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Identifying synergies and complementarities between MDGs: Results from cluster analysis

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Identifying synergies and complementarities between MDGs: Results from cluster analysis.

Abstract: The MDGs are interlinked: acceleration in one goal is likely to speed up progress in others. Nevertheless, these synergies are not always visible, and may differ across countries. Using bivariate cluster analysis, this paper investigates whether distinct groups of developing countries can be identified, using statistical methods, on the basis of the correlation of changes in main MDG indicators over the 1990-2008 period. Potential groups include: [1] "good performers", characterized by strong positive synergies in MDGs indicators; [2] "poor performers", where there are synergies in poor progress towards the MDGs and [3] "partial performers" countries where progress in one MDG went along with regress or stagnation in another. We then study the determinants of cluster membership. While growth in GDP per capita is, unsurprisingly, best able to distinguish between "good" and "poor" performers, a poor institutional framework and deteriorations in the income distribution is a notable correlate of partial progress, thus apparently undermining synergies in reaching the MDGs.
In light of the current discussions about the post-MDG system, our results suggest that synergies between MDG progress can be achieved but they cannot be taken for granted. Improving institutional performance and reducing inequality appear particularly important drivers of promoting such synergies.

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1. Introduction

While the MDGs were constructed as separate goals covering different aspects of the quality of life of people, it is clear that they are related to each other. But the extent of these synergies and the heterogeneity of these synergies across countries remains an open question.

This paper explores interlinkages and possible synergies among progress in different MDGs. It thereby builds, on the one hand, on the long-standing literature on the inter-linkages between health, education, poverty, and gender. For example, the analysis of possible causal relationships between female education and infant and child mortality has been one of the more thoroughly researched issues (starting with the pioneer works of Caldwell, 1979, Mosley and Chen, 1984 and Bourne and Walker, 1991).

On the other hand, it builds on the literature that is mainly focused on measuring achievement of the goals, on the speed of progress, and post-2015 projections (see among others: Abu-Ghaida and Klasen, 2004; Clemens et al., 2007; Lange and Klasen, 2011, White and Blöndal, 2007; Fukuda-Parr and Greenstein, 2010; Lay, 2010). In this context, various country classifications were used to assess progress, either using the pace of progress relative to the target path or other benchmarks (e.g. UNDP, 2004; Lange and Klasen, 2011).

Here we assess possible synergies and complementarities in progress towards different MDGs over the past two decades. More specifically, we seek to identify countries' performance in pairs of non-income MDG indicators applying cluster analysis and distinguish countries where the pair of indicators move in the same direction ('good' or 'bad' performers) from countries where the pair of indicators moved in opposite directions ('partial' performers); in the former case, we see this as evidence of synergies or complementarities in MDG achievement.[1] In particular our study applies measures of relative performance between 1990 and 2008 in MDG 2 (achieve universal primary education), MDG 3 (promote gender equality and empower women), MDG 4 (reduce child mortality) and MDG 5 (reduce maternal mortality). The focus on this specific subset of MDGs is justified by an abundant literature which –both at the micro and the macro level-has confirmed the presence of linkages existing between achievements in education, gender inequality, and health outcomes.[2]

A related attempt to classify countries using cluster analysis can be found in Anderson and Morrissey (2006) and Anderson (2007). Here the authors identify clusters of performers considering both levels and changes in some welfare indicators in order to identify groups of countries where both levels and progress is low and distinguish them from others. Our paper differs from this approach by focusing exclusively on *changes* in welfare indicators. Also, we focus on the MDG indicators to be able to specifically investigate synergies and trade-offs in

[1] Looking at pairs of MDGs indicators-instead of opting out for some overall achievement index- allow us to have a closer inspection on possible synergies which may uniquely derive from achievements in two different human development dimensions. Hence, we avoid the risk (intrinsic in more complex multidimensional indices) of losing precious information on the direction of improvements and on the strength of complementarities between related spheres of human development.

[2] Because of data availabibility constraints we were not able to include in our analysis any indicator for child malnutrition which is also been proven by the related literature to exhibit strong connections with the other MDGs indicators

achieving MDG progress. We also differ from the literature by using a relative performance indicator for MDG progress that considers the different and arguably unequal starting points of developing countries when measuring progress (e.g. Easterly 2008; Harttgen and Klasen, forthcoming; Lange and Klasen, 2011).

After having applied the cluster analysis to these relative performance measures, we then investigate the possible determinants of group membership. In particular, we look at some structural factors such as institutions, ethnic fractionalization as well as changes in political violence and in income levels and distribution and analyze how these can affect membership in these three groups. We find that growth in GDP per capita is particularly important in distinguishing between good and bad performers, while a poor institutional framework and deteriorations in the income distribution increase the likelihood of being a partial performer where synergies are lacking.

The identification of such linkages and complementarities between different MDGs is also of crucial importance for framing a post-2015 process. In the past years, indeed, the true multidimensional essence of the MDGs has been somewhat neglected and- as in the case of the MDG "costing exercise"- the millennium goals have been used as a tool to implement costly vertical programs which poured lots of financial resources for progress in singular indicators (see, as an example, the 2005 report from the UN Millennium Project headed by Jeffrey Sachs). The ongoing debate on the effectiveness of the so-called Millennium Villages testifies the weaknesses of this money-focused approach (see, for example, Clemens and Demombynes, 2011), and, indeed, such a narrow view totally glosses over the presence of transmission channels existing between the goals. At the same time, these linkages cannot be taken for granted and may differ across counties. As a result, a post-MDG system might want to explicitly build on existing linkages by devising a multidimensional goal system that explicitly incorporates the strength (or weakness) of existing synergies. It might also want to focus policy attention on strengthening these synergies.

This paper is structured as follows: section 2 provides an overview on possible synergies and interlinkages between MDGs. Section 3 presents the methodological framework applied to our data and discuss our results from cluster analysis. In section 4 we illustrate the results of multivariate regression analysis. Section 5 provides robustness checks and lastly our concluding remarks are stated in section 6.

2. Background: MDG synergies and linkages

Exploring linkages and possible synergies among different MDGs implies, basically, recognizing the existence of transmission channels that, working as catalyst forces, can speed up progress towards MDG achievements. The framework shown in Fig.1 presents graphically the subset of non-income MDGs that we analyze and the possible links which, according to previous literature, may generate complementarities in progress between them. For example, improving the share of girls in schools might speed up progress in achieving universal primary completion rates (MDG2) as educated women tend to invest more in the education of their children. Similarly,

greater female education reduces early marriage and improves health knowledge, thereby helping to reduce maternal mortality. While below we discuss some of the literature related to these linkages, it is important to emphasize that such synergies are likely to depend on country characteristics, the nature of policy interventions to reach MDGs, as well as the strength of particular transmission channels that link progress of different MDGs. There may also be time lags involved, an issue we examine in a robustness check below.

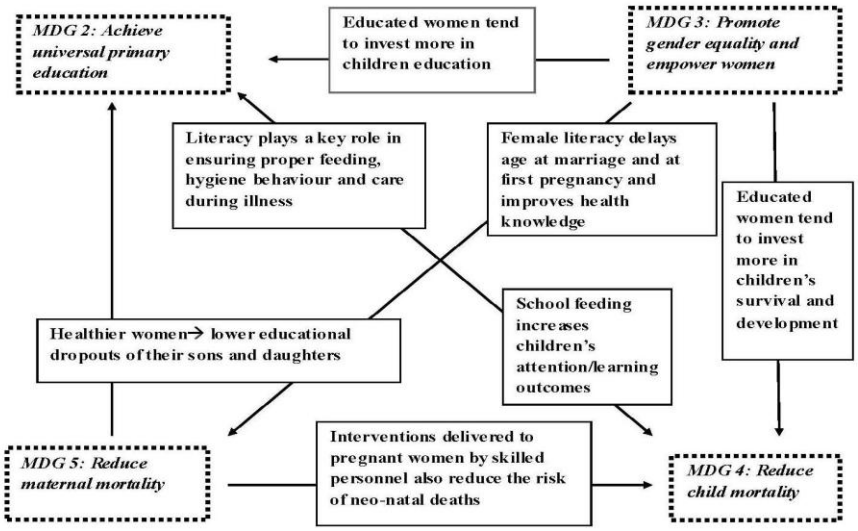

Fig. 1 Linkages and complementarities between the MDGs: an illustrative framework

A comprehensive and innovative contribution which attempts to directly investigate these interlinkages comes from the so called "MAMS studies" (see Bourguignon et al. 2008b). These are simulations based on an economy wide framework designed to analyze the interactions between services, MDGs, economic growth, and aid. Hence by directly examining how different goals can complement one another while at the same time competing for resources, these MAMS are able to identify strategies and policies which can hamper or raise intersectoral synergies. Moreover, there are many examples which can be provided in order to show the existence of this heterogeneous interdependence among MDGs. This framework provides an interesting *ex ante* assessment of the likely synergies and trade-offs that explicitly considers country characteristics.

Apart from this *ex ante* approach, there is a substantial literature that has posited (implicitly or explicitly) linkages between different MDG indicators. For example, a substantial theoretical and empirical literature has argued that closing the gender gap in education (MDG 3) can be regarded as a "leading" item among the MDGs by promoting income poverty reduction, child mortality reduction, and the education of children (see Summers, 1994, Abu-Ghaida and Klasen, 2004; Klasen, 2005, Lay and Robilliard, 2009).

With respect to possible synergies coming from reductions in child mortality (MDG 4), it is widely recognized that school feeding increases children's attention and learning outcomes (e.g. Kazianga, De Walque and Alderman, 2008).

As discussed in detail in King, Klasen, and Porter (2009), improving maternal health is a critical item for ensuring neonatal survival as well as the survival of under-five children.

Interventions delivered by skilled personnel in order to reduce maternal mortality will also help to lower the risk of deaths in the first month of life. Healthier, better nourished women would also presumably have fewer complications during pregnancy and childbirth. Moreover, better maternal health implies lower education drop out. This is true especially for girls who usually have to replace their mother in carrying on the household burdens and care of siblings.

Thus there is ample potential for synergies in MDG achievements. Policy interventions (such as broad-based health and nutrition programs) as well as structural factors can additionally affect such synergies by addressing several MDGs at the same time. On the other hand, this would imply that if complementarities and interlinkages among goals are not visible empirically, there must be some factor which delays or hampers those synergetic processes. For instance, in some cases intersectoral programmes have failed in raising synergies between health and educational spheres by focusing on narrow targets or compartmentalized programs (e.g. White and Masset, 2006).

It is also important to note that interdependencies between different human development spheres may even be stronger when achievements in some dimensions are done not only with respect to quantitative, easy-measurable targets (i.e. school enrolment or completion rates) but also with respect to outcomes related to quality. For example, many African countries have implemented since the mid '90s programmes devoted to achieve universal primary education, which mainly consisted in the elimination of school fees. But the evidence regarding the effectiveness of these programmes is quite mixed. For examples, while Nishimura et al. (2008) find that the Universal Primary Education policy in Uganda has contributed to increase enrolment and completion rates, they also point out the existence of internal inefficiency, raising concern of a possible deterioration in the quality of public primary schools[3] and also of a resulting inequality in the quality of education between different villages. Such effects might reduce or even eliminate possible synergies between education, poverty, and health goals. Also, the distribution of benefits among the population and the possible existence of inequalities in access to health or education may be a barrier to realize synergies. As suggested by Minujin and Delamonica (2003) in their analysis on the differentials in child mortality by wealth level and other social dimensions, in most of the cases, reductions in the average under five mortality rate is driven by the reduction experienced by the middle and top social groups. In such an environment, the benefits of these reductions only affect a minority or a population, thereby limiting potential synergies.

Despite the substantial theoretical case for large synergies between MDG goals, empirically the heterogeneity of the linkage of progress across different MDGs can be quite substantial as shown, for example, by Bourguignon et al. (2008a). They show that there is little correlation between poverty reductions and changes in under-five mortality rates or in primary school completion rates and hardly any correlation between progress in some pairs of non-income MDG indicators. Furthermore they also show evidence of lack of correlation between those non-income MDG indicators and GDP per capita growth suggesting that any progress along non-income MDG is less likely to be merely driven by economic growth. This rather negative result

[3] Analogous conclusions have been conveyed by Deininger, 2003

begs the question, however, whether one can identify clear clusters of countries where such synergies exist (and those where they do not exist), and what drives membership in these clusters.[4] This is indeed, the central subject of investigation in this paper.

3. Exploring inter-linkages between MDGs

3.1 Methodology

In a first step, we need to develop a measure of MDG progress. As argued by Easterly (2008) and others, performance on the basis of just absolute or proportional changes (or reductions in distance to target) can be misleading. For example, considering *absolute* changes, a reduction in maternal or child mortality in country A from 1000 to 950 will arguably be easier to achieve than a reduction from 100 to 50 in country B. Conversely, considering *relative* changes, a 5% reduction in mortality (50 in country A and only 5 in country B) will be harder to achieve when the initial level is very high as argued by, *inter alia*, Kakwani, 1992 (see also Lange and Klasen, 2011).

Similarly, when considering MDG 2, investments in primary education, may yield very high improvements in countries featuring low initial rates of enrolment, but as enrolment rates approach universal coverage, it may become ever harder to reach all out-of-school children. Indeed, as noted by Prennushi et al. (2002) "as a general rule, performances become more difficult as levels improve".

Moreover, individual performance should be also measured and judged by using as a frame of reference not ideally some abstract or predetermined target but considering some measure of real achievements expected given the initial level, hence global performance and deviations from its average could be taken into account. We try to solve these issues by following Anderson and Morrissey (2006) and using a "conditional" approach that mainly consists in using the residuals from a regression of the form:

$$\Delta y_i = \alpha + \beta y_i + e_i$$

Where -for country *i*,- y_i is the initial level of the indicator (i.e. in 1990 or earliest year available) and Δy_i are average relative annual change occurred over the 1990-2008 period. In this way, we take into account the fact that relative performance should be conditional on initial conditions in the country. Thus we define MDG progress in terms of relative performance indicators (RPIs) which describe the rate of change that exceeds the empirically 'expected' rate of change, given initial conditions, i.e. the residual e_i in the above equation.[5] Thus we are essentially asking whether countries that succeeded in achieving *extraordinary* progress in MDG achievements were benefiting from synergies or not. Since the MDGs were about accelerating progress to meet these welfare goals, we believe that this is a sensible way to proceed. This approach effectively ensures

[4] It is important to underline that our study relies on a narrow definition of synergy i.e. on the simultaneous achievements occurring in two dimensions which, deriving from strong complementarity in those two dimensions, would ensure that progress in one dimension will facilitate progress in another.

[5] For other ways to define progress, see Clemens et al. (2007) and Lange and Klasen (2011). The results here are largely robust to defining changes in these ways.

that when achievements in MDG2 and MDG3 are considered, the lower the starting level the higher the expected relative rate of improvement, suggesting sensibly that large relative improvements are easier for countries starting with low levels (also known as "catch-up effect". See fig. 1 and 2 in Appendix).

In contrast for the two health-related indicators (MDGs 4 and 5) the rate of reductions is expected to be lower for countries which started with higher initial levels. This mainly means that countries characterised by an initial heavy burden of under-five and maternal death rate would be expected to perform worse than others[6]. As a result, countries with high initial levels will look better in our progress measure if they were able to achieve more than the expected rates of reduction.

After defining progress, we turn to our cluster analysis. The method we apply to classify countries is bivariate cluster analysis. The main purpose of this method is the natural grouping of pairs of observations[7]. Several general types of cluster analysis methods are available depending on different types of distance measures.

First, in order to build clusters we use the Euclidian distance (ED) as a measure of similarity or dissimilarity between countries. Given that Δx and Δy are two relative performance indicators in country *i* and *j*, this measure of distance could be written as:

$$ED_{ij} = \sqrt{\left(\Delta x_i - \Delta x_j\right)^2 + \left(\Delta y_i - \Delta y_j\right)^2} \qquad (1)$$

Secondly, the distance between any two clusters should be determined. Here, we choose to apply the Ward's linkage approach. Hence, the method starts by identifying each cluster's central value (Δx_c, Δy_c):

$$(\Delta x_c, \Delta y_c) = \left(\frac{1}{n_c}\sum_{i=1}^{n} \Delta x_{ci}\ , \frac{1}{n_c}\sum_{i=1}^{n} \Delta y_{ci}\right) \quad (2)$$

where n_c is the number of countries in cluster *c* and Δx_{ci} and Δy_{ci} are two relative performance indicators computed over the relevant period for country *i* in cluster *c*.

After computing the sum of the squares of the distances between all countries in the cluster and the central value ("within-cluster" sum of squares), the distance between two clusters is computed as the increase in the error sum of squares after combining two clusters into a single cluster.

Lastly, the number of clusters should be determined. Here, as well, there are several rules that can be applied. We follow the Calinski-Harabasz rule (CH). Indeed, this is one of the most applied criterions in cluster analysis[8]. The aim here is to maximize CH(*c*) over the *c* clusters:

[6] With respect to this last point, it should be noted that, if absolute changes are regressed against initial levels a positive relationship is found (i.e. the greater the initial level, the larger is the associated rate of reduction). In other words, in absolute terms, in high mortality countries larger achievements are due to the immediate effect of some basic, cheap and easy-available policies whereas to reduce mortality rates even further would require much more efforts. While this affects the expected improvements, the residuals from these regressions are not dramatically different and do not materially affect the results of the cluster analysis.

[7] Cluster analysis is mainly an exploratory data-analysis technique. As stated by Everitt (1993) "Clustering methods are intended largely for generating rather than testing hypotheses".

[8] In a simulation study, Milligan and Cooper (1985) found that the Calinski-Harabasz criterion recovered the correct number of groups most frequently.

$$CH(c) = \frac{\frac{trace\ B}{(c-1)}}{\frac{trace\ W}{(n-c)}} \qquad (3)$$

where *trace B* is the between cluster sum of squares and cross-products matrix and *trace W* is the within clusters sum of squares and cross-products matrix . So, large values of Calinski -Harabasz pseudo-F index indicate distinct clustering.

3.2 Data

The Cluster analysis is applied to our relative performance measure between 1990 and 2008 in MDG 2 (achieve universal primary education), MDG 3 (promote gender equality and empower women), MDG 4 (reduce child mortality) and MDG 5 (reduce maternal mortality).

In order to compute this measure of performance we rely on data from the World Development Indicators (WDI) 2011 database for the primary completion rate and the female to male ratio of gross secondary school enrolment, and the under-five mortality ratio (deaths per 1,000), while the maternal mortality rate (per 100,000 live births) we take from Hogan et al. (2010). Our sample includes 142 countries classified by the World Bank as low or middle income in 2009.

3.3. Results from Cluster Analysis

We run six different bivariate cluster analyses taking into account all possible pairs of relative performance indicators obtained for the following MDG indicators:

1. Primary completion rate and child mortality rate;
2. Primary completion rate and maternal mortality rate;
3. Primary completion rate and the female to male ratio of gross secondary school enrolment;
4. Female to male ratio of gross secondary school enrolment and child mortality rate;
5. Female to male ratio of gross secondary school enrolment and maternal mortality rate;
6. Child mortality rate and maternal mortality rate.

For each analysis, figures 2-7 provided here below show the results in a graphical form, while in the Appendix Tables 5-10 report for each cluster the means and the range of changes in the two indicators as computed under the conditional approach (i.e. standardised residuals)[9]. We also report the list of countries found in each cluster (tables 5a-10a).

For the first analysis we find evidence of three distinct groups (see fig.2). A group of good performers ("1") is located at the bottom-right corner of the graph. The group is composed of 22 countries, all characterised by strong improvements in terms of reducing child mortality rate

[9] As a robustness check, we have repeated these bivariate cluster analyses using standardised residuals from regressions with absolute annual changes in given MDG indicators (instead of relative annual changes). Also, we have performed multivariate cluster analyses (with three indicators per each). Our original results appear quite robust even though the composition and the location of groups changes slightly.

and in increasing the primary completion rate. A second group of 22 countries ("2") show instead a partial performance i.e. where countries show improvements in education but hardly any improvements or even deteriorations in health. The bad performers ("3") appear at the top-left corner of the graph. In this group we see synergies, but in a negative sense with poor trends in health and education indicators[10].

When primary completion and maternal mortality (fig.3) are considered, we find evidence of four groups. The first two groups are larger (in terms of the number of countries included). These are the good performers ("1") and the partial performers ("2") that despite improvements in the education sphere did not reduce maternal mortality much.

While the third group can be regarded as poorly performing, the fourth group (containing only four observations) seems to show some deterioration in the education indicator while performance in the maternal mortality indicator is not as bad as in group "3".

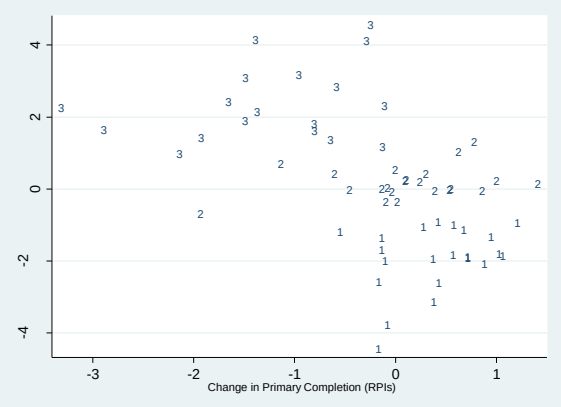

Fig. 2 Clusters of performers in primary completion and child mortality

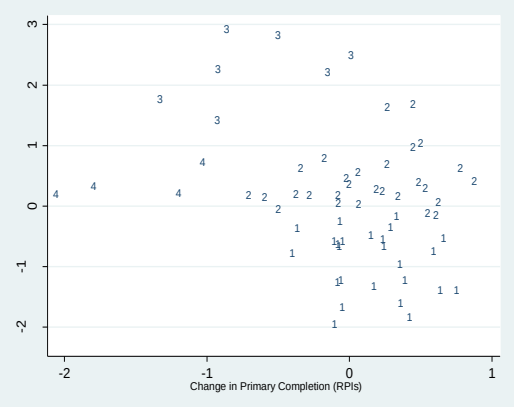

Fig. 3 Clusters of performers in primary completion and maternal mortality

A third cluster analysis uses the primary completion performance indicator and the gender gap in education performance indicator. Three main groups result: at the top right corner of the graph (fig.4), the good performers' ("1") is composed by 23 countries. An example of two countries belonging to this group can be illustrative: Mauritania seems to have been relatively fast in closing the gender gap at school (with an average relative annual change of more than 4%) and Togo (that has started with a low primary completion rate of roughly 35% in the 90s) has made large improvements in overall education. In these two countries progress in one dimension was accompanied by improvements in the other dimension. So, Togo also made some progress in reducing the gender gap at school (i.e. the average relative annual change was around 3.4%) and improvements in education have also been made in Mauritania given its low initial value in the primary completion rate in the 90s (around 30%).

On the other hand, there is a group ("2") of 29 countries in which performance has been not very good in the gender gap indicator, whereas improvements in the education-related indicator have been similar to the good performers' group (1). Lastly, 11 countries have been

[10] One needs to bear in mind that we are using our relative performance measure. So these countries with negative residuals in education might still have improved enrolment rates, but less than expected given initial conditions.

categorised as bad performers (group "3") in both indicators. This group includes mainly African countries among which Congo and Djibouti figure out as particularly bad performers.

When pairs of gender gap related indicator and child or maternal mortality indicator are analysed a clear unambiguous distinction between very good and very bad performers somehow vanishes and partial or "moderate" performers seem to be prominent.

Figure 5 shows the cluster analysis of the standardized residuals of both relative average annual changes in the female to male ratio of gross secondary school enrolment and in under-five mortality. The number of groups, as determined by the larger value of the Calinski/Harabasz pseudo F, is five. Group 1 identifies the "partial-good" performers, i.e. those countries which managed to reduce child mortality and almost closed the gender gap at school. A second group of "partial-good" performers identifies a set of 22 countries that despite larger improvements in the gender gap indicator did not attain large reductions in the under five mortality rate. Group 3 ("partial-bad" performers) has a mean value of the child mortality relative performance indicator that is pretty similar to the value of group 2 (see table 4 in the Appendix) but improvements in the gender gap indicator are much worse. This group is larger in terms of countries included and, interestingly, many transition economies belong to it. A fourth group of 13 countries is characterised by the "worst performers" in the gender gap indicator as well as in the under-five mortality rate performance indicator.

Lastly, a fifth group ("partial-bad") identifies 14 countries that despite experiencing positive changes in the gender gap relative performance indicator can be considered as the worst performers in child mortality. This group seems to unite heavily AIDS affected countries in Southern Africa (South Africa, Lesotho, Swaziland, and Zimbabwe) and a range of Pacific Island states.

Analysing countries' performance with respect to the educational gender gap and in maternal mortality (fig. 6) provides evidence of four possible clusters. Here again, group 1 identifies the "partial-good" performers, while there is a second group which shows a good mean performance in terms of maternal mortality reduction but not in terms of achievements in the gender gap indicator. Symmetrically, a group of 25 simultaneous bad achievers in maternal health and good performers' into the gender-equity dimension appears at the top-right of graph 6. Interestingly, the group featuring a joint bad performance in the two indicators gathers some of the very least developed economies (i.e. Sierra Leone, Congo, Central African Republic) as well as many transition economies (i.e. Azerbaijan, Bulgaria, Kyrgyz Republic or Ukraine among others).

Lastly we consider possible synergies in the achievement of maternal and child mortality goals (fig.7). The Calinski/Harabasz rule suggests evidence of four distinct clusters. There is a group of good performers (group "1") that is characterised by large reductions in both indicators (i.e. relative performance indicators are both ranged below the zero-mean). Conversely, at the top-right corner of graph 10 we can find a group of bad performers mainly composed by sub-Saharan African countries (15 out of 20). At the top-left corner of the graph a group of partial performers is located. These are countries in which progress in the maternal mortality dimension has been accompanied by little progress in the child mortality dimension. Conversely, a fourth group of 50 countries shows improvements in the child mortality goal but not in the maternal mortality one.

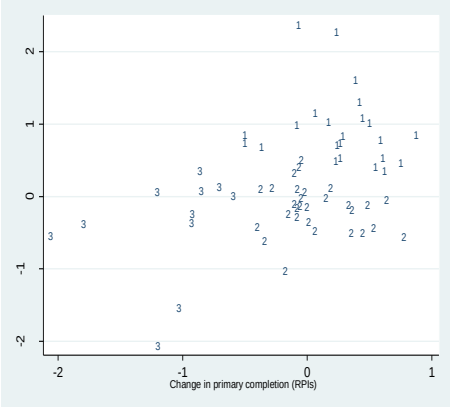

Fig. 4 Clusters of performers in educational gender gap and education

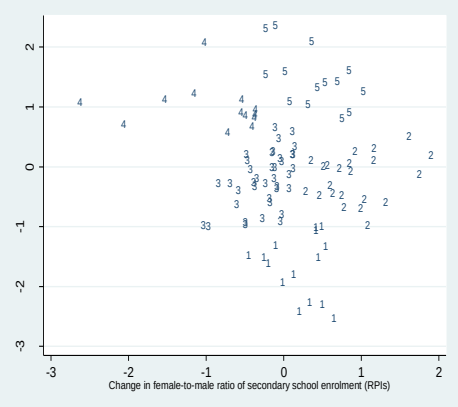

Fig. 5 Clusters of performers in educational gender gap and child mortality

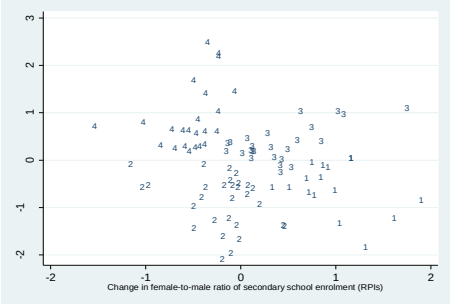

Fig. 6 Clusters of performers in educational gender gap and maternal mortality

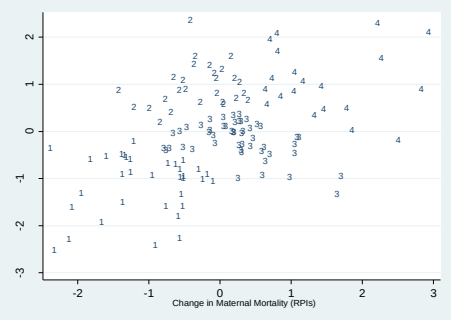

Fig. 7 Clusters of performers in maternal mortality and child mortality

An overview of performance in all of the six bivariate cluster analyses is provided in Table 1, where we list how often countries show up in the 'good', the 'bad', and various forms of 'partial' clusters.[11] While countries like Cape Verde, China, Iran, Laos, Malaysia, Nepal, Syria, Tunisia and Turkey can be highlighted as countries where there are mostly positive synergies in the sense of belonging to the 'good' performance clusters, a group of sub-Saharan countries (Congo, Congo DRC, Swaziland, Central African Republic, Cameroon, Burundi, South Africa and Zimbabwe) plus Guyana have 'negative' synergies and find themselves in the bad cluster in most or all of the analyses. On the other hand, many Latin American countries (like Colombia, Costa Rica, Paraguay, Venezuela and Uruguay) consistently fall in the grey area of partial performance; and transition countries are notable for appearing in a broad range of categories, suggesting that their performance is really quite dependent on the indicator chosen. While we already examined cluster membership in a descriptive sense, it would be useful to have a more formalized assessment of determinants of cluster membership. This is a subject to which we now turn.

[11] Here we only show countries for which we were able to do all six cluster analyses; for all other countries, please see the individual cluster analyses in the appendix.

Table 1 Overview of joint performance

COUNTRY	"Good"	"Partial-good"	"Truly Partial"	"Partial-bad"	"Bad"
Algeria	2	1	3		
Belarus			5	1	
Bolivia	3		2	1	
Botswana			2	1	3
Bulgaria			4	1	1
Burkina Faso			4	1	1
Burundi			1	1	4
Cameroon					6
Cape Verde	4	1	1		
Central African Republic			1	1	4
Chad	1		3	1	1
China	4	1	1		
Colombia	1		5		
Congo, Dem. Rep.				1	5
Congo, Rep.			2		4
Costa Rica			5	1	
Cuba	1		3	1	1
El Salvador	3	1	2		
Ghana			4	1	1
Honduras	1	1	4		
India	2	1	3		
Indonesia	2		4		
Iran, Islamic Rep.	4	1	1		
Jamaica			3	1	2
Jordan	2		3	1	
Lao PDR	3	1	2		
Madagascar			4	1	1
Malaysia	3	1	2		
Mauritius	1		3		2
Mexico	2	1	3		
Morocco	3		2	1	
Mozambique	1		3	1	1
Nicaragua	2		4		
Niger	3	1	2		
Papua New Guinea	1	1	2	1	1
Paraguay			5	1	
Philippines	1	1	4		
Poland	3		2	1	
Romania	3		2	1	
Sao Tome and Principe	2	1	1	1	1
Senegal			3	1	2
Solomon Islands	2	1	2	1	
South Africa			1	1	4
Sri Lanka	1		4	1	
St. Lucia	1		4	1	
Swaziland				1	5
Syrian Arab Republic	4		2		
Tanzania			4	1	1
Togo	1		5		
Tonga	1		4	1	
Tunisia	4	1	1		
Ukraine			3		3
Uruguay			5	1	
Venezuela, RB			5	1	

Note Figures reported in cells show the number of cluster analyses for which a given country was identified as “good”, “partial good”, “truly partial”, “partial bad” or “bad”. The categories “partial-good” and “partial-bad” emerged only in three bivariate cluster analyses and identify countries showing Little change in one indicator and sizable improvements (partial-good) or deteriorations (partial-bad) We only show countries for which we were able to perform all six cluster analyses; see the individual cluster analyses in the appendix for all other countries.

4. Correlates of cluster membership

In this section we use multinomial logit models to examine the determinants of cluster membership. In particular we investigate the effects of initial (i.e. early 90s) conditions.

While the literature on the determinants of economic performance is abundant and provides with a long set of possible determinants of performance, here the dependent variable consists of cluster membership on the basis of performance in progress in pairs of non-income indicators.

Our interest is mainly directed towards the effect of institutions, history and the misallocation of resources. Thus we seek to analyze whether these factors affect synergies or trade-offs in MDG progress.

The set of covariates we retained in our analysis includes:

- *Institutions*, measured in terms of government effectiveness. This is an index that could be defined as "the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies" (source: Kaufmann and Kraay, 2003). We refer to the 1996 value that is first year available;
- *Heterogeneity*: measured by the index of ethno-linguistic fractionalization provided by Alesina et al. (2003);
- *HIV-prevalence*: given by the percentage of population aged 15-49 who are HIV positive in the early 90s. (Source: WDI, 2011)
- *Female education relative to male education:* measured by the female to male ratio of average years of schooling. (Source: author's calculation based on Barro and Lee (2010)).

We also take into account changes that occurred in the GDP per capita and in the distribution of income. Further, the effect of conflict and political violence is considered in dynamic terms:

- *Income Inequality:* absolute changes in the Gini index of income inequality during the 1990-2008 period serve as proxy variable (source: Povcal);
- *Economic Growth:* given by the average annual rate of growth in GDP per capita during the 1990-2000 period. (Source: WDI, 2011);
- *Conflict:* measured by change in main episodes of political violence occurred during the first decade analyzed (1991-2001) and over the whole period (1991-2008). (Source: Monty G. Marshall in CSP, 2011).

On the basis of the six cluster analyses presented above we run multinomial logistic regressions, considering membership to the good performer group as a reference category. Just in two cases (cluster analyses on educational gender gap and child mortality and educational gender gap and maternal mortality) we use the worst performers group as a reference category.[12]

[12] While the identification of a group of bad performers is pretty clear in these last two cases, defining a group of best performers to be used as a reference category is not straightforward.

One should point out that we have rather small numbers of observations and multicollinearity can be a problem here. Thus the results should be interpreted with some caution. Furthermore, as it is likely that observations belonging to the same region might violate the assumption of independence, we run our regressions correcting for the effects of clustered data and thus obtaining robust standard errors. Our results seem to be robust to other specifications (i.e. inclusion of regional dummies).

Table 2 shows the results of multinomial logistic regressions for membership in clusters of performers in education and child health. We report always on two specifications, one with GDP growth and one without; the latter specification implies that the effects of some of the independent variables (e.g. institutions, conflict, or income inequality) affect cluster membership via their effect on economic growth. As is shown below, the specifications without growth tend to show larger and more significant effects.

High growth reduces the likelihood of being in the group of partial or poor performers. When growth is left out, the regressions show that increases in inequality, poor institutions, and high HIV prevalence increase the likelihood of belonging to a partial performer (with poor synergies).

Results for membership in clusters of performers in education and maternal health (see table 3) suggest that three main factors could have influenced the partial performance (i.e. relative bad achievements in terms of maternal mortality reduction but not in terms of primary completion rates): increasing levels of political violence, high rates of HIV prevalence, and poor female/male education ratios. Lower rates of economic growth are correlated instead with the two groups of bad performers.

Table 4 shows results for regressions run on membership in clusters of performance in education (improvements in primary completion rate) and gender gap at school (improvements in closing the female to male ratio of secondary school enrolment). The higher the increase experienced in income inequality the more likely will be the risk of experiencing a trade-off in the two dimensions, i.e. of advancing towards universal primary education but lagging behind in terms of ensuring gender parity at secondary educational level. This shows that rising inequality can significantly disrupt synergies between MDG achievements in the education field. Moreover, we find a positive effect of female years of education on the likelihood to belong to the partial performer group. This is suggests that countries with relatively low initial gender gaps in schooling performed relatively worse in further closing gender gaps, relative to their success in overall educational expansion. Lastly, the group of partial performers is associated with a decrease in main episodes of political violence. This result seems to be driven mainly by countries which – until the early 90s- all experienced dramatic episodes of civil or ethnic conflict (i.e. South Africa, Sri Lanka, Turkey and Mozambique) or of political unrest (i.e. El Salvador and the Philippines), with strong negative repercussions on the education system. Once these countries embarked on a transition path towards more peaceful regimes, all the progress made in the reconstruction of the education system necessarily appeared to be relatively fast even though the efforts made in closing the gender gap at school have been, at best, less remarkable.

Table 2 Education and Child Mortality. Effects of country characteristics on group membership

	G2: Partial Performers (child mortality-lopsided)		G3: Bad performers	
Economic Growth	-0.50*		-0.64*	
	-1.89		*-1.69*	
Conflict	0.08	0.38	0.15*	0.32***
	-0.49	*-1.13*	*-1.73*	*-3.89*
Income inequality	0.97	1.54*	-0.72	-0.26
	-1.31	*-1.71*	*-1.59*	*-0.35*
Female Education	2.90***	-3.05***	1.24	-3.14
	-2.86	*-4.42*	*-0.69*	*-1.39*
Institutions	-0.16	1.69**	-0.16	0.62
	-0.21	*-2.56*	*-0.18*	*-1.03*
Fractionalization	-0.02	-0.07***	0.01	-0.03
	-1.17	*-3.13*	*-0.26*	*-0.91*
HIV		0.57**		0.68*
		-2.28		*-1.76*
N	51	35	51	35

Note: * p<0.10, ** p<0.05, *** p<0.01. T.stat in italics. Group 2 (child mortality lopsided) is the cluster of partial performers featuring improvements in education and any improvement or even deterioration in child mortality indicator. Left-out category: Good performers.

Table 3 Education and Maternal Mortality. Effects of country characteristics on group membership

	G2: Partial Performers (maternal mortality-lopsided)		G3: Bad Performers		G4: Partial-Bad performers	
Economic Growth	0.08		-2.04**		-9.96***	
	-0.11		*-2.01*		*-13.52*	
Conflict	1.39***	1.44***	1.16***	1.50***	12.29***	15.19***
	-4.89	*-5.44*	*-2.69*	*-5.49*	*-14.58*	*-15.77*
Income inequality	-0.92	-0.99	-1.49	-0.68	-7.31***	-3.05*
	-0.53	*-0.58*	*-1.05*	*-0.44*	*-4.75*	*-1.78*
Female education	-6.73**	-7.37**	-5.91*	-7.03**	-40.99***	-131.21***
	-2.10	*-2.17*	*-1.86*	*-2.10*	*-14.31*	*-20.94*
Institutions	-1.12	-1.09	3.77	1.69	1.57	-46.53***
	-0.34	*-0.47*	*-0.98*	*-0.72*	*-0.52*	*-7.55*
Fractionalization	-0.10***	-0.10***	-0.13***	-0.10***	-0.35***	-1.01***
	-2.92	*-3.62*	*-3.80*	*-3.54*	*-12.57*	*-20.08*
HIV	5.73**	6.05*	6.62**	6.72**	8.30***	16.86***
	-2.06	*-1.89*	*-2.48*	*-2.2*	*-3.11*	*-5.34*
N	34	34	34	34	34	34

Note: * p<0.10, ** p<0.05, *** p<0.01. T.stat in italics. Group 2 (maternal mortality lopsided) is the cluster of partial performers featuring improvements in education and any improvement or even deterioration in maternal mortality indicator. Left-out category: Good performers.

Table 4 Education and Educational Gender Gap. Effects of country characteristics on group membership

	G2: Partial Performers (education-lopsided)			G3: Bad Performers		
Economic Growth	0.29		0.08	-1.82*		-1.60**
	-0.71		*-0.19*	*-1.78*		*-2.20*
Conflict	-0.32***	-0.34***	-0.28***	-0.41	-0.11	-0.66
	-6.20	*-4.92*	*-2.86*	*-0.42*	*-0.45*	*-0.61*
Income inequality	2.72	2.4	2.57*	-4.29	-1.93	-4.48
	-1.47	*-1.49*	*-1.83*	*-0.73*	*-0.74*	*-0.83*
Female education	5.68**	4.36	3.27	6.78	0.89	7.89
	-2.12	*-1.49*	*-1.24*	*-0.99*	*-0.63*	*-1.38*
Institutions	-0.05	0.69	0.69	-1.25	-2.4	-1.45
	-0.22	*-0.89*	*-1.08*	*-0.39*	*-1.04*	*-0.54*
Fractionalization	0.03	0.02		-0.02	-0.02	
	-0.75	*-0.61*		*-1.00*	*-1.05*	
HIV	0.09	0.12	0.24	-0.37	0.07	-0.45
	-0.57	*-0.84*	*-1.63*	*-0.42*	*-0.22*	*-0.64*
N	32	32	32	32	32	32

Note: * p<0.10, ** p<0.05, *** p<0.01. T.stat in italics. Group 2 (education lopsided) is the cluster of partial performers featuring improvements in education and any improvement or even deterioration in educational gender gap indicator. Left-out category: Good performers.

Considering the possible drivers of synergies in clusters of performers in educational gender equity and maternal health (table 5), we observe from the analysis that while there are two groups of partial performers (group 2, relatively good in achievements in maternal health and group 3, relatively good in the gender dimension), one group (4) clearly performing bad in both dimensions, and another group (1) of "partial-good" countries showing large improvements in the gender dimensions but narrow improvements in maternal health, there is no clear picture of joint good performance at all Hence, as pointed out above, the reference group is the group of worst performers. Interestingly, here again, the two truly partial performers have experienced a deterioration in the income distribution. In other words, as income inequality rose, improvements in closing gender gaps or in reducing maternal mortality did not promote the other goal.

Also, partial performance in the bi-dimensional cluster of child health and gender equity (taking the worst group as the benchmark) seems to be associated with increase in income inequality whereas a key driver for joint bad performance (i.e. our reference category) can be found in the poor institutional framework (see table 6).

Lastly, results displayed in table 7 for membership in cluster of performers in both child and maternal health suggests that three main factors would increase the risk of partial performance: low institutional level, high HIV prevalence and increasing levels in political violence during the first decade. Moreover, we find a positive correlation between initial levels of female education and bad performance. This last finding is a bit surprising to us since we expected that the effect of female education would benefit both child health and education. This result seems to be driven by a small group of countries such as South Africa, Swaziland, Kenya, Jamaica, Gabon, Panama, Fiji, Ukraine, Tonga, Zimbabwe and Congo that- despite having started with a relatively high average female years of schooling- experienced the largest increase in child mortality rates. This fact is probably highly due to high infectious disease prevalence including HIV/AIDS, wars, epidemics and famines.

Table 5 Educational Gender Gap and Maternal Mortality. Effects of country characteristics on group membership

	G1: Partial-Good Performers (educational gender equity - lopsided)		G2: Partial Performers (maternal health-lopsided)		G3: Partial Performers (educational gender equity-lopsided)	
Economic Growth	0.55***		1.07**		0.31	
	-4.53		*-2.04*		*-0.72*	
Conflict	0.65	0.39	-0.93	-0.48*	1.75***	1.61***
	-1.47	*-1.46*	*-1.13*	*-1.77*	*-8.89*	*-14.14*
Income inequality	4.54***	3.96***	10.63***	7.96***	5.56***	4.76***
	-24.48	*-10.18*	*-2.98*	*-4.62*	*-4.93*	*-9.55*
Female education	-8.41**	-6.91	24.35	12.15**	-3.06	-2
	-1.98	*-1.60*	*-1.3*	*-2.2*	*-0.59*	*-0.71*
Institutions	-0.15	1.32	-1.54	-0.05	0.56	0.95
	-0.06	*-0.72*	*-1.35*	*-0.07*	*-0.63*	*-0.86*
Fractionalization	-0.04	-0.03	-0.02	-0.03	-0.01	-0.01
	-0.96	*-0.85*	*-1.62*	*-1.28*	*-0.33*	*-0.36*
HIV	0	0.05	-0.58***	-0.50***	-0.50**	-0.46***
	-0.1	*-0.46*	*-5.36*	*-7.24*	*-2.34*	*-2.74*
N	40	40	40	40	40	40

Note: * p<0.10, ** p<0.05, *** p<0.01. T.stat in italics. Group 2 (maternal health lopsided) is the cluster of partial performers featuring improvements in the maternal mortality indicator and any improvement or even deterioration in the educational gender gap indicator. Group 3 (educational gender equity lopsided) is the cluster of partial performers featuring improvements in the educational gender gap indicator and any improvement or even deterioration in the maternal mortality indicator. Left-out category: Bad performers.

Table 6 Educational Gender Gap and Child Mortality. Effects of country characteristics on group membership

	G1: Partial-Good Performers (child health-lopsided)		G2: Partial-Good Performers (educational gender equity-lopsided)		G3: Partial-bad Performers (educational gender gap-lopsided)		G5: Partial Bad Performers (child mortality-lopsided)	
Economic Growth	0.67		0.34		0.21		-0.08	
	-0.69		*-0.33*		*-0.21*		*-0.1*	
Conflict	-1.06	-0.93***	-0.79	-0.61	-1.05	-0.87	-1.07	-0.89
	-0.96	*-3.02*	*-0.64*	*-1.36*	*-0.78*	*-1.53*	*-0.74*	*-1.29*
Income inequality	1.15***	1.25**	2.16***	2.19***	2.15***	2.06*	1.23	1.07
	-2.73	*-2.21*	*-3.66*	*-13.41*	*-2.71*	*-1.65*	*-1.57*	*-0.76*
Female education	-2.67	-2.48*	-5.63***	-5.70***	-4.05***	-3.99**	0	-0.17
	-1.04	*-1.74*	*-3.90*	*-4.74*	*-4.08*	*-2.42*	*0*	*-0.05*
Institutions	2.83	4.12	4.21	4.92	3.41*	3.82	4.54	4.3
	-1.31	*-1.17*	*-1.4*	*-1.12*	*-1.78*	*-1.16*	*-1.15*	*-0.94*
Fractionalization	0	-0.02	0	0	-0.02	-0.02	-0.04***	-0.04
	-0.04	*-0.61*	*-0.02*	*-0.07*	*-0.37*	*-0.47*	*-2.58*	*-1.56*
HIV	-0.21	-0.18	0.07	0.12	0.01	0.04	-0.09	-0.03
	-0.59	*-0.45*	*-0.42*	*-0.54*	*-0.07*	*-0.16*	*-0.55*	*-0.14*
N	44	44	44	44	44	44	44	44

Note: * p<0.10, ** p<0.05, *** p<0.01. T.stat in italics. Groups 1 and 2 are the cluster of partial –good performers featuring relatively better achievements in child health ("child-health lopsided") or in the educational gender gap indicator ("educational gender equity lopsided").Groups 3 and 5 are the cluster of partial –bad performers featuring any improvement or even deterioration in the educational gender gap indicator ("educational gender gap lopsided") or in the child mortality indicator ("child mortality lopsided"). Left-out category: Bad performers.

Table 7 Child Mortality and Maternal Mortality. Effects of country characteristics on group membership

	G2: Partial Performers (child mortality-lopsided)		G3: Partial Performers (maternal mortality - lopsided)		G4: Bad Performers	
Economic Growth	-0.22		0.11		-0.41	
	-1.24		*-0.37*		*-0.86*	
Conflict	0.77	0.72*	0.25	0.23	0.67	0.46*
	-0.96	*-1.81*	*-0.79*	*-0.76*	*-1.4*	*-1.77*
Income inequality	-1.39	-1.48	-1.41	-1.33	-1.36	-1.41
	-1.21	*-1.19*	*-1.34*	*-1.57*	*-1.11*	*-1.30*
Female education	-0.77	-1.44	0.15	0.38	5.41***	5.23**
	-0.21	*-0.39*	*-0.08*	*-0.18*	*-3.14*	*-2.12*
Institutions	-0.87	-1.16	-0.60*	-0.48	1.02	0.18
	-0.95	*-1.55*	*-1.91*	*-0.91*	*-0.74*	*-0.19*
Fractionalization	-0.01	-0.01	0.02	0.02	0.04*	0.05**
	-0.32	*-0.35*	*-1.11*	*-1.34*	*-1.65*	*-2.08*
HIV	0.9	0.99	1.27*	1.28*	1.55**	1.49**
	-1.29	*-1.38*	*-1.69*	*-1.65*	*-2.03*	*-2.17*
N	55	55	55	55	55	55

Note: * p<0.10, ** p<0.05, *** p<0.01. T.stat in italics. Group 2 (child mortality lopsided) is the cluster of partial performers featuring improvements in maternal health and any improvement or even deterioration in the child mortality indicator. Group 3 (maternal mortality lopsided) is the cluster of partial performers featuring improvements in child health and any improvement or even deterioration in maternal mortality indicator. Left-out category: Good performers.

Summarizing the findings across the analyses suggests that economic growth, not surprisingly, seems to be a very robust driver of determining whether countries are in a group of good versus bad performers. In low growth environments, negative synergies feed on each other, while in high growth environments the opposite is the case. More interestingly, increases in inequality and poor institutional quality are particularly important in weakening synergies between MDG achievements, thus placing more countries in the group of mixed performers.

5. Robustness Checks

Presumably, the positive effect with which a given MDG (i.e. education) could influence the speed or the intensity of the improvement in another MDG (i.e. health) could not be immediate. From a micro-perspective we know that some time is needed in order to translate knowledge and skills learnt at school into "good" practices concerning, for example, proper feeding, care during illness, hygiene behaviour, not to mention even future decision on investment on own children's health and education.

As our relative performance indicators used in the cluster analyses refer to quite long time period of eighteen years, shorter time lags in the transmission of MDG progress are already taken into account in the analysis we presented above.

Nevertheless, as a robustness check, we performed several additional cluster analyses which try to more carefully address this time lag issue. Specifically, worthy of note are four cluster analyses in which we matched our RPIs computed for the education and the educational gender gap goal over the first decade (1990 to 1999) to those related to child and maternal mortality over the second period of analysis (2000 to 2008).

The majority of countries which in earlier cluster analyses stood out as good or bad performers keep the same label when time lags are taken into account. Nevertheless in a few cases the classification changes. China, Morocco and Turkey, for example, which were listed as "good" performers in education and child health, displayed only partial performance in the time-lags cluster analysis of these two dimensions. This is mainly attributable to the fact that progress in education in the first decade in these countries was not as large as the improvements made in reducing child mortality during the following period; another way of saying this is that these countries managed to achieve reductions in child mortality in the second decade without much prior expansion in education in the first. On the other hand, Swaziland moves from the bad to the partial performer category since despite negative values of its education RPI in the first decade, the country experienced substantial achievements in reducing child mortality (in the period 2000-2008).

Last, another interesting case is Thailand which –for the bivariate cluster analysis of educational gender gap and maternal mortality- moves from the group of partial performers (being lopsided towards positive achievements in the gender equity dimension) to the group of bad performers. Indeed, when considering time lags, as it is also visible from fig.8, this country made relatively low progress in closing the gender gap during the first decade and also performed badly in the maternal mortality dimension during the following period. When looking at the whole period (fig. 9) we can see that this country, despite keeping on its bad performance in maternal mortality, recorded over the years 1990-2008, extraordinary good achievements in the gender equity dimension. To the extent that synergies exist, one could hope for faster improvements in reducing maternal mortality after 2008.

In short, this brief discussion suggests two things. First, the key findings from our cluster analysis are rather robust to considering longer time lags; cluster membership does not change much when time lags are considered. Second, there are notable exceptions which are well worth investigating further as they point to interesting dynamics in the relationship between the two MDG variables.

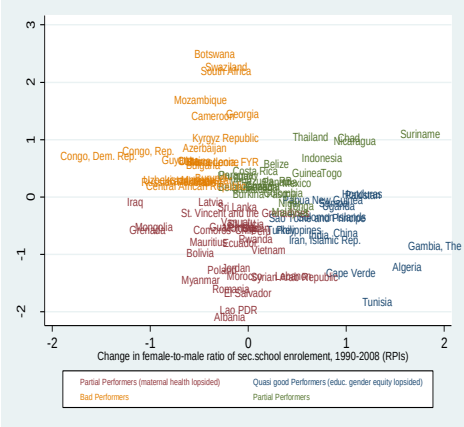

Fig. 8 Clusters of performers in educational gender gap (1990-99) and maternal mortality (2000-08)

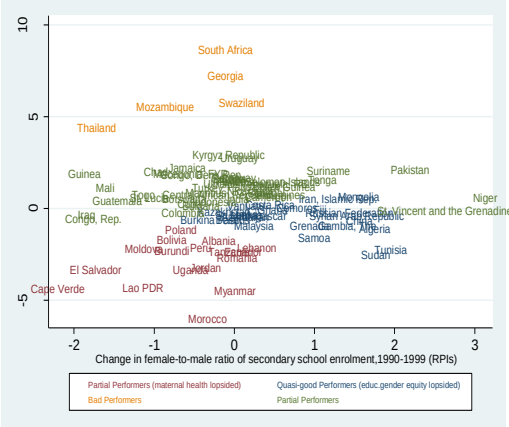

Fig. 9 Clusters of performers in educational gender gap (1990-2008) and maternal mortality (1990-2008)

6. Concluding Remarks

In this paper we investigate synergies and complementarities between MDGs in order to evaluate whether indeed there are close synergies in reaching MDGs. As our cluster analysis has shown, there are synergies, but only for a restricted group of countries (the 'good' performers where progress goes hand in hand, and the 'bad performers' where regress goes hand-in-hand). For a sizable number of countries, the synergies seem to be weak or absent, leading to contrary movements in MDG progress in non-income MDGs. In fact, it appears that for a majority of countries, there are such contrary movements at least in one or two pairs of MDG indicators. Such 'partial' performers are particularly concentrated in Latin America and transition countries, but there are country examples throughout. Our robustness analysis investigates time lags and finds them to play only a small role in the assigning cluster membership.

When investigating the determinants of cluster membership, we first note that GDP growth is the most robust determinant of cluster membership. It is particularly powerful in distinguishing good from bad performers, but also has some impact on distinguishing good from partial performers. When it comes to partial performers, changes in inequality and institutional quality are key variables. Rising inequality and low institutional quality are key factors affecting partial performers.

We should mention that this is largely a descriptive exercise that cannot make definitive statements on causality. Also, there are some data-related problems that suggest caution in interpreting the results. For example, some indicators require careful interpretation, including the

primary enrolment rate and the gender gap both of which can exceed 100%. Also, the majority of developing countries are very close to (or have already reached) the MDG2 and MDG3 related-targets but, since the rationales of these two goals should embody the high intrinsic value of education and of gender parity, real performance should take into account some measure of educational quality, that is certainly not a minor issue for the consolidation of human capital. As it was also implicitly noted by Caldwell's seminal paper (1992), in order to really find out how the education-health link works a greater focus on educational quality is needed. Second, our relative performance indicators can be considered as a better measure of actual performance than absolute change or distance to goal. But of course there are other ways to formulate benchmarks to measure progress.

Third, cluster analysis itself has some limitations. Observations situated in the border line between two clusters (but finally assigned by the algorithm to one of them) are not greatly different to adjacent observations. Yet, to simply establish ex-ante cut-offs for delimiting groups could be even a more problematic and arbitrary approach.

Fourth, the realm of possible determinants of group membership may well be larger than the set of covariates we referred to in our analysis. Physical infrastructures, actual access to medical, sanitation and education facilities are, for example, interesting factors that could have influenced transmission channels among different MDGs. Still, we were limited by the lack of reliable and/or available data for early 90s.

Nonetheless, our first exploration in the area of partial MDG performance can allow us to trace out clearly some elements which have hindered transmission channels between some of the millennium goals. These suggestive results can provide for more detailed analyses of these linkages at the micro level.

A key message from our findings is that economic growth, accompanied by steady or declining inequality, and a strong institutional framework is not only critical for income poverty reduction but appears to also improve synergies between MDG achievements. For the post-2015 framework, our results suggest that one cannot presume that focusing on a few goals will, via synergies and complementarities, achieve broad progress in non-income dimensions of well-being. Thus one needs either to ensure that policies target achievements in a broad set of dimensions or that a policy framework is adopted that maximizes these synergies. Our analysis here may guide further research to develop such a policy framework.

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Appendix

I. Relative-Performance Indicators

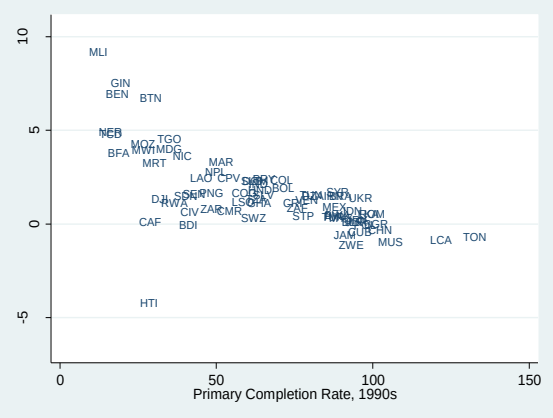

Fig. 1 Relative annual changes in primary completion rate between 1990 and 2008 against initial levels

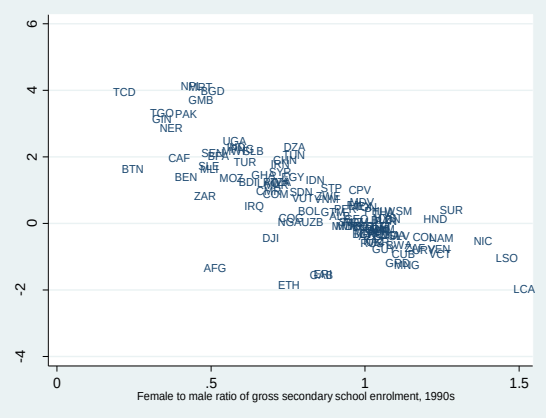

Fig. 2 Relative annual changes in female-to-male ratio of gross secondary school enrolment between 1990 and 2008 against initial levels

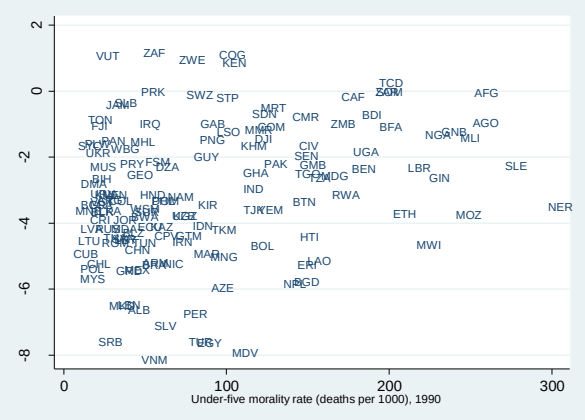

Fig. 3 Relative annual changes in under-five mortality rate(per 1,000 live births) between 1990 and 2008 against initial levels

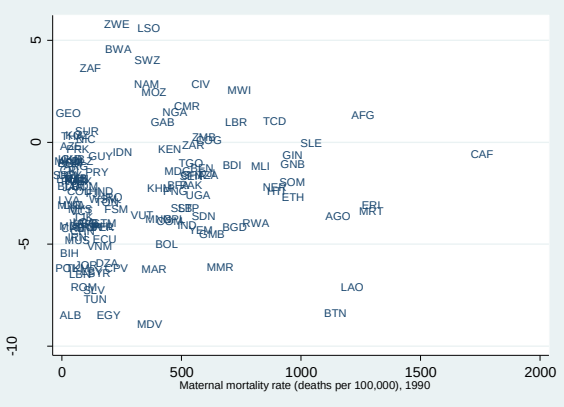

Fig. 4 Relative annual changes in maternal mortality rate between 1990 and 2008 against initial levels

Regressions results:

Dependent variable:	Average relative annual change in primary completion rate, 1990-2008	Average relative annual change in under-five mortality rate, 1990-2008
Intercept	4.84	-3.83
	10.22	*-13.70*
Initial value	-.048	.008
	-7.26	*3.34*
R^2	0.43	0.07
N	71	140
Dependent variable:	Average relative annual change in female to male ratio of gross secondary school enrolment, 1990-2008	Average relative annual change in maternal mortality rate, 1990-2008
Intercept	3.98	-2.64
	15.18	*-7.63*
Initial value	-3.89	.000
	-13.35	*1.19*
R^2	0.62	0.01
N	111	134

Note T-statistics in italics

II. Cluster analyses

Table 1 Primary Completion and Child mortality

Group	Variable: RIP	Number of countries	Mean	Std. Dev.	Min	Max
1	Child Mort.	22	-0.972	0.464	-2.24	-0.46
	Prim.Compl.		0.252	0.302	-0.34	0.752
2	Child Mort.	22	0.318	0.528	-0.185	1.61
	Prim.Compl.		0.284	0.286	-0.082	0.876
3	Child Mort.	22	0.999	0.676	-0.344	2.31
	Prim.Compl.		-0.744	0.538	-2.05	-0.068
Number of clusters			Calinski/ Harabasz Pseudo F			
2			58.45			
3			62.7			
4			58.43			

Table 1a Performance in primary completion and in child mortality. Cluster Membership

G1: Good	**G2: Partial (child mortality-lopsided)**	**G3: Bad**
Bolivia	Algeria	Burkina Faso
Brazil	Belarus	Burundi
Cape Verde	Botswana	Cameroon
China	Bulgaria	Central African Republic
Cuba	Chad	Congo, Dem. Rep.
El Salvador	Colombia	Congo, Rep.
Indonesia	Costa Rica	Cote d'Ivoire
Iran, Islamic Rep.	Dominican Republic	Djibouti
Lao PDR	Honduras	Ghana
Malawi	India	Jamaica
Malaysia	Jordan	Lesotho
Mexico	Madagascar	Mauritania
Morocco	Paraguay	Mauritius
Mozambique	Philippines	Papua New Guinea
Nepal	Solomon Islands	Rwanda
Nicaragua	Sri Lanka	Sao Tome and Principe
Niger	St. Lucia	Senegal
Poland	Togo	South Africa
Romania	Tonga	Sudan
Syrian Arab Republic	Ukraine	Swaziland
Tunisia	Uruguay	Tanzania
Turkey	Venezuela, RB	Zimbabwe

Table 2 Primary Completion and Maternal mortality

Group	Variable: RIP	Number of countries	Mean	Std. Dev.	Min	Max
1	Mat. Mort.	25	-0.915	0.52	-1.94	-0.152
	Prim.Compl.		0.166	0.313	-0.4	0.752
2	Mat. Mort.	28	0.437	0.462	-0.143	1.7
	Prim.Compl.		0.146	0.423	-0.705	0.876
3	Mat. Mort.	7	2.28	0.542	1.42	2.93
	Prim.Compl.		-0.669	0.476	-1.32	0.011
4	Mat. Mort.	4	0.375	0.244	0.204	0.732
	Prim.Compl.		-1.52	0.487	-2.05	-1.02
Number of clusters			Calinski/ Harabasz Pseudo F			
2			49.45			
3			54.85			
4			59.82			

Table 2a Performance in primary completion and in maternal mortality. Cluster Membership

G1: Good	**G2: Partial (maternal mortality-lopsided)**	**G3: Bad**	**G4: Quasi-Bad**
Algeria	Belarus	Botswana	Burundi
Bolivia	Bulgaria	Cameroon	Central African Rep
Brazil	Burkina Faso	Cote d'Ivoire	Congo, Dem. Rep.
Cape Verde	Chad	Lesotho	Djibouti
China	Colombia	South Africa	
El Salvador	Congo, Rep.	Swaziland	
India	Costa Rica	Zimbabwe	
Iran, Islamic Rep.	Cuba		
Jordan	Dominican Republic		
Lao PDR	Ghana		
Malaysia	Honduras		
Mauritania	Indonesia		
Mauritius	Jamaica		
Morocco	Madagascar		
Nepal	Malawi		
Philippines	Mexico		
Poland	Mozambique		
Romania	Nicaragua		
Sao Tome and Principe	Niger		
Solomon Islands	Papua New Guinea		
Sri Lanka	Paraguay		
St. Lucia	Senegal		
Syrian Arab Republic	Tanzania		
Tunisia	Togo		
Turkey	Tonga		
	Ukraine		
	Uruguay		
	Venezuela, RB		

Table 3 Primary Completion and gender gap in education

Group	Variable: RIP	Number of countries	Mean	Std. Dev.	Min	Max
1	Gender Gap	23	0.952	0.527	0.351	2.37
	Prim.Compl.		0.26	0.37	-0.5	0.876
2	Gender Gap	29	-0.156	0.33	-1.02	0.512
	Prim.Compl.		0.065	0.306	-0.4	0.777
3	Gender Gap	11	-0.404	0.748	-2.06	0.361
	Prim.Compl.		-1.1	0.449	-2.05	-0.595
Number of clusters			Calinski/ Harabasz Pseudo F			
2			43.45			
3			47.46			
4			40.96			

Table 3a Performance in female-to male ratio of gross secondary school enrolment and in primary completion rate. Cluster Membership

G1: Good	**G2: Partial (education-lopsided)**	**G3: Bad**
Algeria	Belarus	Burundi
Cape Verde	Bolivia	Cameroon
Chad	Botswana	Central African Republic
China	Bulgaria	Congo, Dem. Rep.
Colombia	Burkina Faso	Djibouti
Honduras	Congo, Rep.	Jamaica
India	Costa Rica	Rwanda
Indonesia	Cuba	Senegal
Iran, Islamic Rep.	El Salvador	Sudan
Lesotho	Ghana	Swaziland
Malawi	Jordan	Zimbabwe
Mauritania	Lao PDR	
Mexico	Madagascar	
Nepal	Malaysia	
Nicaragua	Mauritius	
Niger	Morocco	
Papua New Guinea	Mozambique	
Sao Tome and Principe	Paraguay	
Solomon Islands	Philippines	
Syrian Arab Republic	Poland	
Togo	Romania	
Tonga	South Africa	
Tunisia	Sri Lanka	
	St. Lucia	
	Tanzania	
	Turkey	
	Ukraine	
	Uruguay	
	Venezuela, RB	

Table 4 Gender gap in education and child mortality

Group	Variable: RIP	Number of countries	Mean	Std. Dev.	Min	Max
1	Child Mort.	15	-1.65	0.514	-2.51	-0.981
	Gender Gap		0.207	0.336	-0.449	0.648
2	Child Mort.	22	-0.179	0.388	-0.966	0.529
	Gender Gap		0.922	0.435	0.282	1.9
3	Child Mort.	38	-0.2	0.455	-0.982	0.671
	Gender Gap		-0.249	0.306	-1.03	0.141
4	Child Mort.	13	1.01	0.54	0.587	2.09
	Gender Gap		-0.94	0.376	-2.62	-0.367
5	Child Mort.	14	1.49	0.726	0.829	2.37
	Gender Gap		0.38	0.422	-0.231	1.02

Number of clusters	Calinski/ Harabasz Pseudo F
2	67.99
3	64.38
4	71.07
5	80.51

Table 4a Performance in female-to male ratio of gross secondary school enrolment and in Child Mortality. Cluster Membership

G1: Partial-Good (child health-lopsided)	**G2: Partial-Good (educational gender equity-lopsided)**	**G3: Partial-bad (educational gender gap-lopsided)**	**G4: Bad**	**G5: Partial Bad (child mortality-lopsided)**
Albania	Algeria	Belarus	Burundi	Chad
Azerbaijan	Belize	Bolivia	Cameroon	Fiji
Egypt, Arab Rep.	Cape Verde	Botswana	Central African Republic	Jamaica
El Salvador	China	Bulgaria	Comoros	Lesotho
Lao PDR	Colombia	Burkina Faso	Congo, Dem. Rep.	Panama
Lebanon	Gambia, The	Chile	Congo, Rep.	Papua New Guinea
Macedonia, FYR	Guinea	Costa Rica	Djibouti	Sao Tome and Principe
Malawi	Honduras	Cuba	Gabon	Solomon Islands
Malaysia	India	Ecuador	Guyana	South Africa
Maldives	Indonesia	Georgia	Iraq	Sudan
Mexico	Iran, Islamic Rep.	Ghana	Mauritius	Swaziland
Niger	Namibia	Grenada	Myanmar	Tonga
Peru	Nicaragua	Guatemala	Ukraine	Vanuatu
Turkey	Pakistan	Jordan		Zimbabwe
Vietnam	Philippines	Kazakhstan		
	Samoa	Kyrgyz Republic		
	Suriname	Latvia		
	Syrian Arab Republic	Madagascar		
	Thailand	Mali		
	Togo	Moldova		
	Tunisia	Mongolia		
	Uganda	Morocco		
		Mozambique		
		Paraguay		
		Poland		
		Romania		
		Russian Federation		
		Rwanda		
		Senegal		
		Sierra Leone		

	Sri Lanka St. Kitts and Nevis St. Lucia St. Vincent and the Grenadines Tanzania Uruguay Uzbekistan Venezuela, RB

Table 5 Gender gap in education and maternal mortality

Group	Variable: RIP	Number of countries	Mean	Std. Dev.	Min	Max
1	Mat. Mort.	16	-0.575	0.529	-1.82	0.052
	Gender Gap		0.975	0.396	0.332	1.9
2	Mat. Mort.	29	-0.869	0.552	-2.07	-0.065
	Gender Gap		-0.19	0.376	-1.15	0.463
3	Mat. Mort.	25	0.36	0.374	-0.24	1.1
	Gender Gap		0.408	0.439	-0.149	1.75
4	Mat. Mort.	23	0.904	0.693	0.2	2.5
	Gender Gap		-0.517	0.309	-1.53	-0.063

Number of clusters	Calinski/ Harabasz Pseudo F
2	47.06
3	55.3
4	55.88

Table 5a Performance in female-to male ratio of gross secondary school enrolment and in Maternal Mortality. Cluster Membership

G1: Quasi-Good (educational gender equity -lopsided)	**G2: Partial (maternal health-lopsided)**	**G3: Partial (educational gender equity-lopsided)**	**G4: Bad**
Algeria	Albania	Belarus	Azerbaijan
Cape Verde	Bolivia	Belize	Botswana
China	Chile	Burkina Faso	Bulgaria
Gambia, The	Comoros	Chad	Burundi
Honduras	Ecuador	Colombia	Cameroon
India	El Salvador	Costa Rica	Central African Republic
Iran, Islamic Rep.	Grenada	Fiji	Congo, Dem. Rep.
Pakistan	Guatemala	Ghana	Congo, Rep.
Papua New Guinea	Iraq	Guinea	Cuba
Philippines	Jordan	Indonesia	Georgia
Samoa	Lao PDR	Jamaica	Guyana
Sao Tome and Principe	Latvia	Malaysia	Kazakhstan
Solomon Islands	Lebanon	Mexico	Kyrgyz Republic
Tunisia	Mauritius	Nicaragua	Macedonia, FYR
Turkey	Moldova	Niger	Madagascar
Uganda	Mongolia	Panama	Mali
	Morocco	Paraguay	Mozambique
	Myanmar	Senegal	Russian Federation
	Peru	Suriname	Sierra Leone
	Poland	Tanzania	South Africa
	Romania	Thailand	Swaziland
	Rwanda	Togo	Ukraine
	Sri Lanka	Tonga	Uzbekistan
	St. Lucia	Uruguay	

St. Vincent and the Grenadines	Venezuela, RB	
Sudan		
Syrian Arab Republic		
Vanuatu		
Vietnam		

Table 6 Child Mortality and Maternal Mortality

Group	Variable: RIP	Number of countries	Mean	Std. Dev.	Min	Max
1	Child Mort.	34	-1.1	0.627	-2.52	-0.185
	Mat. Mort.		-1.06	0.648	-2.38	-0.099
2	Child Mort.	27	0.986	0.46	0.208	2.37
	Mat. Mort.		-0.301	0.482	-1.42	0.395
3	Child Mort.	50	-0.168	0.38	-1.31	0.37
	Mat. Mort.		0.257	0.561	-0.79	1.7
4	Child Mort.	20	1.07	0.703	-0.18	2.31
	Mat. Mort.		1.45	0.751	0.641	2.93

Number of clusters	Calinski/ Harabasz Pseudo F
2	91.74
3	78.7
4	93.33

Table 6a Performance in child mortality and in maternal mortality. Cluster Membership

G1: Good	**G2: Partial (child mortality-lopsided)**	**G3: Partial (child mortality-lopsided)**	**G4: Bad**
Albania	Algeria	Argentina	Afghanistan
Bangladesh	Angola	Armenia	Botswana
Bhutan	Bosnia and Herzegovina	Belarus	Cameroon
Bolivia	Burkina Faso	Belize	Chad
Brazil	Burundi	Benin	Congo, Dem. Rep.
Cape Verde	Cambodia	Bulgaria	Congo, Rep.
Chile	Central African Republic	Colombia	Cote d'Ivoire
China	Comoros	Costa Rica	Gabon
Egypt, Arab Rep.	Djibouti	Cuba	Georgia
El Salvador	Fiji	Dominican Republic	Guyana
Eritrea	Gambia, The	Ecuador	Kenya
Ethiopia	Iraq	Ghana	Korea, Dem. Rep.
Grenada	Jamaica	Guinea	Lesotho
Guatemala	Mauritania	Guinea-Bissau	Namibia
Haiti	Mauritius	Honduras	Nigeria
Iran, Islamic Rep.	Micronesia, Fed. Sts.	India	South Africa
Jordan	Myanmar	Indonesia	Swaziland
Lao PDR	Panama	Kazakhstan	Ukraine
Lebanon	Papua New Guinea	Kyrgyz Republic	Zambia
Libya	Paraguay	Latvia	Zimbabwe
Malaysia	Sao Tome and Principe	Liberia	
Maldives	Solomon Islands	Lithuania	
Mongolia	Somalia	Madagascar	
Morocco	Sudan	Malawi	
Nepal	Tonga	Mali	
Niger	Vanuatu	Mexico	

Peru	West Bank and Gaza	Moldova
Poland		Montenegro
Romania		Mozambique
Syrian Arab Republic		Nicaragua
Tunisia		Pakistan
Turkey		Philippines
Turkmenistan		Russian Federation
Vietnam		Rwanda
		Samoa
		Senegal
		Sierra Leone
		Sri Lanka
		St. Lucia
		St. Vincent and the Grenadines
		Suriname
		Tajikistan