On the Merit of Debt Relief Programs in Heavily Indebted Poor Countries

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Abstract: Although the HIPC Initiative is nearly complete, its merit is still being debated among policymakers as well as academicians. Debt relief under the Initiative was intended to help beneficiary countries achieve the Millennium Development (MDG) goals. Using four key indicators of development, this paper assesses the impact of HIPC Initiative on countries that achieved the completion point. Our results, based on dynamic panel model estimations provide supporting evidence indicating the failure of the Initiative to produce the expected outcome.

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1. Introduction

In the 1980s, most developing countries adopted the structural adjustment program (SAP) under the supervision of the Bretton Woods Institutions. Officially speaking, SAP aimed to help low-income countries stabilize their public finances through drastic budget cuts in social expenditure. A decade after its inception, the public finance results expected from this policy did not mature into their full potential. As a result of this situation, social and economic indicators of most countries worsened, leaving them with a huge debt burden (Krugman 1988). To help address the issue of debt overhang, the Bretton Woods Institutions and the majority of creditors created the Heavily Indebted Poor Countries (HIPC) initiative. This program provides faster, deeper, and broader debt relief among poor countries. It also fosters poverty reduction and improves social conditions in the concerned countries. In the past few years, concerns that developing countries will achieve debt relief though HIPC have come to table. In 2011, a report by IMF and International Development Association (IDA) revealed that, while poverty reducing expenditures have increased by more than three percent on average between 2001 and 2010 and debt service payments declined, the HIPCs have made uneven and in some cases limited progress toward achieving the MDGs" (IDA and IMF, Stuff Report (2011), pp 11**).** Similar conclusions have been drawn by such authors as Temah (2009), Arslanalp and Henri (2006), Dessy and Vencatachellum (2007), as well as Heller (1999). Building on the dynamic panel data model, this paper discusses the impact of social policies under HIPC on key indicators regarding two defining issues of the United-Nations Millennium Development Goals (MDGs), such as education and health.

The HIPC initiative was launched in 1996 by the IFM and the World Bank to assist the developing countries which debt ratio GDP is between 200 and 250% and to provide additional resources for social sectors. However, many developing countries did not meet that threshold. Therefore, the ratio was lower to 150% in 1999 and the initiative was enhanced HIPC. In 2005, to help accelerate progress toward the United Nations Millennium Development Goals (MDGs), the HIPC Initiative was supplemented by the Multilateral Debt Relief Initiative. The MDRI allows the relief of 100 percent of debts by three multilateral institutions; the IMF, the World Bank, and the African Development Fund (AfDF), for countries completing the HIPC Initiative process.

Finally, in 2007, the Inter-American Development Bank (IaDB) also decided to provide additional ("beyond HIPC") debt relief to the five HIPCs in the Western Hemisphere.

The literature on the subject is quite poor because of the lack of sufficient data (Depetris Chauvin and Kraay 2005 and 2007). However, some studies have been undertaken since late 1990s.

Therefore, the result can be summarized within two categories. In the first one, there is no evidence that debt relief has had a positive impact neither on economic growth nor on investment rates or public spending (Heller 1999, Sun 2004, Depetris Chauvin and Kraay 2005, Arslanlp and Henry 2006, Dessy and Vencatachellum 2007, Kaddar and Furrer 2008, Nwachukwu 2008, Freytag and Pehnelt 2009, Gunter 2011). In fact, the main reasons of the failure of HIPC initiative are that : (i) the amount of debt relief released under HIPC is trivial, (ii) the lack of functioning economic institutions, (iii) HIPC initiative intrinsically contains an element of adverse selection that penalize countries which managed well their economies and have sustainable debt burdens; (iv) no guaranty that countries will not embark on a new borrowing binge and find themselves in the same situation years later; (v) freed-up resources may be overestimated if the country was only paying a fraction of debt service before debt relief; (vi) the social outcomes are not the direct target; and (vii) the public expenditure is fungible and there is no evidence that expenditure will increase for the targeted services.

Nevertheless, in the second category, there is positive evidence sustaining the relationship between debt relief and social outcomes such as education and health (Cuaresma and Vincelette 2010 and 2008, Temah 2009, Nafula 2002, Easterly 2002). The main reasons of the success are (i) spending time up to the completion point; (ii) the additional resources freed up to the social sector after the debt relief (poverty reduction expenditure); and (iii) better economic management from all undertaken structural reforms.

Moreover, some studies have focuses on some specific countries. Through the use of a general equilibrium macroeconomic model, Bayraktar & Fofack (2011) analyzed the dynamic of growth in post-HIPC era in Ethiopia. They found out a stagnation of real income, a persistence of large fiscal deficits and deterioration of external debt indicators. As of Uganda, LeBlanc and al. (2009) evaluated the impact of HIPC era, nine year post completion point. They found out that the proportion of people under the national poverty line declined from 34 percent in 2000 to 31.3 percent in 2006. The life expectancy at birth was around 49 years. Other key social indicators such as the primary completion rate, the primary schooling enrollment rate and the mortality under 5, have improved since 1990s. Somerville (2005) finds that the government of Uganda has increased the expenditure to the education sector by 2.5 percent since 2000. However, the results on health and water remain modest due to the privatization's approach of the sectors. This is also true about agricultural production and trade liberalization. For the case of Cameroon, Essama-Nssah and Bassole (2010) use a counterfactual analysis of the poverty impact of economic growth, find that poverty fell about 13 percent between 1996 and 2001. However, between 2001 and 2007, growth weakened significantly due to low productivity of sectors in the informal segment of the economy which slowed down the reduction rate from 13 percent to 1 percent. For the case of Bolivia, Lopez (2002) finds that the expenditures for poverty reduction purposes have increased substantially after the decision point in 1998 (especially for the social sectors such as education, health…). However, the achievement of the MDGs is far attainable due to its high costs and the lack of financing.

In this paper, the following indicators will be analyzed: the primary completion rate, the primary schooling enrollment rate, the life expectancy at birth, and the mortality rate under five. I use the dynamic panel data model to evaluate the effect full debt relief under the HIPC initiative on these indicators for the HIPCs countries in comparison to non HIPCs countries and the HIPCs countries with partial debt relief. Besides, the paper tries to bring new insights of the topic by using a rigorous scientific method to evaluate the impact of the HIPC initiative in comparison to other countries which are not eligible. The results may help policymakers to measure the gap between the actual situation to achieve the MDGs and the efforts that should be undertaken and maintained, in terms of sound reforms, in order to reach the targets of the MDGs by 2015 or later.

This paper finds that the HIPC initiative has positive effects on HIPC countries which have received full debt relief in comparison to non HIPC and those with partial relief. Studies show that the HIPC initiative has increased the primary completion rate by 14 percent, the primary schooling enrollment by 23 percent and the secondary schooling enrollment by 10 percent and the life span at birth by 5 percent. Besides, it has decreased the mortality rate under five by 192 percent.

The last part of the paper is organized as follows: Section 2 describes the data; section 3 presents the model; section 4 presents the empirical results; and section 5 concludes the study.

2. Data description

We collected data for 90 developing countries for the period spanning 1980 to 2011 from the World Bank website. The countries are selected based on their income levels according to the World Bank classification. We chose two categories of countries: low income and low middle income. Furthermore, our model specification included the following variables:

- Primary completion rate (percentage of the relevant age group): total number of new entrants in the last grade of primary education, regardless of age, expressed as percentage of the total population of the theoretical entrance age to the last grade of primary school;
- Primary schooling enrollment rate: is the total enrollment in primary education, regardless of age, expressed as a percentage of the population of official primary education age. It can exceed 100 percent due to the inclusion of over-aged and under-aged students because of early or late school entrance and grade repetition;
- Life expectancy at birth: indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life;
- Mortality rate under-5 (per 1,000 live births): probability per 1,000 that a newborn baby will die before reaching age five, if subject to current age-specific mortality rate.
- Government revenues (in percentage of GDP): are cash receipts from taxes, social contributions, and other revenues such as fines, fees, rent, and income from

government property or sales. Grants are also considered as revenue but are excluded here.

- Tax revenues (in percentage of GDP): refers to compulsory transfers to the central government for public purposes. Certain compulsory transfers such as fines, penalties, and most social security contributions are excluded. Refunds and corrections of erroneously collected tax revenue are treated as negative revenue;
- Growth rate of gross domestic products (annual percentage change on the GDP): is the annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2000 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions of depreciation of fabricated assets or of depletion and degradation of natural resources;
- Growth rate of Gross domestic products per capita in current US$ (annual percentage change on GDP per capita);
- Public expenditure on education as % of GDP: is the total public expenditure (current and capital) on education expressed as a percentage of the Gross Domestic Product (GDP) in a given year. Public expenditure on education includes government spending on educational institutions (both public and private), education administration, and transfers/subsidies for private entities (students/households and other privates entities);
- Total health expenditure (% of GDP): is the sum of public and private health expenditure. It covers the provision of health services (preventive and curative),

family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation;

- Public health expenditure (% of total health expenditure): refers to expenditure on health care incurred by public funds. Public funds are state, regional and local Government bodies and social security schemes. Public capital formation on health includes publicly-financed investment in health facilities plus capital transfers to the private sector for hospital construction and equipment; and
- Health expenditure per capita (current US$).
- We create a time-varying dummy variable HIPC, which equals one if the country has gotten the full debt relief; and zero otherwise.

3. Modeling Framework

We estimated the following four one-way error component models which have dependent variables:

- Primary completion rate (PCR)
- Primary schooling enrollment (PSE)
- Life span at the birth (LE)
- Mortality rate under-5 (MRU5)

The rest of variables were considered as independent variables:

- GDP growth rate (GROWTH)
- GDP per capita growth rate (GROWTHPC)
- Public spending on education (PSED)
- Public expenditure on health (PUHE)

- Total expenditure on health (HE)
- Health expenditure per capita (PRHE)
- Government Revenues (GR)
- HIPC

Model 1: $LPCR_{it} = \delta_1 PCR_{it-1} + X_{it}\beta_1 + \gamma_1 HIPC + u_i + \varepsilon_{it}$; (1)

Model 2: $LPSE_{it} = \delta_2 PSE_{it-1} + X_{it}\beta_2 + \gamma_2 HIPC + u_i + \varepsilon_{it}$; (2)

Model 3: $LLE_{it} = \delta_3 LE_{it-1} + X_{it}\beta_3 + \gamma_3 HIPC + u_i + \varepsilon_{it}$; and (3)

Model 4: $LMRU5_{it} = \delta_4 MRU5_{it-1} + X_{it}\beta_4 + \gamma_4 HIPC + u_i + \varepsilon_{it}$ (4)

Where $i = 1, \dots, 90;\ \ t = 1, \dots, 32;$

$X_{it} = [GROWTH,\ GRPWTHPC,\ GTR,\ GR,\ HE,\ PRHE, PUHE,\ PSED]$, $v_{it} = u_i + \varepsilon_{it}$ with $\mu_i \sim iid(0, \sigma_\mu^2)$, $\varepsilon_{it} \sim iid(0, \sigma_\varepsilon^2)$ and HIPC is the time-varying dummy variable, u_i is the country fixed effect, λ_t is the time fixed effect, and ε_{it} is the error terms.

Obviously, the estimation of the parameters of the models above faces the following econometric problems: (i) all lagged variables are correlated with u_i, which will make the ordinary least square (OLS) estimator biased and inconsistent even if v_{it} is not serially correlated; (ii) the fixed effect (FE) estimator will be also biased but consistent for long series ($T \to \infty$); and (iii) the random effect (RE) estimator will be also biased.

3.1. Problem of biasedness and inconsistency of OLS, FE, and RE estimators

Let rewrite the dynamic model in general for all our four models:

$$y_{it} = \delta y_{it-1} + x_{it}^{'}\beta + v_{it} \qquad (5)$$

where $v_{it} = \mu_i + \varepsilon_{it}$ with the same meaning as the model 1-4.

In matrix form, $Y = Z\theta + Z_\mu \mu + V$ (6)

where $\theta = \binom{\delta}{\beta}$, X=$(y_{it-1}\ x_{it}^{'})$, $Z = (\iota_{NT} \vdots X)$, $Z_\mu = I_N \otimes \iota_T$

$$\mu = \begin{pmatrix} \mu_1 \\ \mu_2 \\ \vdots \\ \mu_N \end{pmatrix},\ Z_\mu \mu = \begin{pmatrix} \mu_1 \\ \vdots \\ \mu_1 \\ \mu_2 \\ \vdots \\ \mu_2 \\ \vdots \\ \mu_N \\ \vdots \\ \mu_N \end{pmatrix}, \text{ and } \iota_{NT} = \begin{pmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{pmatrix}.$$

a) The OLS estimator

Since y_{it} is function of μ_i, $y_{it-1} = \delta y_{it-2} + x_{it-1}^{'}\beta + v_{it-1}$ is also function of μ_i. Therefore, if we run the regression of (6) to get the estimator of $\theta = \binom{\delta}{\beta}$, the OLS estimator will be biased and inconsistent.

$\hat{\theta} = (Z^{'}Z)^{-1}Z^{'}Y$ (6)

$\hat{\theta}$ is biased since $E(\hat{\theta}) = \theta + (Z^{'}Z)^{-1}Z^{'}Z_\mu \mu E(\mu|Z, Z_\mu)$ because $E(\mu|Z, Z_\mu) \neq 0$.

If $E(\mu|Z, Z_\mu) = 0$, there is no bias. Therefore, the OLS estimator may overestimate or underestimate (depending on the sign of the correlation between μ and X) the effect of independents variable on Y.

Moreover, the inconsistency of $\hat{\theta}$ is due to the fact that its variance will not converge in probability to the variance of θ.

b) The FE estimator

The RE estimator is derived from equation (6) by transforming through the subtraction of the group means from every observations and by running the regressing of the transformed observations.

$$\hat{\theta}_{FE} = (Z' M_\mu Z)^{-1} Z' M_\mu Y \qquad (7)$$

Where $M_\mu = I - Z_\mu (Z_\mu' Z_\mu)^{-1} Z_\mu'$

Let $P_\mu = Z_\mu (Z_\mu' Z_\mu)^{-1} Z_\mu'$, thus $M_\mu = I - P_\mu$,

$$M_\mu Y = \begin{pmatrix} Y_{11} - \overline{Y_{1.}} \\ Y_{12} - \overline{Y_{1.}} \\ \vdots \\ Y_{12} - \overline{Y_{1.}} \\ \vdots \\ Y_{N1} - \overline{Y_{N.}} \\ Y_{N2} - \overline{Y_{N.}} \\ \vdots \\ Y_{NT} - \overline{Y_{N.}} \end{pmatrix}, \text{ and } M_\mu Z = \begin{pmatrix} Z_{11} - \overline{Z_{1.}} \\ Z_{12} - \overline{Z_{1.}} \\ \vdots \\ Z_{12} - \overline{Z_{1.}} \\ \vdots \\ Z_{N1} - \overline{Z_{N.}} \\ Z_{N2} - \overline{Z_{N.}} \\ \vdots \\ Z_{NT} - \overline{Z_{N.}} \end{pmatrix}.$$

$M_\mu Y$ and $M_\mu Z$ expressions wipe out μ_i. However, the expression $(Z' M_\mu Z)$ and $(Z' M_\mu Y)$ still correlated with $\overline{\varepsilon_i}$ through ε_{it-1}. Therefore, $\hat{\theta}_{FE}$ is biased.

c) The RE estimator

The RE estimator is known as

$$\hat{\theta}_{RE} = (Z' \Omega^{-1} Z)^{-1} Z' \Omega^{-1} Y \qquad (8)$$

$$\text{Where } \Omega = \begin{bmatrix} \sigma_1^2 \begin{bmatrix} 1 & \cdots & 1 \\ \vdots & \ddots & \vdots \\ 1 & \cdots & 1 \end{bmatrix} + \sigma_V^2 I_T & 0 \ \cdots & 0 \\ 0 & \ddots & \vdots \\ 0 & \cdots & \sigma_N^2 \begin{bmatrix} 1 & \cdots & 1 \\ \vdots & \ddots & \vdots \\ 1 & \cdots & 1 \end{bmatrix} + \sigma_V^2 I_T \end{bmatrix}$$

Again, since Z includes v_{it-1}, so the expressions $(Z^{'}\Omega^{-1}Z)$ and $(Z^{'}\Omega^{-1}Y)$ is correlated with v_{it}. Therefore, $\hat{\theta}_{RE}$ is biased but consistent for $T \to \infty$.

3.2. The solution to the problems above

The solution to the problem of biasedness and inconsistency of OLS estimators, in one hand, and the biasedness of both RE and FE estimators has been proposed by many authors since 1981. The first solution was proposed by Anderson and Hsiao 1981. In fact, these authors suggested a method on two steps: (i) take the first difference of the model to wipe out μ_i, and then (ii) use the instrumental variables method to solve the problem of endogeneity of the lagged variable.

a) Anderson and Hsiao method

Let recall the model (5) $y_{it} = \delta y_{it-1} + v_{it}$ without the covariate x_{it}. Applying the Anderson and Hsiao 1981's method, we obtain on the first step (first difference of (5)):

$$\Delta y_{it} = \delta \Delta y_{it-1} + \Delta\varepsilon_{it}, \tag{9}$$

where $\Delta y_{it} = y_{it} - y_{it-1}$, $\Delta y_{it-1} = y_{it-1} - y_{it-2}$, $\Delta\varepsilon_{it} = \varepsilon_{it} - \varepsilon_{it-1}$, and $E(\varepsilon_{it}\varepsilon_{is}) = 0 \; \forall \; s \neq t \; and \; \sigma_\varepsilon^2 \; \forall \; t = s.$

Because y_{it-1} and ε_{it-1} are correlated, the OLS estimator of δ is biased and inconsistent. Therefore we need to get the instrument variables to get unbiased estimators.

The second step which consists in finding a variable instrument that is correlated with y_{it-1} and uncorrelated with ε_{it-1}. The authors proposed y_{it-2} as instrument variable because it has the two required conditions mentioned above for a good instrument. In fact, $y_{it-2} = \delta y_{t-3} + \varepsilon_{it-2}$ which does not depend on ε_{it} and ε_{it-1}. Besides, y_{it-2} and y_{it-1} are correlated since $y_{it-1} = \delta y_{t-1} + \varepsilon_{it-1}$. Therefore, the Anderson and Hsaio instrumental variable estimators can be written as follow:

$$\hat{\delta}_{AH} = (Z'X)^{-1}Z'X\Delta Y \tag{10}$$

where $Z = \begin{pmatrix} y_{1,1} \\ y_{1,2} \\ \vdots \\ y_{1,T-2} \\ \vdots \\ y_{N,1} \\ y_{N,2} \\ \vdots \\ y_{N,T-2} \end{pmatrix}$, X= $\begin{pmatrix} y_{12} - y_{11} \\ Y_{13} - y_{12} \\ \vdots \\ Y_{1T-1} - y_{1T-2} \\ \vdots \\ Y_{N2} - y_{N1} \\ Y_{N2} - y_{N2} \\ \vdots \\ Y_{NT-1} - y_{NT-2} \end{pmatrix}$, and $\Delta Y = \begin{pmatrix} y_{13} - y_{12} \\ Y_{14} - y_{13} \\ \vdots \\ Y_{1T} - y_{1T-1} \\ \vdots \\ Y_{N3} - y_{N2} \\ Y_{N4} - y_{N3} \\ \vdots \\ Y_{NT} - y_{NT-1} \end{pmatrix}$.

$\hat{\delta}_{AH}$ is unbiased and consistent. However, it is not necessary efficient because it does not make use of all available moment conditions and does not take into account the differenced structure on the residual disturbances $\Delta\varepsilon_{it}$.

Thus, Arellano and Bond 1991 proposed a more efficient estimation method which adds additional instrument variables depending on time period.

b) Arellano and Bond method

As Anderson and Hsiao method, Arrelano and Bond 1991 proposed a method in two steps:

- Take the first difference to get rid of μ_i and
- Use all the past information of y_{it} as instruments.

Let recall the modified model (5) as in point (a) $y_{it} = \delta y_{it-1} + v_{it}$ with all information mentioned above on. The first difference of later yields

$\Delta y_{it} = \delta\Delta y_{it-1} + \Delta\varepsilon_{it}$.

The possible instruments to estimate δ depend on time period. Let W_i be the instrument for y_{it-1} (matrix of $y_{it-1} - y_{it-2}$). For t=3, we get $(y_{i3} - y_{i2}) = \delta(y_{i2} - y_{i1}) + (\varepsilon_{i3} - \varepsilon_{i2})$. Thus, there is only one possible instrument which is y_{i1}.

For t=4, we get $(y_{i4} - y_{i3}) = \delta(y_{i3} - y_{i2}) + (\varepsilon_{i4} - \varepsilon_{i3})$. Thus, there are two available instruments which are y_{i2} and y_{i1}. We can repeat the same exercise up to t=T, $(y_{iT} - y_{iT-1}) = \delta(y_{iT-1} - y_{iT-2}) + (\varepsilon_{iT} - \varepsilon_{iT-1})$. Thus there are T-2 available instruments which are $y_{iT-2}, \cdots, y_{i1}$.

Let write down the matrix W_i of instruments as

$$W_i = \begin{bmatrix} y_{i1} & 0 & \cdots & \cdots & & \cdots & 0 \\ 0 & y_{i1}\, y_{i2} & 0 & \cdots & & \cdots & 0 \\ 0 & 0 & y_{i1}\, y_{i2}\, y_{i3} & 0 & & \cdots & 0 \\ \vdots & \vdots & 0 & & \ddots & 0 & \vdots \\ \vdots & \vdots & 0 & 0 & & \ddots & 0 \\ 0 & 0 & 0 & 0 & 0 & & y_{i1}\, y_{i2} \cdots y_{iT-2} \end{bmatrix}$$

W_i has the dimension of $\frac{(T-2)\times(T-2)(T-1)}{2}$.

But we still need to account for the differenced error term $\Delta\varepsilon_{it}$. The variance-covariance matrix of the error term $E(\Delta\varepsilon_i \Delta\varepsilon_i{}') = \sigma_\varepsilon^2 (I_N \otimes G)$,

Where $G = \begin{bmatrix} 2 & -1 & 0 & \cdots & \cdots & 0 \\ -1 & 2 & -1 & 0 & \cdots & \vdots \\ \vdots & -1 & \ddots & \ddots & 0 & \vdots \\ 0 & 0 & -1 & \ddots & \ddots & 0 \\ \vdots & \cdots & 0 & -1 & 2 & -1 \\ 0 & \cdots & 0 & 0 & -1 & 2 \end{bmatrix}$.

Since the instruments are orthogonal to the error by construction, we have the moment condition $E(W_i{}' \Delta\varepsilon_i) = 0$. There are $\frac{(T-2)(T-1)}{2}$ moment conditions for one parameter to estimate (δ).

To estimate δ by the generalized method of moments (GMM), we need to minimize the criterion $\overline{m}(\delta)' A \overline{m}(\delta)$ which states that the matrix A is a positive definite. Baltagi 2008 shows that the optimal matrix A to choose is V^{-1} where $V = W' \Delta\varepsilon_i \Delta\varepsilon_i{}' W$. Thus, the two-step Arellano and Bond 1981 GMM estimator is given by

$$\hat{\delta}_{AB} = (\Delta y_{-1}^{'} W V^{-1} W^{'} \Delta y_{-1})^{-1} \Delta y_{-1}^{'} W V^{-1} W^{'} \Delta y. \tag{11}$$

Now, let go back to the original model (5). In this model, we include the covariates of the variable y_{it-1} which is x_{it}. As in the case of modified model (5) above, we need two-steps. On the first one, we get rid of the μ_i through the first difference and the original model (5) becomes

$$\Delta y_{it} = \delta \Delta y_{it-1} + \Delta x_{it}^{'} \beta + \Delta \varepsilon_{it} \ . \tag{12}$$

On the second one, we need to find the instruments for all independent variables (y_{it-1}, and all x_{it}). The instruments for Δy_{it-1} are the same as before. However, there is two conditions to consider in order to find the instruments for Δx_{it-1}.

If $E(x_{it} \varepsilon_{is}) = 0 \ \forall \ s, t$, all the variables contained in x_{it} are strictly exogenous. Therefore, we do not need to find instruments for Δx_{it}.

Nevertheless, if $E(x_{it} \varepsilon_{is}) \neq 0 \ \forall \ s \geq t$, all the variable are predetermined. In this case, we need to find instruments for Δx_{it} depending on time period. It is a more reasonable assumption that the previous one.

Let $\mathrm{t} = 3$, there are $y_{i1}, x_{i2}, and \ x_{i1}$ instruments. We can repeat the same exercise up to $\mathrm{t} = \mathrm{T}$ to get the following instruments $y_{i1}, \cdots, y_{iT-2,} \ \ x_{i1}, \cdots, x_{iT-1}$.

$$W_i = \left(\begin{array}{cccccc|cccccc}
y_{i1} & 0 & 0 & \cdots & \cdots & 0 & x_{i1}x_{i2} & 0 & 0 & 0 & \cdots & 0 \\
0 & y_{i1}\, y_{12} & 0 & \cdots & \cdots & 0 & 0 & x_{i1}x_{i2}x_{i3} & 0 & \cdots & \cdots & 0 \\
0 & 0 & \ddots & 0 & \cdots & 0 & 0 & 0 & \ddots & 0 & \cdots & \vdots \\
\vdots & \cdots & 0 & \ddots & 0 & 0 & \vdots & \cdots & 0 & \ddots & 0 & \vdots \\
\vdots & \cdots & \cdots & 0 & \ddots & 0 & \vdots & \cdots & \cdots & 0 & \ddots & 0 \\
0 & \cdots & \cdots & \cdots & 0 & y_{i1} \cdots y_{iT-2} & 0 & \cdots & \cdots & \cdots & 0 & x_{i1} \cdots x_{1T-1}
\end{array}\right).$$

Comparatively, we could have used only one moment condition in order to estimate one parameter of the modified model (5) instead of using $\frac{(T-2)(T-1)}{2}$ moment conditions. Then, we can estimate $\Delta\varepsilon_{it}$ by $\Delta\hat{\varepsilon}_{it}$ to check if the instruments are valid ($E(W_i^{'}\Delta\varepsilon_i) = 0$). Sargan (1958) and Hasen (1982) proposed the test of overidentification conditions. The test checks the null hypothesis that $E(W_i^{'}\Delta\varepsilon_i) = 0$ against the alternative that $E(W_i^{'}\Delta\varepsilon_i) \neq 0$. The test has a χ^2 distribution with degree of freedom equal to the number of over-identifying restrictions.

Finally, it is important to check the validity of the instruments by testing whether they are uncorrelated with the ε_{it-1}.

4. The empirical results

The results of the estimation of the model 1-4 are presented in Table 1-4. We use two specifications as described above, related to the determination of the instruments. The first specification that we call DPM1 (Dynamic Panel Model 1) considers all covariate variables to the lagged variable as strictly exogenous. However, the second specification (DPM2) considers all covariate variables as predetermined. Moreover, following Sargan (1958), we carry out two diagnostic tests to check for overidentification restrictions and serial correlation issue.

Our estimated results show that HIPC have increased the primary education completion rate by 16 percent for the first specification. In terms of the sign (positive), our results are in line with the findings by Nafula (2002) who found that the HIPC initiative has increased the primary completion rate by 3%. Besides, the growth rate of per capita GDP increases only the primary completion rate by 0.4% which seems very low and the past rate increases the current one by 46% and 33% respectively for the second and first specifications. Nevertheless, there is not impact of HIPC on the primary completion rate according to the second specification. Moreover, the other covariate variables do not have any impact on the primary completion point for each specification. This may be due to the fact that the total expenditure on primary education is not considered in the model as explanatory variable. In addition to the later explanation, the majority of funds from donors available to developing countries are oriented to the social sectors, especially education and health. Therefore, the available and mostly scarce internal funds are reallocated to other sectors such as defense, infrastructures, corruption… The study of LeBlanc and al. (2009) in Uganda found that its government has increased the military spending since the completion point of HIPC through its internal resources in substitution of sectors of education and health because these sectors have been funded by the foreign donors.

The results from the Sargan and serial correlation tests performed on both estimated models fail to reject the null hypothesis. Therefore, the overidentification restrictions are valid and there is no serial correlation.

The results of the model 2 show that the completion point of HIPC has increased the primary schooling enrollment rate by 8% according to the second specification. The past rate has increased the current one by 56% and 70%, respectively for the first and second specifications. However, there is a contradiction on the impact of growth rate of GDP per capita between the two specifications. In fact, the first specification suggests that the per capita growth of GDP decreases the primary schooling rate by 0.7% and the second shows there is a positive impact of 0.2%. Even though there is contradiction, the impact is very low. As in the previous, other covariates are not significant.

The post estimation tests (Sargan and serial correlation) performed on the estimated model 2 indicate the null hypothesis cannot be rejected. Therefore, both specifications are valid and there is no serial correlation.

The results of the estimated model 3 suggest that the completion point of HIPC initiative has increased the life expectancy at birth by 2%. Also, the past number of years of life expectancy increased the current one by 88%. Besides, the growth rate of GDP per capita has very low impact on life expectancy at birth and both private and total health expenditure have a positive impact on life expectancy of birth. However, the tax revenues and the total public heath expenditure a have a negative impact on life expectancy by 0.2% and 0.1%, respectively. This corroborates LeBlanc and al. (2009) case in Uganda for the total public health expenditure. Moreover, the post estimation tests performed on the estimated model 3 fail to reject the null hypothesis for the second specification, but can run properly for the first specification. Therefore, the best specification is the second one.

Additionally, the results of the estimated model 4 shows that the HIPC initiative does not have any impact on mortality rate under-5. Besides, the past mortality rate increases the actual one by 94% to 98%. The total health and the private expenditures contribute negatively to the mortality rate under-5. This result may be explained by the fact that the health cares are not affordable to the majority of inhabitants of developing countries since the majority of them are poor. Also, the majority of people in these countries leaves in rural areas where there is no available hospital working properly or the available hospital is far from leaving area. In other hands, others factors can explain the results such as the lack of good sanitation, drinking water, foods…

5. Conclusion

This paper sought to evaluate the debt relief of developing countries under the HIPC initiative for the countries which have reached the completion point (full debt relief) before 2011, in comparison to other developing countries which have not reached the completion point or are not eligible for the initiative. To do so, the paper evaluated the HIPC initiative through the achievement of MDGs goals. Therefore four key indicators were chosen which are related to education and health: the primary completion rate, the primary schooling enrollment rate, the life expectancy at birth, and the mortality under five.

The paper finds that the HIPC initiative has contributed positively to the improvement of the three of the four chosen indicators. The strongest impact is on the primary completion rate (16%). Other indicators also have been improved. In fact, the primary enrollment rate has been improved by 7 percent in 11 years which is not sufficient to reach the target of the MDGs by 2015. Besides, the life expectancy at birth has improved by 2 percent during the period studied, which is also insufficient to achieve the target of the universal basic education by 2015. However, the initiative has not had any impact on a very important indicator on health, the mortality rate under five. This shows that all the reforms undertaken under the initiative have mitigated impact on the indicators under investigation. These results are closed to the previous independent evaluation of the IDA and the IMF (2011, 2006) as mentioned above. Nevertheless, the achievement of the MDGs need more reforms which should help the benefiting countries to maintain the momentum on their implementation.

It is worth mentioning that data availability has proven to be a limitation of this study. Thus, proxy variables were used in order to circumvent the issue of data availability.

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Appendix

Table 1 Estimation of the model 1

VARIABLES	(1) DPM1	(2) DPM2
L.lpcr	0.334***	0.463***
	(0.086)	(0.018)
HIPC	0.094	0.158***
	(0.108)	(0.017)
lgrowthpc	0.007	0.004**
	(0.009)	(0.002)
lgr	-0.028	-0.015
	(0.066)	(0.039)
lgtr	-0.068	0.031
	(0.071)	(0.039)
lpsed	0.103	0.011
	(0.109)	(0.007)
t2	-0.119**	-0.042**
	(0.048)	(0.019)
t3	-0.149***	-0.070***
	(0.051)	(0.019)
t4	-0.112**	-0.056***

	(0.045)	(0.016)
t5	-0.087*	-0.027*
	(0.048)	(0.015)
t6	-0.105**	-0.046***
	(0.042)	(0.014)
t7	-0.094**	-0.032**
	(0.043)	(0.015)
t8	-0.121***	-0.074***
	(0.040)	(0.014)
t9	-0.147***	-0.093***
	(0.048)	(0.013)
t10	-0.124***	-0.045***
	(0.046)	(0.016)
t11	-0.102**	-0.034***
	(0.045)	(0.013)
t12	-0.099**	-0.045***
	(0.043)	(0.012)
t13	-0.112**	-0.039**
	(0.044)	(0.016)
t14	-0.100**	-0.041***
	(0.048)	(0.015)
t15	-0.122***	-0.060***
	(0.046)	(0.015)
t16	-0.070	0.003
	(0.047)	(0.015)
t17	-0.080*	-0.012
	(0.046)	(0.014)
t18	-0.061	0.004
	(0.044)	(0.011)
t19	-0.034	0.002
	(0.039)	(0.015)
t20	-0.057	-0.025*
	(0.045)	(0.013)
t21	-0.055	0.003
	(0.043)	(0.012)
t22	-0.039	0.028*
	(0.040)	(0.015)
t23	-0.016	0.033***
	(0.032)	(0.012)
t24	-0.012	0.041***
	(0.030)	(0.012)
t25	-0.035	0.033***
	(0.025)	(0.011)
t26	-0.015	0.034***
	(0.022)	(0.013)
t27	0.006	0.044***

	(0.018)	(0.014)
t28	0.017	0.054***
	(0.019)	(0.013)
t29	0.006	0.047***
	(0.018)	(0.014)
t30	-0.000	0.040***
	(0.018)	(0.013)
t31	-0.002	0.047***
	(0.018)	(0.012)
Constant	2.917***	2.168***
	(0.434)	(0.090)
Observations	2,700	2,700
Number of countrycode	90	90
Adj. R-squared	.	.

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Test of overidentification conditions for DPM1

```
. estat sargan;

Sargan test of overidentifying restrictions

        H0: overidentifying restrictions are valid


        chi2(1669)   =  50.46856

        Prob > chi2  =    1.0000
```

Test of serial correlation for DPM1

```
. estat abond;


Arellano-Bond test for zero autocorrelation in first-differenced errors

  +-----------------------+

  |Order |  z     Prob > z|

  |------+----------------|

  |   1  |-3.8824  0.0001 |

  |   2  |-.33223  0.7397 |

  +-----------------------+

   H0: no autocorrelation
```

Test of overidentification conditions for DPM2

```
. estat sargan;

Sargan test of overidentifying restrictions

        H0: overidentifying restrictions are valid


        chi2(464)    =  52.16555

        Prob > chi2  =    1.0000
```

Test of serial correlation for DPM2

```
. estat abond;


Arellano-Bond test for zero autocorrelation in first-differenced errors

  +-----------------------+

  |Order |  z     Prob > z|

  |------+----------------|

  |   1  |-4.7855  0.0000 |

  |   2  | .05416  0.9568 |

  +-----------------------+

   H0: no autocorrelation
```

Table 2 Estimation of the model 2

VARIABLES	(1) DPDM2	(2) DPDM2
L.lpse	0.556*** (0.078)	0.699*** (0.019)

HIPC	0.031	0.077***
	(0.035)	(0.012)
lgrowthpc	-0.007*	0.002*
	(0.004)	(0.001)
lgr	-0.117	-0.008
	(0.074)	(0.019)
lgtr	-0.006	0.010
	(0.049)	(0.021)
lpsed	-0.033	0.005
	(0.040)	(0.007)
t2	-0.045	-0.005
	(0.028)	(0.009)
t3	-0.074***	-0.032***
	(0.024)	(0.008)
t4	-0.033	0.002
	(0.024)	(0.010)
t5	-0.075***	-0.038***
	(0.022)	(0.007)
t6	-0.067***	-0.024**
	(0.024)	(0.010)
t7	-0.061**	-0.018**
	(0.024)	(0.009)
t8	-0.051**	-0.012
	(0.023)	(0.011)
t9	-0.050**	-0.015*
	(0.023)	(0.009)
t10	-0.059**	-0.027***
	(0.023)	(0.010)
t11	-0.062***	-0.023***
	(0.023)	(0.009)
t12	-0.066***	-0.008
	(0.025)	(0.009)
t13	-0.058**	-0.020**
	(0.023)	(0.010)
t14	-0.055**	-0.017**
	(0.023)	(0.009)
t15	-0.047**	-0.006
	(0.023)	(0.009)
t16	-0.033	0.007
	(0.022)	(0.008)
t17	-0.021	0.016*
	(0.020)	(0.009)
t18	-0.025	0.018**
	(0.019)	(0.008)
t19	-0.041**	0.011
	(0.021)	(0.010)

t20	-0.038*	-0.003
	(0.021)	(0.009)
t21	-0.016	0.022**
	(0.019)	(0.008)
t22	-0.002	0.028***
	(0.017)	(0.008)
t23	0.004	0.030***
	(0.016)	(0.008)
t24	0.004	0.025***
	(0.016)	(0.008)
t25	0.021	0.039***
	(0.013)	(0.007)
t26	0.003	0.017**
	(0.012)	(0.007)
t27	0.006	0.020***
	(0.011)	(0.007)
t28	0.012	0.018**
	(0.010)	(0.007)
t29	0.019**	0.023***
	(0.009)	(0.008)
t30	0.021***	0.020***
	(0.008)	(0.007)
t31	0.031***	0.031***
	(0.010)	(0.009)
Constant	2.417***	1.331***
	(0.418)	(0.088)
Observations	2,700	2,700
Number of countrycode	90	90
Adj. R-squared	.	.

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Test of overidentification conditions for DPM1

```
. estat sargan;

Sargan test of overidentifying restrictions

        H0: overidentifying restrictions are valid


        chi2(1679)   =  42.02846

        Prob > chi2  =    1.0000
```

Test of serial correlation for DPM1

```
. estat abond;


Arellano-Bond test for zero autocorrelation in first-differenced errors

  +-----------------------+

  |Order |  z     Prob > z|

  |------+----------------|

  |   1  |-2.5377  0.0112 |

  |   2  | 1.7017  0.0888 |

  +-----------------------+

   H0: no autocorrelation
```

Test of overidentification conditions for DPM2

```
. estat sargan;

Sargan test of overidentifying restrictions

        H0: overidentifying restrictions are valid


        chi2(464)    =   55.0931

        Prob > chi2  =    1.0000
```

Test of serial correlation for DPM2

```
. estat abond;


Arellano-Bond test for zero autocorrelation in first-differenced errors

  +-----------------------+

  |Order |  z     Prob > z|

  |------+----------------|

  |   1  |-2.5149  0.0119 |

  |   2  | 1.6528  0.0984 |

  +-----------------------+

   H0: no autocorrelation
```

Table 3 Estimation of the model 3

VARIABLES	(1) DPDM1	(2) DPDM2
L.lle	0.889***	0.881***
	(0.026)	(0.004)
HIPC	-0.000	0.016***
	(0.002)	(0.001)
lgrowthpc	0.000**	0.000**
	(0.000)	(0.000)
lgr	0.001	0.001
	(0.002)	(0.001)
lgtr	-0.002	-0.002*
	(0.002)	(0.001)
lhe	0.004	0.008***
	(0.003)	(0.001)
lpuhe	-0.002**	-0.001***
	(0.001)	(0.000)
lprhe	0.001	0.006***
	(0.002)	(0.001)
t2	0.001	-0.009***
	(0.001)	(0.001)
t3	-0.001	-0.011***
	(0.001)	(0.001)
t4	0.000	-0.008***
	(0.000)	(0.001)
t5	-0.000	-0.009***
	(0.000)	(0.001)
t6	0.000	-0.009***
	(0.000)	(0.001)
t7	-0.013***	-0.009***
	(0.003)	(0.001)
t8	-0.012***	-0.007***
	(0.003)	(0.001)
t9	-0.013***	-0.010***
	(0.003)	(0.001)
t10	-0.012***	-0.009***
	(0.003)	(0.001)
t11	-0.010***	-0.008***
	(0.002)	(0.001)
t12	-0.012***	-0.009***
	(0.002)	(0.001)
t13	-0.012***	-0.008***
	(0.002)	(0.001)

t14	-0.012***	-0.008***
	(0.002)	(0.001)
t15	-0.012***	-0.007***
	(0.002)	(0.001)
t16	-0.010***	-0.003***
	(0.002)	(0.001)
t17	-0.010***	-0.003***
	(0.002)	(0.001)
t18	-0.009***	-0.002**
	(0.002)	(0.001)
t19	-0.008***	-0.002***
	(0.002)	(0.001)
t20	-0.008***	-0.000
	(0.002)	(0.001)
t21	-0.007***	-0.000
	(0.002)	(0.001)
t22	-0.006***	-0.001*
	(0.002)	(0.001)
t23	-0.005***	0.000
	(0.002)	(0.001)
t24	-0.005***	-0.001
	(0.001)	(0.001)
t25	-0.004***	-0.000
	(0.001)	(0.001)
t26	-0.003**	0.001
	(0.001)	(0.001)
t27	-0.002***	0.000
	(0.001)	(0.000)
t28	-0.002**	0.001
	(0.001)	(0.000)
t29	-0.001	0.002***
	(0.001)	(0.000)
t30	-0.001	0.001***
	(0.000)	(0.000)
t31	0.000	0.001***
	(0.000)	(0.000)
Constant	0.457***	0.475***
	(0.107)	(0.018)
Observations	2,700	2,700
Number of countrycode	90	90
Adj. R-squared	.	.

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Test of overidentification conditions for DPM1

```
. estat sargan;

Sargan test of overidentifying restrictions

        H0: overidentifying restrictions are valid

        cannot calculate Sargan test with dropped variables


        chi2(1467)   =         .

        Prob > chi2  =         .
```

Test of serial correlation for DPM1

```
. estat abond;

        cannot calculate AR tests with dropped variables


Arellano-Bond test for zero autocorrelation in first-differenced errors

  cannot calculate test with dropped variables

  +-----------------------+

  |Order |  z     Prob > z|

  |------+----------------|

  |   1  |      .       . |

  |   2  |      .       . |

  +-----------------------+

   H0: no autocorrelation
```

Test of overidentification conditions for DPM2

```
. estat sargan;

Sargan test of overidentifying restrictions

        H0: overidentifying restrictions are valid


        chi2(322)    =  68.45158

        Prob > chi2  =    1.0000
```

Test of serial correlation for DPM2

```
. estat abond;

Arellano-Bond test for zero autocorrelation in first-differenced errors

  +-----------------------+

  |Order |  z     Prob > z|

  |------+----------------|

  |   1  |-1.4504  0.1469 |

  |   2  | 1.8874  0.0591 |

  +-----------------------+

   H0: no autocorrelation
```

Table 4 Estimation of the model 4

VARIABLES	(1) DPDM1	(2) DPDM2
L.lmru5	0.978***	0.941***
	(0.035)	(0.005)
HIPC	-0.001	-0.000
	(0.008)	(0.001)
lgrowthpc	-0.000	0.000
	(0.001)	(0.000)
lgr	-0.003	-0.001
	(0.009)	(0.001)
lgtr	0.004	0.003*
	(0.005)	(0.002)
lhe	0.028	-0.007***
	(0.025)	(0.002)
lpuhe	-0.014	0.000
	(0.012)	(0.001)
lprhe	-0.011	-0.004***
	(0.011)	(0.001)
t2	0.035	0.068***
	(0.032)	(0.005)
t3	0.042	0.072***
	(0.032)	(0.005)
t4	0.034	0.058***
	(0.030)	(0.004)
t5	0.033	0.062***
	(0.029)	(0.004)
t6	0.020	0.056***
	(0.029)	(0.004)
t7	0.033	0.060***

	(0.027)	(0.004)
t8	0.033	0.058***
	(0.026)	(0.004)
t9	0.037	0.060***
	(0.026)	(0.004)
t10	0.032	0.055***
	(0.025)	(0.004)
t11	0.030	0.051***
	(0.024)	(0.003)
t12	0.036	0.056***
	(0.023)	(0.004)
t13	0.035	0.054***
	(0.022)	(0.004)
t14	0.035	0.054***
	(0.021)	(0.004)
t15	0.034	0.053***
	(0.021)	(0.003)
t16	0.028	0.045***
	(0.021)	(0.003)
t17	0.024	0.041***
	(0.020)	(0.003)
t18	0.023	0.040***
	(0.019)	(0.003)
t19	0.022	0.038***
	(0.018)	(0.003)
t20	0.019	0.034***
	(0.017)	(0.002)
t21	0.017	0.030***
	(0.016)	(0.002)
t22	0.015	0.028***
	(0.015)	(0.002)
t23	0.014	0.026***
	(0.013)	(0.002)
t24	0.014	0.024***
	(0.011)	(0.002)
t25	0.013	0.022***
	(0.010)	(0.001)
t26	0.011	0.019***
	(0.009)	(0.001)
t27	0.011	0.018***
	(0.007)	(0.001)
t28	0.009	0.014***
	(0.006)	(0.001)
t29	0.008*	0.012***
	(0.005)	(0.001)
t30	0.007**	0.011***

	(0.003)	(0.001)
t31	0.010***	0.013***
	(0.002)	(0.002)
Constant	0.022	0.206***
	(0.136)	(0.022)
Observations	2,700	2,700
Number of countrycode	90	90
Adj. R-squared	.	.

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Test of overidentification conditions for DPM1

```
. estat sargan;

Sargan test of overidentifying restrictions

        H0: overidentifying restrictions are valid

        chi2(1517)   =  44.85977

        Prob > chi2  =    1.0000
```

Test of serial correlation for DPM1

```
. estat abond;

Arellano-Bond test for zero autocorrelation in first-differenced errors

  +-----------------------+

  |Order |  z     Prob > z|

  |------+----------------|

  |   1  |-2.6971  0.0070 |

  |   2  |-.06329  0.9495 |

  +-----------------------+

   H0: no autocorrelation
```

Test of overidentification conditions for DPM2

```
. estat sargan;

Sargan test of overidentifying restrictions

        H0: overidentifying restrictions are valid

        chi2(464)    =  49.88047

        Prob > chi2  =    1.0000
```

Test of serial correlation for DPM2

```
. estat abond;

Arellano-Bond test for zero autocorrelation in first-differenced errors

  +-----------------------+
  |Order |  z     Prob > z|
  |------+----------------|
  |   1  |-2.6541  0.0080 |
  |   2  | .02515  0.9799 |
  +-----------------------+
   H0: no autocorrelation
```