012). Table 3 summarizes the descriptive statistics of the data used in the panel regression.

The estimation results of the model using OLS fixed effect is presented in Table 4 and Table 5[11]. Random effects are also reported as a robustness check, though the Hausman test suggests that the fixed-effect model is appropriate.

8 The time lags also allow to mitigate the endogeneity concerns.
9 Coppedge *et al*. (2022). "VDem [Country–Year/Country–Date] Dataset v12" Varieties of Democracy (V-Dem) Project. https://doi.org/10.23696/vdemds22 . (Accessed: 10 January 2022).
10 Central Intelligence Agency (2022). "The World Factbook" Available at: https://www.cia.gov/the-world-factbook (Accessed 10 January 2022).
11 The use of ratio implies that the effect of increasing investment in education or cutting military expenditure are symmetric. Since our estimation employs logs it takes the form:

$$Eq.1)\ y_{i,t} = \beta_0 + \beta_1 y_{i,t-1} + \beta_2 (e-m)_{i,t-n} + \beta_3 (e-m)^2_{i,t-n} + \beta_4 (e-m)^3_{i,t-n} + \beta_5 X_{i,t} + \varepsilon_{i,t}$$

Where e is the investment in education and m is the military expenditure. We also consider the two variables independently as follows:

$$(Eq.2)\ y_{i,t} = \gamma_0 + \gamma_1 y_{i,t-1} + \gamma_2 e_{i,t-n} + \gamma_3 m_{i,t-n} + \gamma_4 e^2_{i,t-n} + \gamma_5 m^2_{i,t-n} + \gamma_6 e^3_{i,t-n} + \gamma_7 m^3_{i,t-n} + \gamma_8 e^2_{i,t-n} m_{i,t-n} + \gamma_9 m^2_{i,t-n} e_{i,t-n} + \gamma_{10} m_{i,t-n} e_{i,t-n} + \gamma_{11} X_{i,t} + \varepsilon_{i,t}$$

With the aim of corroborating our hypothesis we compute the F-stat of Eq.(2) against Eq. (1). F-statistic critical value is 3.10 at a significance level of 1% in all models. F-statistic values are 16.5 when GDP per capita is the dependent variable and independent ones are 8 years lagged; 7.91 when GDP per capita is the dependent variable and independent ones are 5 years lagged; 8.25 when labor productivity is the dependent variable and independent ones are 8 years lagged; 3.6 when labor productivity is the dependent variable and independent ones are 5 years lagged. These results confirm the hypothesis that the ratio matters. We thank one referee for suggesting this.

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Table 3: Cross-section analysis

Variable	*Source*	*Obs.*	*Mean*	*Std. dev.*	*Min*	*Max*
EDUMILEX	UNESCO/ SIPRI	1,068	4.25	3.95	0.29	33.44
GDP per capita	UNCTAD/ World Bank	1,200	18,964.71	21,640.79	258.41	106,721.5
Labor productivity	UNCTAD/ World Bank	1,200	46,129.91	51,383.07	511.35	248480.6
Military Conscription	CIA The World Factbook	1,200	0.45	0.50	0	1
Electoral Democracy Index	V-Dem	1,200	0.69	0.22	0.16	0.919

When considering GDP per capita as a dependent variable, the findings show the expected non-linearity, suggesting a cubic relation between GDP per capita and EDUMILEX. This means that for very low levels of EDUMILEX, an increase in EDUMILEX will result in increase in GDP per capita until a turning point is reached—after which GDP per capita starts to decrease. After reaching the minimum level of GDP per capita, any additional increase of EDUMILEX generates further GDP per capita growth. As EDUMILEX goes beyond a certain level, a lasting increase in GDP per capita can be observed. The result holds when the EDUMILEX is five-year lagged and eight-year lagged. The same relationship is suggested for labor productivity and EDUMILEX, even though it is statistically significant only when the EDUMILEX is eight-years lagged.

To infer a policy prescription, the turning points of such non-linearities are computed—when the value of EDUMILEX beyond which the relationship between EDUMILEX and dependent variables turns unambiguously positive. The turning point of EDUMILEX might thus be considered a target variable for economic policy.

The minimum turning point is computed when the first derivative of the function is zero and the second derivative is positive at that point. When GDP per capita is the dependent variable and EDUMILEX is eight-years lagged, the function derived from the regression is $y = 3.17 + 0.023\,x - 0.081\,x^2 + 0.025\,x^3$. Then the minimum turning point is 2 and, taking the natural antilog, the value of EDUMILEX is 7.39. If control variables are included, the turning point of EDUMILEX rises to 7.46. When labor productivity is the dependent variable, the coefficient associated with the EDUMILEX ratio at *t-8* is 1.49 and, taking the natural antilog, the turning point of EDUMILEX is 4.44. If the control variables are included the turning point of EDUMILEX increases slightly to 4.53 (see Table 6).

In sum, the regression results indicate that if GDP per capita is considered as the dependent variable, a higher value of EDUMILEX is required to enable long-lasting growth than when labor productivity is the dependent variable. When the model is augmented with control variables, the turning point of EDUMILEX slightly increases for both dependent variables. The hypothesis that higher EDUMILEX is associated to better economic performance in the future is thus confirmed.

Table 4: GDP per capita and the EDUMILEX ratio

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Dependent variable	*GDP per capita (log)*	*GDP per capita (log)*	*GDP per capita (log)*	*GDP per capita (log)*	*GDP per capita (log)*	*GDP per capita (log)*
GDP per capita$_{t-1}$ (log)	**0.732***** (0.019)	**0.732***** (0.018)	**0.727***** (0.018)	**0.680***** (0.024)	**0.660***** (0.026)	**0.651***** (0.027)
EDUMILEX$_{t-5}$ (log)	-0.022 (0.018)	-0.001 (0.034)	0.002 (0.034)			
EDUMILEX$_{t-5}$ (log) squared		**-0.036**** (0.023)	-0.035 (0.023)			
EDUMILEX$_{t-5}$ (log) cubic		**0.009*** (0.005)	**0.009*** (0.005)			
EDUMILEX$_{t-8}$ (log)				0.004 (0.024)	0.023 (0.029)	0.031 (0.028)
EDUMILEX$_{t-8}$ (log) squared					**-0.081***** (0.019)	**-0.086***** (0.020)
EDUMILEX$_{t-8}$ (log) cubic					**0.025***** (0.004)	**0.026***** (0.005)
Military conscription			0.002 (0.013)			-0.034 (0.030)
Electoral Democracy Index	**0.732***** (0.019)	**0.732***** (0.018)	**0.727***** (0.018)	**0.680***** (0.024)	**0.660***** (0.026)	**0.651***** (0.027)
Constant	**2.493***** (0.175)	**2.510***** (0.171)	**2.454***** (0.173)	**2.943***** (0.229)	**3.168***** (0.246)	**3.149***** (0.257)
Groups	60	60	60	60	60	60
Obs.	846	846	846	673	673	673
R-squared within	0.7333	0.7349	0.7366	0.4937	0.5094	0.5141
R-squared between	0.9996	0.9995	0.9992	0.9998	0.9994	0.9986
R-squared overall	0.9951	0.9949	0.9949	0.9954	0.9949	0.9942
F-Stat	**841.94*****	**518.77*****	**414.99*****	**412.61*****	**228.13*****	**146.38*****

Notes: Robust standard error in parentheses. *** significant at 1%, **significant at 5%, *significant at 10%. For sake of readability statistically significant coefficients are in bold.

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Table 5: Productivity and the EDUMILEX ratio

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Dependent variable	*Labor productivity (log)*	*Labor productivity (log)*	*Labor productivity (log)*	*Labor productivity (log)*	*Labor productivity (log)*	*Labor productivity (log)*
Labor productivity$_{-1}$ (log)	**0.759***** (0.017)	**0.760***** (0.017)	**0.752***** (0.016)	**0.660***** (0.028)	**0.639***** (0.031)	**0.627***** (0.032)
EDUMILEX$_{t-5}$ (log)	0.005 (0.018)	0.010 (0.033)	0.014 (0.033)			
EDUMILEX$_{t-5}$ (log) squared		-0.015 (0.020)	-0.012 (0.020)			
EDUMILEX$_{t-5}$ (log) cubic		0.004 (0.005)	0.004 (0.005)			
EDUMILEX$_{t-8}$ (log)				0.033 (0.021)	0.033 (0.028)	**0.044*** (0.025)
EDUMILEX$_{t-8}$ (log) squared					**-0.069***** (0.017)	**-0.075***** (0.017)
EDUMILEX$_{t-8}$ (log) cubic					**0.026***** (0.004)	**0.027***** (0.004)
Military conscription			-0.017 (0.106)			**-0.048*** (0.026)
Electoral Democracy Index			**0.161**** (0.068)			**0.187**** (0.081)
Constant	**2.462***** (0.163)	**2.466***** (0.134)	**2.430***** (0.166)	**3.445***** (0.283)	**3.694***** (0.317)	**3.705***** (0.330)
Groups	60	60	60	60	60	60
Obs.	846	846	846	673	673	673
R-squared within	0.8126	0.8129	0.8145	0.5042	0.5195	0.5264
R-squared between	0.9996	0.9997	0.9987	0.9992	0.9987	0.9962
R-squared overall	0.9947	0.9947	0.9940	0.9943	0.9936	0.9913
F-Stat	**1271.12*****	**748.30*****	**635.25*****	**285.97*****	**178.06*****	**116.15*****

Notes: Robust standard error in parentheses. *** significant at 1%, **significant at 5%, *significant at 10%. For sake of readability statistically significant coefficients are in bold.

Since the existing literature finds that the impact of military expenditures may differ between developed and developing economies (e.g., Kollias and Paleologou, 2019), it is hypothesized that the turning points of EDUMILEX could differ substantially between developing and developed countries. Splitting the sample gave the results in Table 7 and 8 for high-income and for middle- and low- income countries combined. These confirm the previous findings. In the two sub-samples, the cubic coefficient of EDUMILEX, eight-years lagged, is statistically significant.

In sum, regression results suggest that in middle- and low- income countries EDUMILEX needs to be considerably higher compared to high-income countries in order to trigger economic growth. It should be almost double if the dependent variable is GDP per capita, and around 65% higher if the dependent variable is labor productivity. EDUMILEX turning points are higher when controls are included in the regression in both sub-samples.

Figure 4 illustrates the implications of the results. Plotting GDP per capita (upper plot) and labor productivity (lower plot) in 2018 against EDUMILEX in 2010 and adding the regression lines for the high-income countries and the middle- and low-income countries, show a relatively close fit, with goodness of fit higher for labor productivity.

Table 6. Turning points of 8-year lagged EDUMILEX ratios

Country Type	*Dependent variable*	*Controls*	*EDUMILEX*
All countries	GDP per capita	No	7.39
High Income	GDP per capita	No	4.48
Middle and Low Income	GDP per capita	No	8.85
All countries	GDP per capita	Yes	7.46
High Income	GDP per capita	Yes	4.66
Middle and Low Income	GDP per capita	Yes	8.76
All countries	Labor productivity	No	4.44
High Income	Labor productivity	No	3.63
Middle and Low Income	Labor productivity	No	5.99
All countries	Labor productivity	Yes	4.53
High Income	Labor productivity	Yes	3.82
Middle and Low Income	Labor productivity	Yes	6.36

Notes: In column EDUMILEX the turning points of EDUMILEX ratio are highlighted beyond which economic performance, (namely GDP per capita and labor productivity) unambiguously increase.

Table 7: Baseline results: High income countries

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Dependent variable	*GDP per capita (log)*	*GDP per capita (log)*	*GDP per capita (log)*	*GDP per capita (log)*	*Labor productivity (log)*	*Labor productivity (log)*	*Labor productivity (log)*	*Labor productivity (log)*
GDP per capitat-1 (log)	**0.678***** (0.025)	**0.679***** (0.026)	**0.635***** (0.032)	**0.639***** (0.032)				
Labor Productivity$_{t-1}$ (log)					**0.708***** (0.021)	**0.698***** (0.023)	**0.507***** (0.046)	**0.506***** (0.045)
EDUMILEX$_{t-5}$ (log)	0.008 (0.091)	0.010 (0.095)			0.067 (0.105)	0.068 (0.107)		
EDUMILEX$_{t-5}$ (log) squared	-0.127 (0.017)	-0.137 (0.082)			**-0.151*** (0.083)	**-0.161*** (0.082)		
EDUMILEX$_{t-5}$ (log) cubic	**0.046**** (0.004)	**0.049**** (0.020)			**0.058***** (0.020)	**0.062***** (0.019)		
EDUMILEX$_{t-8}$ (log)			0.061 (0.167)	0.090 (0.157)			-0.013 (0.245)	0.026 (0.225)
EDUMILEX$_{t-8}$ (log) squared			-0.209 (0.137)	**-0.240*** (0.134)			-0.140 (0.186)	-0.184 (0.172)
EDUMILEX$_{t-8}$ (log) cubic			**0.084**** (0.032)	**0.091***** (0.032)			**0.075*** (0.043)	**0.087**** (0.039)
Military conscription		0.005 (0.014)		-0.009 (0.023)		**-0.027**** (0.013)		-0.026 (0.019)
Electoral Democracy Index		**-0.145**** (0.063)		-0.118 (0.072)		-0.143 (0.092)		-0.167 (0.113)
Constant	**3.449***** (0.266)	**3.572***** (0.254)	**3.859***** (0.351)	**3.927***** (0.334)	**3.358***** (0.223)	**3.610***** (0.242)	**5.682***** (0.534)	**5.846***** (0.518)
Groups	406	406	325	325	406	406	325	325
Obs.	28	28	28	28	28	28	28	28
R-squared within	0.5927	0.5944	0.4926	0.4943	0.7213	0.7241	0.3926	0.3993
R-squared between	0.9923	0.9905	0.9944	0.9930	0.9980	0.9957	0.9893	0.9854
R-squared overall	0.9717	0.9698	0.9750	0.9735	0.9765	0.9732	0.9664	0.9615
F-stat	**210.71*****	**168.89*****	**144.68*****	**102.88****	**473.49*****	**352.60*****	**89.90*****	**107.41*****

Notes: Robust standard error in parentheses. *** significant at 1%, **significant at 5%, *significant at 10%. For sake of readability statistically significant coefficients are in bold.

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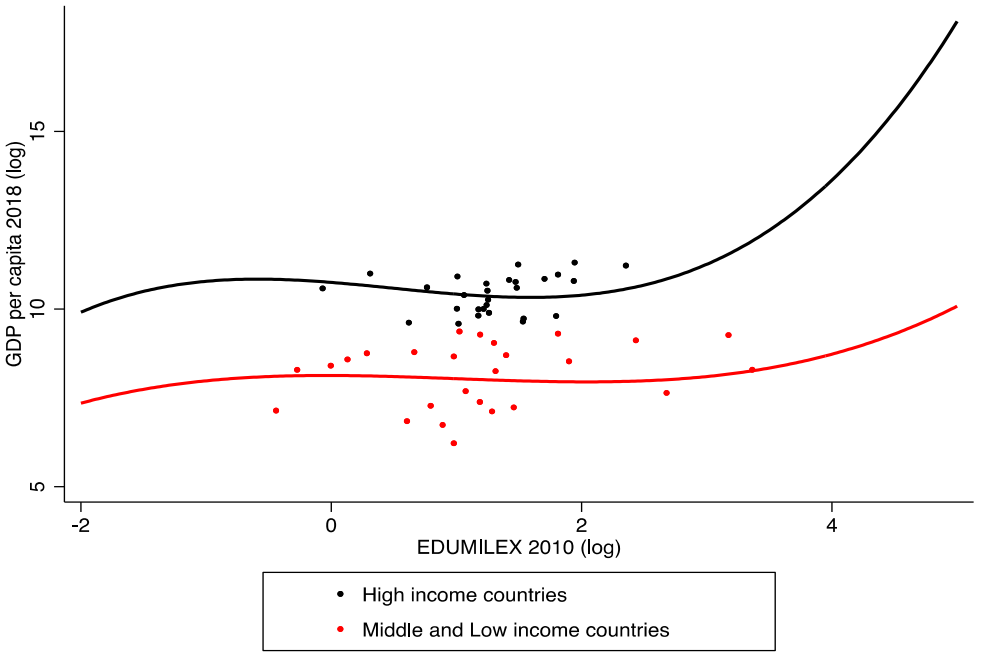
Table 8: Baseline results: Middle and low income countries

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Dependent variable	*GDP per capita (log)*	*GDP per capita (log)*	*GDP per capita (log)*	*GDP per capita (log)*	*Labor productivity (log)*	*Labor productivity (log)*	*Labor productivity (log)*	*Labor productivity (log)*
GDP per capitat-1 (log)	**0.747***** (0.023)	**0.736***** (0.023)	**0.667***** (0.033)	**0.641***** (0.041)				
Labor Productivity$_{t-1}$ (log)					**0.773***** (0.021)	**0.762***** (0.020)	**0.668***** (0.036)	**0.638***** (0.040)
EDUMILEX$_{t-5}$ (log)	0.005 (0.036)	0.009 (0.035)			0.016 (0.034)	0.022 (0.034)		
EDUMILEX$_{t-5}$ (log) squared	-0.033 (0.024)	-0.031 (0.023)			-0.016 (0.021)	-0.013 (0.020)		
EDUMILEX$_{t-5}$ (log) cubic	0.007 (0.005)	0.006 (0.005)			0.003 (0.005)	0.002 (0.004)		
EDUMILEX$_{t-8}$ (log)			0.026 (0.032)	0.046 (0.029)			0.036 (0.029)	**0.058**** (0.025)
EDUMILEX$_{t-8}$ (log) squared			**-0.088***** (0.022)	**-0.105***** (0.023)			**-0.077***** (0.019)	**-0.096***** (0.019)
EDUMILEX$_{t-8}$ (log) cubic			**0.025***** (0.005)	**0.029***** (0.006)			**0.025***** (0.005)	**0.029***** (0.005)
Military conscription		-0.012 (0.039)		**-0.142***** (0.033)		-0.001 (0.029)		**-0.139**** (0.021)
Electoral Democracy Index		**0.203***** (0.069)		**0.258***** (0.083)		**0.230***** (0.065)		**0.307***** (0.078)
Constant	**2.086***** (0.183)	**2.060***** (0.190)	**2.733***** (0.280)	**2.867***** (0.332)	**2.084***** (0.182)	**2.047***** (0.177)	**3.043***** (0.325)	**3.203***** (0.362)
Groups	440	440	348	348	440	440	348	348
Obs.	32	32	32	32	32	32	32	32
R-squared within	0.7829	0.7866	0.5257	0.5428	0.8418	0.8449	0.5693	0.5864
R-squared between	0.9987	0.9966	0.9983	0.9826	0.9990	0.9947	0.9984	0.9748
R-squared overall	0.9867	0.9850	0.9867	0.9707	0.9862	0.9826	0.9855	0.9622
F-stat	**398.89*****	**341.05*****	**211.33*****	**160.18*****	**551.43*****	**520.50*****	**190.20*****	**222.01*****

Notes: Robust standard error in parentheses. *** significant at 1%, **significant at 5%, *significant at 10%. For sake of readability statistically significant coefficients are in bold.



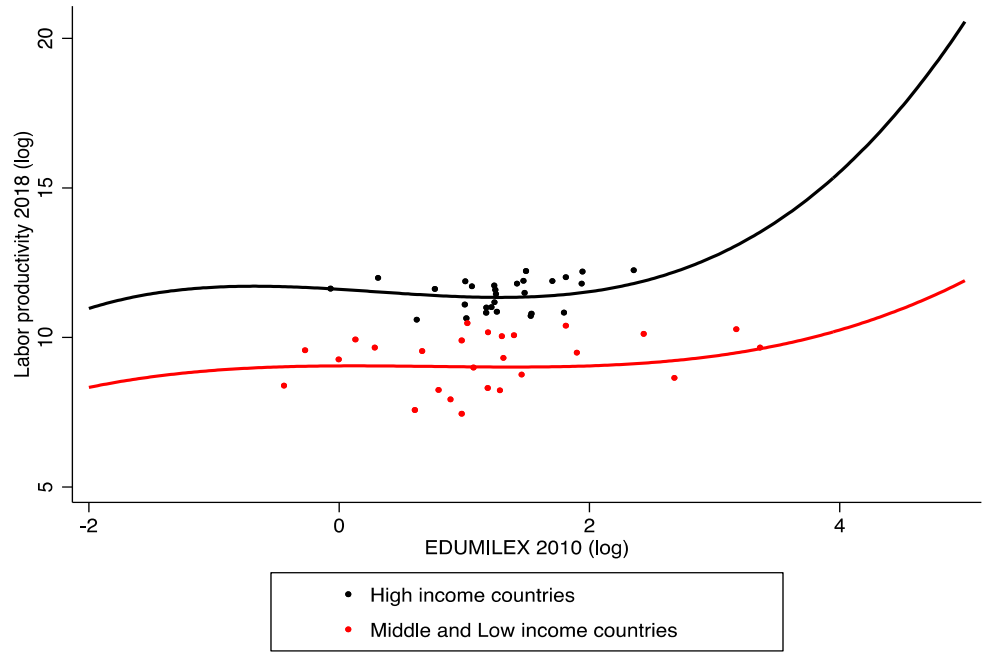


Figure 4: GDP per capita 2018 and labor productivity 2018 against EDUMILEX ratio

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Conclusion

The aim of this article was to propose a target variable for a peaceful economic policy based on the evidence that education and military expenditures are countervailing factors in securing long-run growth. The key implication from a policy perspective is that appropriately balancing investments in education and the burden of unproductive military spending is a first-order importance for positive economic performance in the long-run. In order to analyze that, the ratio between public investment in education and military expenditures, here named EDUMILEX, was employed as the relevant variable to capture the impact of such balance on economic growth over time. The findings of the empirical analysis show a non-linear relationship between the EDUMILEX ratio and both GDP per capita and labor productivity. In particular, the results suggest that a cubic relation exists between GDPs per capita and the EDUMILEX ratio. This means that for very low levels of EDUMILEX, an increase of the ratio will result in increased GDP per capita until a turning point—after which GDP per capita decreases. Eventually however, beyond a further turning point, an additional increase of EDUMILEX ratio generates further GDP per capita growth.

From a policy perspective, it is reasonable to consider the minimum turning point of the function derived from the regression as a target variable for economic policy. In fact, when considering GDP per capita as the dependent variable and EDUMILEX eight years lagged, the computed target variable is 4.5 for high-income countries and 8.9 for middle- and low-income countries. When labor productivity is considered, the target variable computed is 3.8 for high-income countries and 6.3 for middle- and low-income economies. Looking at current data, it is clear that several developed economies appear to be far from such values.

Needless to say, this work cannot be considered as conclusive evidence, but it does provide a point of departure for future research intended to provide policymakers with a workable set of instruments for peaceful economic policy.

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