



Welfare Regimes and Human Capital Index Dynamics in Developing Countries

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Abstract

Previous research indicated that public spending on health, education, and social protection in developing countries very weakly, if they are at all, correlated with their human capital outcomes. Thus, it is unlikely that developing countries could close the gap in human capital with OECD countries through additional government social spending. This paper is motivated by an attempt to correct and improve this conclusion. The literature on the international and comparative social policy and welfare regimes in developing countries showed that their social spending priorities vary considerably. This paper investigates how developing countries' social spending priorities, operationalized via their welfare clusters, influenced their human capital outcomes in terms of the World Bank Human Capital Index components. Hypotheses describing these influences and their differences between productive and protective welfare clusters were tested with regression analysis of the panel dataset on 22 developing countries for 7 benchmark years (from the 2000 to the 2019), including 26 indicators. The findings confirm that social spending priorities matter and that these priorities of developing countries with productive welfare better transform into human capital outcomes (at least in some sub-components and before they reach some threshold levels). Unfortunately, there are also some unintended consequences of productive welfare that restricts its stock of human capital.

Keywords

International comparisons; regression analysis; developing countries; welfare regime; human capital; effectiveness of social spending; late development

1. Introduction

The literature on international and comparative social policy and welfare in developing countries, on the one hand, and the parallel literature on late development, economic growth, and human capital in these countries, on the other, largely exist in mutual isolation. (The few exceptions are (Heckman, 2000; Baldacci et al., 2004; Colin & Weil, 2020)). At first instance, it is reasonable and predictable, since economic growth is often taken as something opposed to redistribution. Furthermore, most developing countries prioritized growth over redistribution or took the former as a necessary condition for the latter. It is commonly accepted to consider public social spending as served to redistribution ends, including social security, de-commodification, poverty and inequality reduction, etc. However, the human capital theory allows us to take into account not only private but also public social spending as an investment that could spur and bolster productivity and ultimately stimulate economic growth.

Human capital is defined as «the knowledge, skills, competencies and attributes embodied in individuals that

facilitate the creation of personal, social and economic well-being» (OECD, 2001). In addition to a varied educational characteristic of people – their knowledge and skills, this definition embraces people’s health conditions (even if it is challenging to measure). Thus, theoretically speaking, if developing countries had risen their public social spending, they would have caught-up developed countries at least in human capital outcomes if not in economic performance. Such a perspective looks very similar to «*productivist welfare regime*» (Holliday, 2000) distinguished for some developing countries, when coverage and generosity of public welfare programs is subordinated to economic growth's ends (and lesser to regime legitimization ends).

Unfortunately, *productivist welfare* is not common for all developing countries for several reasons. First, their previous economic performance determines how much they can spend on human development, and only on this basis policymakers can decide which social spending item should be prioritized. (For example, one should not increase spending on primary education if the infant mortality rate remains high; otherwise, it will look irrational). Previous research in developing welfare regimes indicated that developing countries differ with each other and with OECD countries in patterns of state, market and household forms of social provision as well as in their welfare outcomes, human security, well-being and ultimately human capital. In contrast to OECD countries, in developing countries' markets (including companies), communities, families or households and international actors often play a bigger role in social protection in comparison with public welfare. I. Gough and his coauthors (Gough et al., 2004; Gough & Wood, 2006) captured it with the concept of «welfare mix». For sure, the data scarcity on private and «out-of-pockets social spending» for the developing world is a big issue; even data on government social spending is not always available for some developing countries. I will return to the issue of different developing welfare regimes and corresponding differences in social spending priorities below.

Second, the human capital approach does not work as well for developing countries as it does for OECD countries. It is an empirical fact that, for some reasons (presumably neo-institutional), public social spending in developing countries is less well transformed into human capital outcomes (Pritchett, 2013). In the 2019 World Bank experts – K. Andrews, G. Avitabile and R. Gatti (2019) – concluded that public spending on health, education, and social protection very weakly, if they are at all, correlated with Human capital outcomes. (It was an obvious revision of what was previously taken for granted by their colleagues from IMF (see Baldacci et al., 2004) and many others). In other words, using the World Bank Human Capital Index (HCI) (Kraay, 2018) as a cross-country ranking metric, co-authors argued that low-income countries at the bottom of the HCI ranking can hardly close that gap with rich countries through additional public social spending. Thus, co-authors continued the other enduring tradition among World Bank experts to emphasize large cross-countries differences in returns of an additional dollar spent on human capital (see e.g., Pritchett, 2001; Al-Samarrai et al., 2018).

In detail, to control above mentioned differences Andrews, Avitabile and Gatti (2019) stratified countries by income groups and calculated correlations between HCI scores and public social spending by corresponding items within them. And what they observed was no positive and statistically significant correlation between corresponding social spending and HCI outcomes for all developing countries groups (i.e., low-income, low-middle, and most upper middle) or all non-OECD countries. The only exception was a correlation between health spending and HCI outcomes, that was positive and statistically significant for all developing countries’ groups (Andrews, Avitabile, & Gatti, 2019, p. 16, Fig. 6). More specifically, the relationship between social protection spending and HCI outcomes was positive for developing countries with low-middle incomes, while it was negative for upper-middle income developing countries and for low-income developing countries. Or, the relationship between educational spending and HCI was positive for low-income developing countries, yet it was negative for middle-income developing countries and statistically insignificant (absent) for low-middle income developing countries. Authors stressed the data limitations, showing that the above result could be partly explained by the higher density of the health spending data in developing countries and called for following research in that vein.

This paper is motivated by an attempt to correct and improve the World Bank experts’ conclusion. They highlighted that the developing countries’ inability to transform resources into human capital outcomes is explained, among other reasons, by their failure to prioritize items of public social spending in a cost-effective way. Fortunately, previous studies in the field of welfare regimes in the developing world quantitatively distinguished clusters of welfare regimes in developing countries that differ exactly in their social spending priorities. Thus, it allows us to test how developing countries’ social spending priorities, operationalized via welfare clusters affiliation, influence human capital outcomes in terms of HCI sub-components.

2. Welfare regimes in developing countries and hypotheses on human capital public spending efficiency

Over the last decades there were numerous attempts to distinguish clusters of welfare regimes in the developing world. Those attempts were motivated by the fact that developing welfare regimes neither can be assigned to one of the welfare regimes distinguished by Esping-Andersen (1990), nor necessarily convergent with them, as appeared. Furthermore, emergent welfare regimes in developing countries faced changes that affected the composition of the welfare regimes groups (or clusters) there. Among leading and most influential recent approaches to the developing countries' social regimes clustering, there are ones of I. Holliday and his coauthors (Holliday, 2000; 2005; Kwon & Holliday, 2007) or his opponents (Aspalter, 2006; 2011; Choi, 2012), as well as I. Gough and his coauthors (Gough, 2001, Gough et al., 2004; Gough & Wood, 2006; Abu Sharkh & Gough, 2010), N. Rudra (2002, 2004, 2007; Rudra & Haggard, 2005), S. Haggard and R. Kaufman (2004, 2008), etc. (Reviewing the literature on welfare regimes in the developing world, including latest findings, is not the aim of this paper; for more details on developing welfare clustering see e.g., (Roumpakis, 2020).

For the purposes of this paper N. Rudra's (2007) clusters of welfare regimes in the developing world is the best fit. For sure, her developing welfare clusters, being distinguished in 2007, somehow changed since then in their composition and social spending priorities. It is also true that numerous intermediate and mixed sub-clusters can be distinguished. This is precisely what scholars following Rudra and influenced by her are looking into (see e.g., Hudson, Kühner, 2012; Kühner, 2015; Yang & Kühner, 2020). However, for the purposes of this paper, let's assume that the Rudra's clusters are relatively stable. Analysis that followed, as well as its results proved that this assumption is not so misleading.

N. Rudra quantitatively distinguished her *productive* and *protective* welfare clusters exactly based on their governments' social policy priorities, which can be observed in percent shares of different social spending items normalized per capita of recipients. (Her clustering approach is designed to exclude influence of cross-countries differences in economic growth and consequently amounts of tax revenues as well as in their demography). The obvious advantage of her clustering approach is that it captured the past dependency of distinct developing welfare regimes from different development strategies – Import Substitution Industrialization (ISI) and Export-Led Industrialization (ELI). Furthermore, her clusters are derived from different trajectories of labor commodification/de-commodification chosen by different developing countries.

Developing countries with a *productive welfare* regime aimed at finishing labor commodification, encouraging participation in export markets and increasing the export competitiveness of domestic firms. That is why they kept social costs low and invested more in primary and secondary education, basic healthcare, including vaccination against DPT3, as well as in reduction of infant mortality. Developing countries with *protective welfare*, in contrast, aspired to decommodification before finishing full-fledged commodification as well as to protection of local labor market and enterprises from international market competition, risks, and uncertainties. Thus, *protective* welfare regimes heavily invested in social protection including (old-age pensions, family allowances, unemployment, sickness and disability insurance), housing subsidies, labor market protections, and in the tertiary education as a privilege for regime loyalists. In other words, public social spending items that were higher in the *productive* welfare regimes, appeared to be lower in the *protective* welfare regimes, and vice versa.

Thus, one or another public social spending allocation between items and normalized by recipients indicates priorities in social spendings of the country – either to better save human capital of current workers, or to facilitate human capital accumulation of future generation workers at the expense of the current generation. It must be noted that both strategies have their strengths and limitations that will be briefly discussed in conclusion. What is more important, it allowed to formulate empirically testable hypothesis about the relationship between public social spending priorities and human capital outcomes:

H.1: *Productive* developing countries spend more on primary and secondary education per student and have higher corresponding HCI components outcomes (primary-, lower-/upper-secondary- TNER and/or HLO scores).

H.2: *Productive* developing countries spend more to reduce infant mortality and increase immunization per child and have higher corresponding HCI components outcomes (probability of survival to 5 years).

H.3: *Protective* developing countries spend more on tertiary education per student and have higher corresponding

outcomes (School life expectancy at tertiary education)¹.

H.4: *Protective* developing countries spend more on social protection and extended healthcare per recipient and have higher corresponding HCI components outcomes (adult survival rate from 15 to 60 years).

H.5: *Protective* developing countries spend more on social protection, family allowances and subsidies and have higher corresponding HCI components outcomes (fraction of children under 5 not stunted).

Furthermore, since UNESCO Institute for Statistics and WHO Global Health Expenditure Database provide some panel data on private (or out-of-pockets) expenditures on education and healthcare in the developing world, additional sub-hypotheses about the influence of this «welfare mix» of public and private expenditures (Gough et al., 2004) on human capital outcomes was constructed. (It should be noted that Abu Sharkh and Gough (2010) quantitatively identified clusters of developing countries on the basis of a combination of particular «welfare mix» spending and their social outcomes in terms of UNDP HDI components).

3. World Bank HCI components and panel data

Unlike other approaches to human capital measurement, the World Bank HCI designed to highlight «how investments that improve health and education outcomes today will affect the productivity of future generations of workers» (Kraay, 2018., p. 2). It measures human capital, expected to be attained by a child born today by age 18, given the risks to poor health and education in the country where he or she would grow up. It includes 3 components – survival, expected education (its quantity and quality) and expected health – that can be subdivided into sub-components. Unfortunately, the data on some HCI sub-components is of low density and available for a not so long historical period. And this problem is especially relevant for developing countries.

In more detail, expected education (in primary-, lower- and upper-secondary school) is measured by the «total net enrollment rate» (TNER) adjusted by repetition rate (at corresponding level) and then normalized by quality of education measured by harmonized international tests results TIMSS, PISA, and PIRLS, according to the thesis «schooling in not learning» (Pritchett, 2013). Expected health includes two sub-components – adult survival rate from 15 to 60 years normalized by fraction of children under 5 not stunted (for more details and explanation of the normalization see (Kraay, 2018, Weil, 2007).

In order to have enough data on HCI sub-components and to reduce cross-countries income differences there were selected two groups of low-middle and upper-middle income counties that represented the two Rudra's clusters of welfare regimes in the developing world with higher data density: for *productive* cluster – Colombia, Indonesia, Malaysia, Thailand, Panama, Paraguay, Costa Rica, Chile, Korea²; and for *protective* cluster – Iran, Morocco, Tunisia, Turkey, Zimbabwe, Egypt, Bolivia, Dominican Republic, El Salvador, India, Lesotho. Then, the panel data were collected for these countries for several benchmark years³ (2000, 2003, 2007, 2009, 2012, 2015, 2019) on above mentioned indicators from sources enumerated in the Table 1.

Table 1 shows indicators of social expenditures and HCI sub-components included into the panel as well as the sources of data on them.

In sum, the panel dataset on 22 developing countries for 7 benchmark years (from 2000 to 2019) included 26 indicators of social expenditures and HCI sub-components (*in the application*). Because of extremely few data available on the following indicators – (1) repetition rate in education, (2) Harmonized Learning Outcomes (HLO), (3) household spending per student by level of education, (4) government social protection spending – the total share of missing data (NA) is about 30%. (Missing data imputation for some indicators was technically possible, but has not practically been used). Thus, we had to utilize those indicators less or drop them and employ step by step regression analysis to investigate statistical relationships between each spending item and each corresponding HCI sub-component. The HCI sub-components were independent variables, and the corresponding items of social expenditure – were regressors.

¹ School life expectancy at tertiary education is not included in the World Bank's HCI.

² Korea joined the OECD in the 1996, yet the country presents one of the principal examples of transformation of the productivist welfare regime into the liberal one in the East Asia (Choi 2012, Yang 2013, Yang, Kühner 2020). Colombia and Costa Rica joined the OECD only after the 2019 – in the 2020 and 2021, correspondingly.

³ Selected benchmark years explained by availability of data on HLO results and under-5 stunting rate for the countries under the study (see Table 1).

Table 1. Sources and indicators of social expenditures and HCI sub-components

Sources:	Indicators:
<p><i>UNESCO Institute for Statistics</i> (http://data.uis.unesco.org)</p> <p><i>Harmonized Learning Outcomes (HLO) Database</i> (Patrinós, Angrist, 2018)</p> <p><i>World Bank World Development Indicators database</i> (https://data.worldbank.org/indicator)</p> <p><i>WHO Global Health Expenditure Database</i> (https://apps.who.int/nha/database)</p> <p>UNDP, UNICEF WHO WBG, UN IGME, (https://data.unicef.org/resources/resource-topic/malnutrition/) (https://population.un.org/wpp/) (https://childmortality.org) IMF Data – Functional Expenditure (COFOG) (https://data.imf.org/regular.aspx?key=61037799)</p>	<ul style="list-style-type: none"> ● Total net enrolment rate (TNER) by level of education (in %) ● Repetition rate by level of education (in %) ● School life expectancy by level of education (in years) ● Initial government funding per student by level of education (in constant PPP\$) ● Household funding per student by level of education (in constant PPP\$) ● Harmonized Learning Outcomes (HLO) on reading at primary school (for both sexes) ● Harmonized Learning Outcomes (HLO) on math at secondary school (for both sexes) ● Harmonized Learning Outcomes (HLO) on science at secondary school (for both sexes) <ul style="list-style-type: none"> ● GDP (in constant PPP\$) ● Population, total ● Urbanization rate (%) ● Government schemes and compulsory contributory health care financing schemes (in constant PPP\$ per capita) ● Compulsory contributory health insurance schemes (in constant PPP\$ per capita) ● Voluntary health insurance schemes (in constant PPP\$ per capita) ● Household out-of-pocket payments (in constant PPP\$ per capita) ● Mortality rates for 15–60-year-olds ● Under-5 mortality rate (per 1000 birth) ● Children under-5 stunting rate (%) ● Government social protection spending (as % of GDP)

* If data for an indicator for certain country for benchmark year was not available, then data for nearby year was taken.

** IMF data on social protection spending (as % of GDP) was transformed into per capita (in constant PPP\$) format by using WBG GDP and population data.

4. Research procedures and results

In order to estimate how public and private (if data available) social expenditure influenced corresponding HCI sub-components and realize are there any statistically significant differences in these influences between *productive* and *protective* welfare clusters dozens of regression models and statistical tests were computed via R-Studio. (One model for each social spending item and for each HCI sub-component, that is, one model for each sub-hypothesis). Differences in these influences between developing countries with *productive* and *protective* welfare regimes were controlled by adding the dummy variable «Cluster» («1» for *productive* and «0» for *protective*) into every model. This generally raised the quality of models in terms of their R², AIC, BIC. The Wild test, testing the hypothesis that the extra parameters in the larger model are equal to zero, also confirmed it. Then followed another attempt to improve the quality of the resulting model by choosing its specification. Model specification was determined according to Hausman test (Durbin–Wu–Hausman test) results, with fixed-effects estimation selected when country-specific heterogeneity was statistically significant and random-effects selected when an unobserved individual effects existed (Breusch-Pagan test).

The research procedures and the underlying logic will be described in detail below in this section. In order to make it evident and transparent, a case of testing one sub-hypothesis – influence of governments expenditure on

primary education ('Gvsp_pr') on TNER in the same education level ('C_2.1.1_TNERpr') in developing countries with *productive* and *protective* welfare regimes – will be presented with results of R calculations at each step. In the end, all statistically significant findings describing differences in the influences between *productive* and *protective* welfare regimes will be presented in the form of regression equations. (These equations allowed us to accept some and reject other sub-hypotheses deduced from the hypotheses in above).

At the first step the influence of each social spending item on each corresponding HCI sub-component was checked by pooled OLS regression, without the «Cluster» dummy variable, for all developing countries in the panel, i.e. without controlling their social spending priorities via welfare cluster affiliation. As expected, many of such tentative models showed significant influence, yet either coefficient for an regressor, or quality of most of the models (in terms of R^2) was not very high. However, most of such models were valid, since all social spendings by countries were normalized by the number of recipients. Thus, heteroscedasticity in data was typically absent. Yet, its presence was still tested with the Goldfeld-Quandt test for small-N ($N < 1000$). In some cases logarithm of regressor was taken in order to exclude heteroscedasticity.

Then, the «Cluster» dummy variable was added into the pooled regression models (one model for each social spending item) to control social spending priorities of developing countries' groups. Typically it raised the quality of the updated model in terms of R^2 , AIC, BIC. Furthermore, the Wald test was performed to compare the two models (with and without the dummy variable). In the vast majority of cases the Wald test determined that the additional dummy predictor in the larger model significantly improved its fit. Since, there are two ways of adding dummy variable – either as it is ($x + \text{dummy}$), or through creating an addition synthetic variable equal to product of one or more regressors by dummy variable ($x * \text{dummy}$) – the Wald test was utilized again to determine which way gave a better model. If the «Cluster» dummy variable appeared to be insignificant when the social spending regressor was, it means that there was an influence of some social spending item on some corresponding HCI sub-component, however there was no significant differences between developing countries with *productive* and *protective* welfare. In such rare cases no additional test or efforts followed. Otherwise, followed a subsequent attempts to improve the quality of the resulting model by choosing its specification.

It is not uncommon for the panel data that Fixed Effects (FE) or Random Effects (RE) regression models are better performed than pooled OLS regression. This is true for those cases when significant individual or time effects (observed or unobserved) are presented. For example, either observations for some country or for some benchmark year heavily influence the model, or some unobserved individual properties of the country (not presented explicitly as a regressors) influenced stronger than presented regressors. Furthermore, Random Effects (RE) model estimated using Generalized Least Squares (GLS) can solve the problem of autocorrelation of residuals, if it rises. For each pooled OLS regression (each for each social spending item) that included the «Cluster» dummy variable additional Fixed Effects (FE) and Random Effects (RE) regression models were computed. Model specification was determined according to Hausman test (Durbin–Wu–Hausman test) results, with fixed-effects estimation selected when country-specific heterogeneity was statistically significant. Otherwise, random-effects selected if Breusch-Pagan Lagrange Multiplier test fixed the existence of significant unobserved effects. Otherwise, the original pooled OLS regression was accepted as the preferred one.

The regression equation obtained from the best performing model was used to test the influence of each specific item of social expenditure on each corresponding HCI sub-component as well as the differences in that influence between developing countries with *productive* and *protective* welfare. It should be noted that some crossinfluences between directly unconnected items of social spending and the HCI sub-components (for example, between government spending per student in primary education and TNER in low secondary education) are possible, yet regression models estimated only influences specified in the hypothesis above. A significance level (α) of 0.05 was chosen for all statistical tests and regression coefficients.

In order to make evident and transparent all above described step by step regression methodology, below it will be reproduced in detail in one case. The test of one sub-hypothesis (**H.1.1**) that described influence of governments expenditure on primary education (Gvsp_pr) on TNER in primary education (C_2.1.1_TNERpr) in developing countries with *productive* and *protective* welfare regimes (as shown in the Figure 1) will be supported by pictures of calculations in R-Studio and comments at each step. (During the research the same operations were mutually repeated for each item of social spending and each sub-hypothesis, correspondingly).

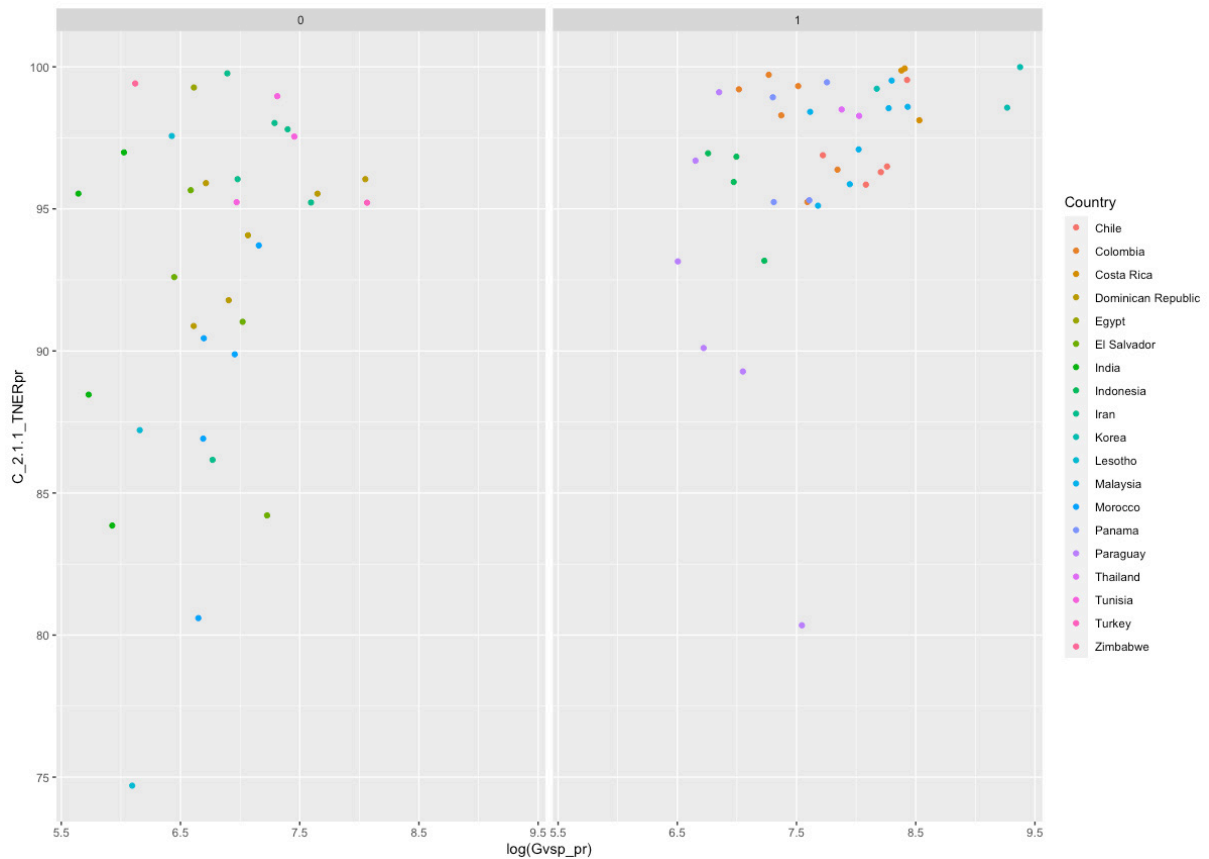


Figure 1. The relationship between logarithm (log) of public expenditure on primary education (Gvsp_pr) and TNER in primary education (C_2.1.1_TNERpr) in developing countries with productive (1) and protective (0) welfare regimes.

1) Rows with missing values were removed, if needed, took the logarithm of regressors to avoid heteroscedasticity, and calculated the pooled OLS regression model ('m5') that described the influence of 'Gvsp_pr' on 'C_2.1.1_TNERpr'.

```
> summary(m5)

Call:
lm(formula = C_2.1.1_TNERpr ~ Gvsp_pr, data = HCI5.2p)

Residuals:
    Min       1Q   Median       3Q      Max
-18.8247  -1.0318   0.9911   2.7679   5.8768

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 9.309e+01  8.142e-01 114.326 < 2e-16 ***
Gvsp_pr      9.851e-04  2.779e-04   3.545 0.000728 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.601 on 66 degrees of freedom
Multiple R-squared:  0.1599,    Adjusted R-squared:  0.1472
F-statistic: 12.56 on 1 and 66 DF,  p-value: 0.000728
```

2) The Goldfeld-Quandt test for homoscedasticity in the 'm5' model was conducted.

```
> gqtest(m5, order.by = ~ Gvsp_pr, data = HCIS.2p, fraction = 0.2) # accepted
```

Goldfeld-Quandt test

```
data: m5
GQ = 0.33499, df1 = 28, df2 = 27, p-value = 0.9973
alternative hypothesis: variance increases from segment 1 to 2
```

Observed p-value (0.997) ≥ 0.05 means that the null hypothesis (H_0): «The residuals from a linear regression are homoscedastic» is failed to be rejected at the significance level ($\alpha = 0.05$).

3) The 'Cluster' dummy variable was added to the 'm5' model. The best way to do it was specified with the Wald test. The same test also showed that the larger model with the dummy variable is better than that without it, testing the null hypothesis (H_0): «The extra parameters in the larger model are equal to zero».

```
Calls:
m5_d1: lm(formula = C_2.1.1_TNERpr ~ Gvsp_pr + Cluster, data = HCIS.2p)
m5_d2: lm(formula = C_2.1.1_TNERpr ~ Gvsp_pr * Cluster, data = HCIS.2p)
```

	m5_d1	m5_d2
(Intercept)	92.198*** (0.809)	89.891*** (1.346)
Gvsp_pr	0.000 (0.000)	0.003* (0.001)
Cluster	3.970** (1.220)	6.866*** (1.813)
Gvsp_pr x Cluster		-0.002* (0.001)
R-squared	0.278	0.325
adj. R-squared	0.255	0.293
AIC	396.253	393.660
BIC	405.131	404.758

```
Significance: *** = p < 0.001;
** = p < 0.01; * = p < 0.05
> waldtest(m5,m5_d1) # H_0 rejected
Wald test

Model 1: C_2.1.1_TNERpr ~ Gvsp_pr
Model 2: C_2.1.1_TNERpr ~ Gvsp_pr + Cluster
  Res.Df Df    F Pr(>F)
1     66
2     65  1 10.597 0.0018 **
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
> waldtest(m5_d1,m5_d2) # H_0 rejected
Wald test

Model 1: C_2.1.1_TNERpr ~ Gvsp_pr + Cluster
Model 2: C_2.1.1_TNERpr ~ Gvsp_pr * Cluster
  Res.Df Df    F Pr(>F)
1     65
2     64  1  4.4715 0.03836 *
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

In both cases Wald test's F-statistic (0.002 and 0.038) ≤ 0.05 . Thus, H_0 was rejected at the significance level ($\alpha = 0.05$) – the second way of adding the dummy «Gvsp_pr * Cluster», in 'm5_d2' model is better than the first way «Gvsp_pr + Cluster» in 'm5_d1' model, that in turn is better than 'm5' model without the «Cluster» dummy variable.

4) Fixed Effects (fe5_d1) and Random Effects (re5_d1) models were computed.

```

> summary(fe5_d1)

Call:
lm(formula = C_2.1.1_TNERpr ~ Gvsp_pr + Cluster + factor(cn_id) +
    factor(Year), data = HCIS.2p)

Residuals:
    Min       1Q   Median       3Q      Max
-11.2432  -1.4262   0.0802   1.4825  10.8650

Coefficients: (1 not defined because of singularities)
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  84.0742012  2.7260756  30.841 < 2e-16 ***
Gvsp_pr      -0.0004591  0.0007216  -0.636  0.52762
Cluster      11.5053107  3.2879242   3.499  0.00102 **
factor(cn_id)2 -3.3072727  2.8487803  -1.161  0.25141
factor(cn_id)3  0.1665621  2.5507652   0.065  0.94821
factor(cn_id)4  0.1929507  3.6663831   0.053  0.95825
factor(cn_id)5 -0.3933437  2.7843368  -0.141  0.88825
factor(cn_id)6 -6.9046251  2.5478669  -2.710  0.00930 **
factor(cn_id)7  1.9310847  3.4485762   0.560  0.57811
factor(cn_id)8 -0.8766153  2.7827730  -0.315  0.75412
factor(cn_id)10  5.1261660  5.5517097   0.923  0.36044
factor(cn_id)12  8.7918919  3.2029450   2.745  0.00849 **
factor(cn_id)13  1.5242132  3.2617479   0.467  0.64240
factor(cn_id)14 11.3892168  3.7751952   3.017  0.00408 **
factor(cn_id)15  8.8235724  5.1835284   1.702  0.09518 .
factor(cn_id)16 11.3316019  5.1583315   2.197  0.03290 *
factor(cn_id)17 11.7590474  5.1160884   2.298  0.02593 *
factor(cn_id)19  6.7667351  3.1604978   2.141  0.03738 *
factor(cn_id)20  4.4327385  3.3335745   1.330  0.18989
factor(cn_id)21  4.2791696  3.3404216   1.281  0.20634
factor(cn_id)22      NA           NA         NA      NA
factor(Year)2003  3.6649743  1.9286092   1.900  0.06341 .
factor(Year)2007  3.6628166  1.9555027   1.873  0.06715 .
factor(Year)2009  4.1800602  1.9898526   2.101  0.04095 *
factor(Year)2012  4.2168010  2.0339585   2.073  0.04354 *
factor(Year)2015  3.7884723  2.3398322   1.619  0.11197
factor(Year)2019  3.7810820  2.6060476   1.451  0.15332
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.254 on 48 degrees of freedom
Multiple R-squared:  0.5568, Adjusted R-squared:  0.3259
F-statistic: 2.412 on 25 and 48 DF, p-value: 0.004365

> summary(re5_d1)

Oneway (individual) effect Random Effect Model
(Swamy-Arora's transformation)

Call:
plm(formula = C_2.1.1_TNERpr ~ Gvsp_pr + Cluster, data = HCIS.2p,
    model = "random")

Unbalanced Panel: n = 19, T = 1-7, N = 74

Effects:
              var std.dev share
idiosyncratic 18.152  4.261 0.807
individual     4.353  2.086 0.193
theta:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 0.1019  0.2856  0.3257  0.3066  0.3597  0.3890

Residuals:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-16.408 -1.350  0.957  -0.052  2.360  6.366

Coefficients:
              Estimate Std. Error z-value Pr(>|z|)
(Intercept)  9.2326e+01  1.1013e+00  83.8343 < 2e-16 ***
Gvsp_pr      5.1987e-04  3.5113e-04  1.4806  0.13872
Cluster      3.0133e+00  1.5810e+00  1.9059  0.05666 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:  4955.7
Residual Sum of Squares: 1301.9
R-Squared:  0.74146
Adj. R-Squared: 0.73418
Chisq: 10.0546 on 2 DF, p-value: 0.0065564

```

5) Model specification was determined according to Hausman test results, with fixed-effects estimation selected when country-specific heterogeneity was statistically significant. The RE model was selected when significant unobserved effects existed (according to Breusch-Pagan test). Otherwise, pooled OLS regression is preferable.

```
> phtest(fe5_d1, re5_d1) # Accepted

Hausman Test

data: C_2.1.1_TNERpr ~ Gvsp_pr + Cluster
chisq = 0.96556, df = 1, p-value = 0.3258
alternative hypothesis: one model is inconsistent
```

In the Hausman test the null hypothesis (H_0): «There is no significant correlation between the unique errors (individual effects) and regressors», i.e. random effects is the preferred model. Observed p-value (0.326) \geq 0.05, indicates that the H_0 hypothesis is failed to be rejected at the significance level ($\alpha = 0.05$).

The Breusch-Pagan Lagrange Multiplier determines whether the RE model is better than pooled OLS regression.

```
> plmtest(re5_d1, type=c("bp")) # H_0 Accepted

Lagrange Multiplier Test - (Breusch-Pagan) for unbalanced panels

data: C_2.1.1_TNERpr ~ Gvsp_pr + Cluster
chisq = 1.769, df = 1, p-value = 0.1835
alternative hypothesis: significant effects
```

Observed p-value (0.184) \geq 0.05 indicates the null hypothesis (H_0): «There are no significant unobserved individual or time effects» is failed to be rejected at the significance level ($\alpha = 0.05$). Thus, pooled OLS regression with the dummy ('m5_d2' model; Figure 2 shows it) is the best performed model that describes the significant influence of government expenditure on primary education (Gvsp_pr) on TNER in primary education (C_2.1.1_TNERpr) in developing countries with productive and protective welfare regimes. The resulting equation described the influence is the following:

```
> summary(m5_d2)

Call:
lm(formula = C_2.1.1_TNERpr ~ Gvsp_pr * Cluster, data = HCIS.2p)

Residuals:
    Min       1Q   Median       3Q      Max
-16.3362  -1.7783   0.2073   2.0317   8.3472

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  89.890595   1.345841  66.791 < 2e-16 ***
Gvsp_pr       0.002585   0.001042   2.481 0.015752 *
Cluster       6.866401   1.813242   3.787 0.000339 ***
Gvsp_pr:Cluster -0.002298   0.001087  -2.115 0.038365 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.189 on 64 degrees of freedom
Multiple R-squared:  0.3249,    Adjusted R-squared:  0.2932
F-statistic: 10.27 on 3 and 64 DF,  p-value: 1.317e-05
```

for productive cluster:

TNER_primary = 96.8 + 0.0003 * Government spending per student_primary;

for protective cluster:

$$\text{TNER_primary} = 83 + 0.0025 * \text{Government spending per student_primary}.$$

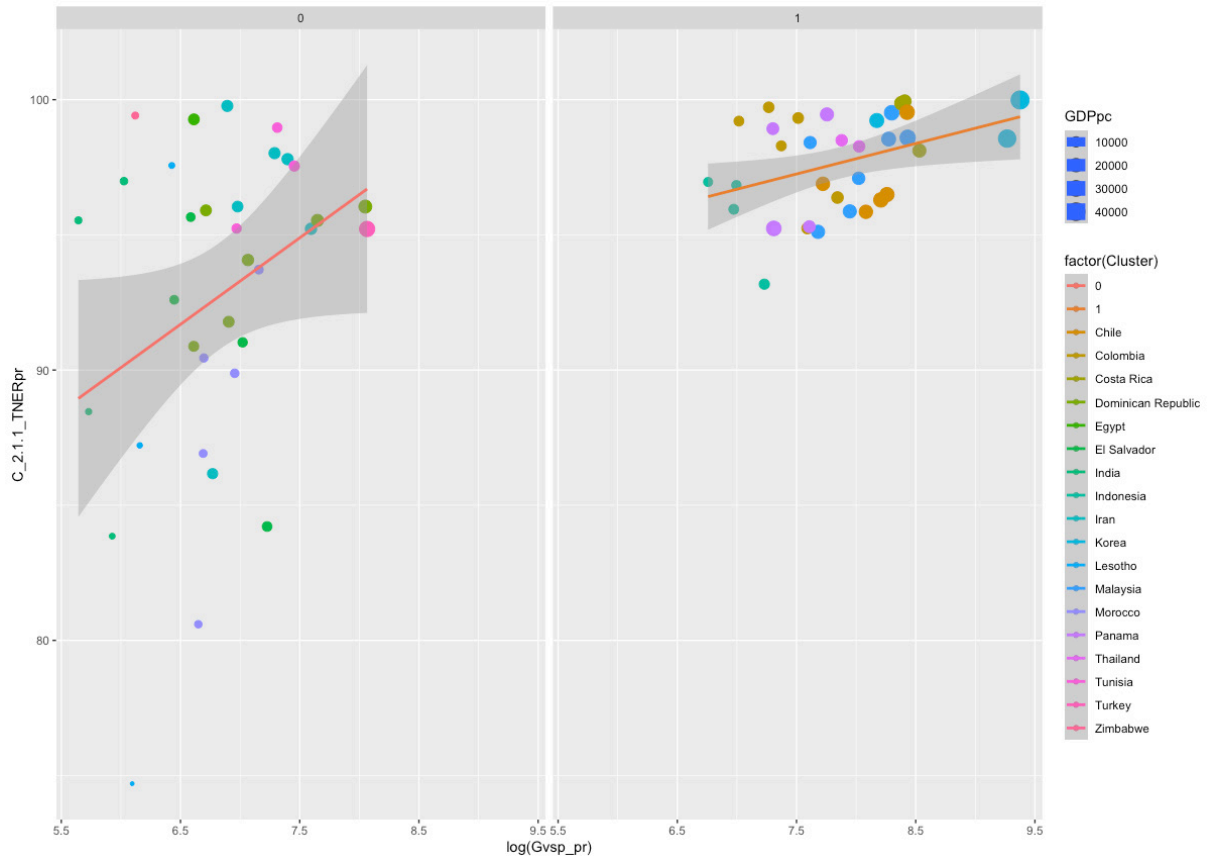


Figure 2. Pooled OLS regression model that describe relationship between logarithm (log) of public expenditure on primary education (Gvsp_pr) and TNER in primary education (C_2.1.1_TNERpr) in developing countries with productive⁴ (1) and protective (0) welfare regimes.

The same research algorithm was repeated for each social spending item as a regressor and for each respective HCI sub-component as a dependent variable.

Below presented all statistically significant findings describing differences in the influences will be presented in the form of regression equations for productive and protective welfare regimes:

H.1.1 – Accepted: There is a statistically significant influence of Government spending per student in primary education on TNER in primary education and there are statistically significant differences between productive and protective clusters in this influence:

for productive cluster:

$$\text{TNER_primary} = 96.8 + 0.0003 * \text{Government spending per student_primary};$$

for protective cluster:

$$\text{TNER_primary} = 83 + 0.0025 * \text{Government spending per student_primary}.$$

H.1.1.1 – Accepted: There is a statistically significant influence of Government spending per student in primary education on Repetition rate in primary education and there are statistically significant differences between productive and protective clusters in this influence:

⁴ Paraguay from the productive welfare cluster was excluded from the panel in the course of that regression experiment because of its paradox (or strong individual effect of Paraguay in case of TNER in primary education). It is a single country where in the observed period TNER in primary education decreased markedly (from about 99 to about 80 %) despite the uneven growth in government spending per recipient in primary education.

for productive cluster:

Repetition rate_primary = 4.86 – 0.001 * Government spending per student_primary;

for protective cluster:

Repetition rate_primary = 9.18 – 0.002 * Government spending per student_primary.

H.1.1.2 – Rejected: There is no statistically significant influence of Government spending per student in primary education on results of international tests on reading at primary school.

H.1.2 – Rejected: There is no statistically significant influence of Government spending per student in secondary education on TNER_lower-secondary.

H.1.2.1 – Accepted: There is statistically significant influence of Government spending per student on repetition rate in lower-secondary education and there are statistically significant differences between productive and protective clusters in this influence:

for productive cluster:

Repetition rate_lower-secondary = 4.06 – 0.0004 * Government spending per student_lower-secondary;

for protective cluster:

Repetition rate_lower-secondary = 9.36 – 0.001 * Government spending per student_lower-secondary.

H.1.3 – Partly rejected: There is a statistically significant influence of Government spending per student in secondary education on TNER in upper secondary education; however, there are no statistically significant differences between productive and protective clusters in this influence.

H.1.3.1 – Not enough data to test this hypothesis.

H.1.3.2.1 – Rejected: There is no statistically significant influence of Government spending per student in secondary education on results of international tests on math at secondary school.

H.1.3.2.2 – Rejected: There is no statistically significant influence of Government spending per student in secondary education on results of international tests on science at secondary school.

H.2.1 – Accepted: There is a statistically significant influence of Government social spending on infant survival to 5 years and there are statistically significant differences between productive and protective clusters in this influence:

for productive cluster:

log (Survival to 5 years) = -0.04 + 0.004 * log (Government social spending);

for protective cluster:

log (Survival to 5 years) = -0.03 + 0.0005 * log (Government social spending).

H.2.2 – Accepted: There is a statistically significant influence of Government and compulsory contributory health schemes spending and Household out-of-pocket payments on survival to 5 years and there are statistically significant differences between productive and protective clusters in this influence:

for productive cluster:

log (Survival to 5 years) = + 0.006 * Government and compulsory contributory health schemes spending + 0.003 * Voluntary health schemes spending + 0.0003 * Household out-of-pocket payments;

for protective cluster:

log (Survival to 5 years) = + 0.02 * Government and compulsory contributory health schemes spending + 0.003 * Voluntary health schemes spending + 0.003 * Household out-of-pocket payments.

H.3 – Partly rejected: There is a statistically significant influence of Government spending per student in tertiary education on tertiary school life expectancy. (Unexpectedly, this influence appeared to be negative in contrast to positive influence of countries GDP per capita). However, there are no statistically significant differences between productive and protective clusters in both influences.

pooled regression:

log (School life expectancy tertiary) = 1.62 * log (GDP per capita) – 0.31 * Government spending per student_tertiary.

H.4.1 – Rejected: There is no statistically significant influence of Government social spending per capita on the adult survival rate from 15 to 60 years.

H.4.2 – Accepted: There is a statistically significant influence of Government and compulsory contributory health schemes spending and Household out-of-pocket payments on the Adult survival rate and there are statistically

significant differences between productive and protective clusters in this influence (unfortunately not all coefficients for an «Cluster» dummy variables statistically significant):

for productive cluster:

Adult survival rate = $0.823 + 0.00004 * \text{Government and compulsory contributory health schemes spending} + 0.000004 * \text{Household out-of-pocket payments}$;

for protective cluster:

Adult survival rate = $0.694 + 0.0001 * \text{Government and compulsory contributory health schemes spending} + 0.0002 * \text{Household out-of-pocket payments}$.

H.5 – Not enough data to test this hypothesis.

5. Conclusions and Discussion

Developing countries' social spending priorities, operationalized via welfare cluster affiliation, matter. They do influence human capital outcomes in terms of some, but not all, HCI sub-components.

Social spending priorities of *productive* developing countries better transformed into better education results in terms of TNER (total net enrollment rate) at primary and low-secondary level. They spent more on primary and lower-secondary education in the late 20th century, and at the beginning of the 21st century they had higher results in terms of corresponding HCI sub-components (TNER and repetition rate). And the outcomes in these sub-components can be raised through additional government spending either by developing countries with *productive* welfare, or by developing countries with *protective* welfare. This conclusion is in the line with findings of previous studies – public investment in primary education is more cost-effective than that in higher levels of education (Ganimian & Murnane, 2014; Al-Samarrai et al., 2018). In the period under the study: 2000–2019, *protective* welfare regimes differ with markedly higher repetition rate in primary and lower-secondary education as well as markedly lower international learning outcomes tests. Unfortunately, developing countries with *protective* welfare cannot close the gap in the HLO through additional public educational spending (see **H.1.1.2**, **H.1.3.2.1**, **H.1.3.2.2**; probably explained with scarcity of HLO data). However, according to the models, they have some “advantage of backwardness”. They can reduce the gap in repetition rate at primary and lower-secondary education and in TNER at primary education with *productive* welfare regimes through additional public expenditure if they change their social spending priorities. Returns of an additional dollar spent in this area is higher for developing countries with *protective* welfare than for the countries with the *productive*, due to lower base levels in target indicators.

Social spending priorities of protective welfare regimes has not transformed into better outcomes in corresponding HCI sub-components (school life expectancy at tertiary education, adult survival rate, fraction of children under 5 not stunted) by the beginning of the 21st century (**H.3**, **H.4**). (Some authors, including Rudra assume, that social spending in *protective* developing countries protected only privileged and/or important for their regimes groups, or served for rent seeking ends). It was found that additional government spending per student in tertiary education in the developing world has a negative impact on school life expectancy at this level, in contrast to the positive impact of income level (in terms of GDP per capita) (**H.3**). It means that, for some reason, students receiving government scholarships tend to leave universities earlier in developing countries. It is a puzzling question – why? Furthermore, despite of the fact that the adult survival rate of *protective* developing countries (0,694) lower than of the *productive* (0,823), they still has a potential to reduce this gap via additional Government and compulsory contributory health schemes spending as well as Household out-of-pocket payments (**H.4.2**). Again, the returns of additional expenditures are higher for developing countries with *protective* welfare, due to lower base levels in target indicators.

In sum, it seems that there are some threshold levels of HCI sub-components after that additional public social spending can make only a very limited contribution – regression coefficients for corresponding social spending items' variables in regression equations are very small, yet statistically significant. (For instance, see **H.1.1**, **H.1.1.1**, **H.1.2.1**). To put it simpler, the enumerated hypotheses just show that TNER is already so high and repetition rate is already so negligible in primary and lower-secondary education level for developing countries with *productive* welfare regime (neck to neck with OECD levels), that no matter how much they additionally spend on them, the impact would be very limited. (The only important exception is Paraguay, where TNER in primary education decreased markedly despite the uneven growth in government spending per recipient in primary education). However, for developing countries with *protective* welfare systems, where repetition rates in primary and lower-secondary

education are twice as high, – the opposite is true. There, relatively high repetition rates can be successfully reduced through additional government spending. But they are again faced with a choice: spend more on primary and lower-secondary education (**H.1.1**, **H.1.1.1**, **H.1.2.1**), changing their social spending priorities, or on adult survival rate (**H.4.2**), stimulating private expenditures, as well. (In both spheres developing countries with *protective* welfare have an “advantage of backwardness”). Interestingly, does a ratchet effect in public social spending exist: if developing countries with *productive* welfare reduce their public spending on primary education, will the decline in its quantity and quality be as small as predicted by the regression equation in hypothesis **H.1.1** for the opposite circumstances (i.e. rising expenditures), or will it be bigger?

Following Andrews, Avitabile, Gatti (2019) we call for further research. As the Korean case showed, the unintended consequence of a *productive* welfare regime that restricts social costs on the current generation of workers in favour of the future generation, is a decline in birth rate. Thus, the total stock of human capital (the number of children born multiplied by the HCI of the country where he or she would grow up) of developing countries with *protective* welfare with above the middle HCI and high birth rates could be higher than that of developing countries with *productive* welfare with higher HCI and significantly lower birth rates.

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