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Future paths of poverty: a scenario analysis with integrated assessment models

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What is Chronic Poverty?

The distinguishing feature of chronic poverty is extended duration in absolute poverty.

Therefore, chronically poor people always, or usually, live below a poverty line, which is normally defined in terms of a money indicator (e.g. consumption, income, etc.), but could also be defined in terms of wider or subjective aspects of deprivation.

This is different from the transitorily poor, who move in and out of poverty, or only occasionally fall below the poverty line.

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Abstract

The estimation of poverty levels is crucial in creating effective policies on escaping poverty traps. Over time, scholars have implemented forecast exercises with various tools to provide decision-makers with understanding of the optimal timing for specific actions and the necessary funds to implement a coordinated set of measures. To investigate future scenarios assuming different paths of poverty reduction levers, this paper adopts a sophisticated and integrated assessment model, and hopes to answer: (1) what is a plausible range of poverty levels between pessimistic and optimistic scenarios? (2) what is the path of poverty for single relevant countries? (3) what is the path of other relevant variables such as greenhouse gas emissions and MDGs gaps? and (4) what is the impact of single policy interventions on poverty reduction?. Two distinguished exercises are implemented in this paper: first, analysing the impact of a package of policies including social and economic factors; and studying the impact of individual policies.

Keywords: integrated assessment model, estimation of poverty, poverty traps

Acknowledgements

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1 Background

The estimation of poverty levels is crucial to arrange the most opportune policies aiming at escaping poverty traps. This is a very interesting research topic, as decision makers can acquire information to understand the optimal timing for specific actions and the necessary funds that are needed to implement a coordinated set of measures. The relevance of this research field pushed many scholars to implement forecast exercises over time with different tools.

The simplest models, and by far the most common approach, take time as the only determinant of poverty. In this case, future forecasts are just based on previous trends. But even if this methodology is appealing as it is very simple to apply in different contexts, it can lead to several estimation biases, because information contained in the historical data may not bring correct information for future trends, and because this approach totally fails to consider a wide set of poverty drivers.

White and Blöndal (2007) use a very common approach. They use a poverty-income elasticity to base the forecast on projections of economic growth, the latter usually being taken from some other source, such as the World Bank's Global Economic Prospects (GEP) with the elasticity varying according to the level of initial inequality. This methodology is grounded on an interesting finding by Ravallion (1997). His results confirm that higher initial levels of inequality are associated with lower rates of poverty reduction at any given positive rate of growth. Inequality-corrected poverty elasticity to income is also the methodology adopted by Chen and Ravallion (2004) to implement their estimations of poverty over time.

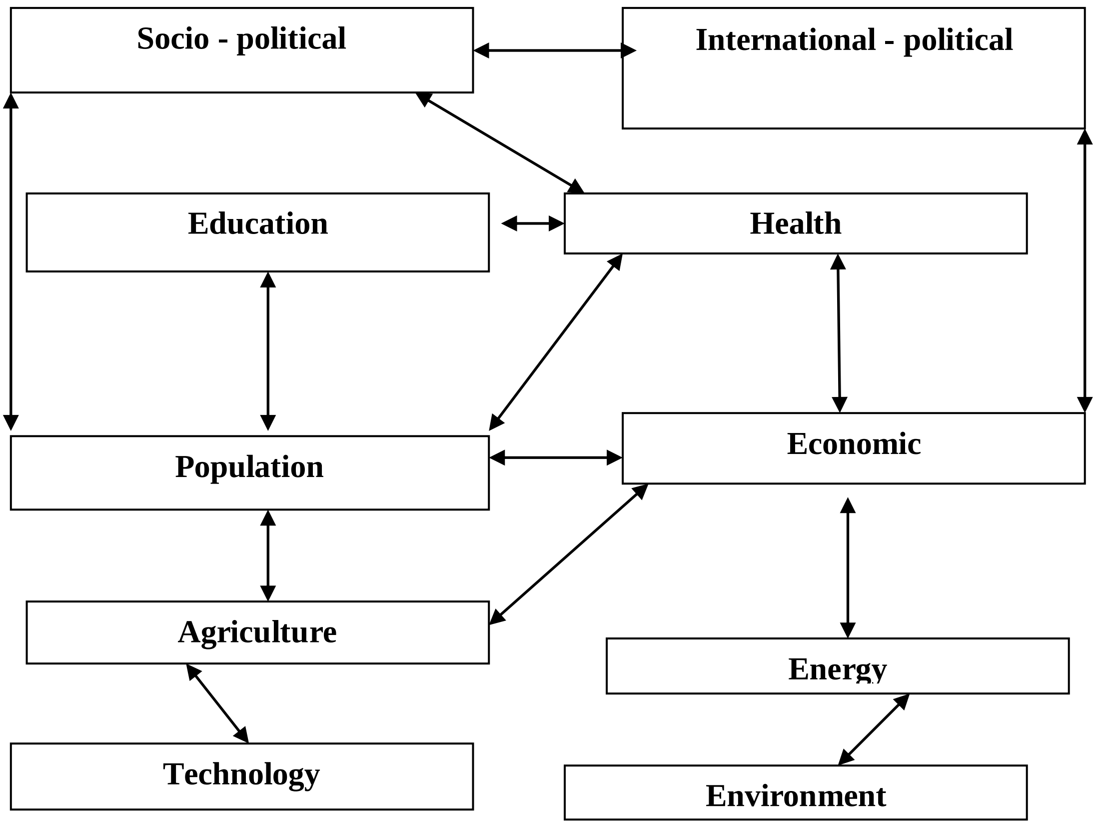
Hanmer and Naschold (2000) point out that this estimation strategy may lead to biased estimates. They stress that using 'blanket' elasticities derived from a bi-variate regression model of per capita GDP growth on poverty to produce future projections is likely to be highly misleading. Estimations derived from such a model will be biased, as relevant variables such as labour productivity growth (real labour income growth), the volume of employment creation and the sectoral origin of economic growth have been omitted from the model. For all these reasons to overcome this methodological problem they estimate poverty levels on the basis of a wider set of determinants including labour and capital productivity, openness of economy and share of value added for modern sectors.

Hillebrand (2008) uses a different approach. She estimates future levels of poverty by assuming that the within-country distribution of income and consumption remains constant, that the ratio of consumption to income is constant and by suing forecasts of GDP. Forecasts of GDP are taken from the IFs integrated assessment model (Hughes and Hillebrand, 2006).

The International Futures (IFs) integrated assessment model is implemented by the Pardee Centre for International Futures (USA) to investigate poverty and social exclusion issues both in Europe and the United States. This is a sophisticated and integrated assessment model connecting economy, environment and social variables in different countries. I adopt this model as it includes a very detailed overview of the economies of 183 countries over the world.

IFs was a core component of a project exploring the New Economy sponsored by the European Commission. Moreover, IFs is also a key piece of the research project supported by DG INFSO of the European Commission to forecast ICT trends. Forecasts from IFs supported Project 2020 of the National Intelligence Council (NIC) as well as the NIC's Global Trends 2025 for the Obama administration who took office in early 2009. Finally, it was used to provide driver forecasts for the fourth Global Environment Outlook of the United Nations Environment Program. The great advantage in using IFs to estimate poverty if compared to the methodologies I have described above is that integrated assessment models encourage a deep investigation of the economic, environmental and social poverty reduction determinants. Scenario analyses are run by assuming different paths over time of relevant parameters. Relevant parameters are chosen by the modeller among the most important ones identified by the literature and policy makers to affect poverty. IFs incorporates a very complex block of equations as illustrated by Figure 1.

Figure 1: IFs model main equations blocks



Pardee Centre researchers adopt two strategies to estimate future poverty levels on the basis of the model outcomes in different scenarios. The cross section formulation of poverty is obtained by estimating poverty elasticity to GDP per capita according to a linear regression analysis relating poverty levels to GDP per capita and the Gini index for different countries. Once the model generates forecasts of GDP per capita in different scenarios, poverty levels are then calculated on the basis of those elasticities. The lognormal approach implies that poverty levels depend on income distribution pattern over time that is assumed to change according to the levels of income per capita and the Gini index. The lognormal approach is very common in the literature. However, Hughes (2007) points out that a comparison with the cross sectional methodology is useful for two reasons. First, it helps estimate poverty levels for countries for which there are no survey data. Second, there is basis on which to question the pure form of the log-normal curve as average income improves (even when aggregate measures like the Gini coefficient changes very little).

Hughes *et al.* (2008) implement a scenario analysis through the integrated assessment model IFs by assuming improvements in relevant domestic and international parameters affecting relevant economic and social variables. On the basis of the GDP outcomes deriving from scenarios simulations they estimate poverty levels. The aim of their experiment is to verify changes of poverty when important parameters governing economy, social protection, and environment improve over time. And also to investigate the magnitude of the impact of the whole package of interventions as well as the impact of each single intervention to identify those actions that are more effective in reducing poverty. The drawback of this exercise as emphasised by Hughes *et al.* (2008: 102) is that

> 'The search for silver bullets in the fight of poverty for those measures that can have the greatest impact is unending. Identification of prospective silver bullets changes over time and across philosophical viewpoints'.

This statement clearly shows the need to use the IFs model to test the impact of different levers of poverty to identify the most effective policies in a wider set of scenarios than that implemented by Hughes *et al.* (2008). Moreover, the recent discussion about the ways to reach a sustainable growth path in developing countries raises the need to investigate a wider set of output variables than poverty including environmental, economic and social dimensions to deal with a more complicated policy agenda. The present paper will try to fill this gap by answering the following research questions:

(1) What is a plausible range of poverty levels between pessimistic and optimistic scenarios?

(2) What is the path of poverty for single relevant countries?

(3) What is the path of other relevant variables such as greenhouse gas emissions and MDGs gaps?

(4) What is the impact of single policy interventions on poverty reduction?

Section 2 will explain the methodology I will adopt, Section 3 will include discussion of results, the final section will conclude with policy implications.

2 Methodology

To mitigate the Hughes *et al.* (2008) claim that 'The search for silver bullets in the fight of poverty for those measures that can have the greatest impact is unending' I implement a different exercise from that implemented by Hughes *et al.* (2008).

Both experiments focus on parameters shifts applied to world regions. The main differences between the IFs scenario analysis and the Overseas Development Institute (ODI) scenario analysis can be summarised as follows:

(1) They contain a set of different parameters that increases the appeal of my experiment as Hughes *et al.* acknowledge that the set of interventions they propose is not likely to be the most effective in reducing poverty. Hence a wider effort is needed to investigate the effectiveness of different policy interventions packages;

(2) Whereas Hughes *et al.* only investigate improvements in parameters, I also investigate pessimistic and intermediate scenarios;

The next table briefly summarises the parameters adopted by Hughes *et al.* (2008) and those adopted in my paper. As the reader can notice from Table 1, I change many parameters if compared to the Hughes *et al.* experiment as the majority of the parameters adopted in this paper are different from those implemented by IFs modellers.

Table 1: Adopted parameters in the scenario analysis and regional coverage[1]

IFs 2008	Regions of interest	ODI 2010	Regions of interest
Fertility rate	Eastern Africa, Western Africa, Poor Oceania, Middle Africa	**Fertility rate**	Asia East Poor, Asia South Central, North Africa – Middle East, Asia South East, Africa Middle, Africa West, Africa East, Africa South, Latin America - Caribbean
Female labour participation	North Africa, Western Asia, South Central Asia, Central America	**Agricultural productivity**	Asia East Poor, Asia South Central, North Africa – Middle East, Asia South East, Africa Middle, Africa West, Africa East, Africa South, Latin America - Caribbean
Economic investments	Southern Africa, Caribbean, South Central Asia, South America, Western Asia, Eastern Europe, Northern Africa, Middle Africa, Western Africa	**Total factor productivity**	Asia East Poor, Asia South Central, North Africa – Middle East, Asia South East, Africa Middle, Africa West, Africa East, Africa South, Latin America - Caribbean
Education expenditure	Western Africa, Middle Africa, Asia East Poor, South East Asia, Central America. South Central Asia, Eastern Africa, Northern Africa, Eastern Europe, South America	**Secondary and tertiary education survival rate (higher effectiveness of education expenditure)**	Asia East Poor, Asia South Central, North Africa – Middle East, Asia South East, Africa Middle, Africa West, Africa East, Africa South, Latin America - Caribbean
Effectiveness of government expenditure	non OECD countries	**Effectiveness of government expenditures**	Asia East Poor, Asia South Central, North Africa – Middle East, Asia South East, Africa Middle, Africa West, Africa East, Africa South, Latin America - Caribbean
Free market	non OECD countries	**Social capital**	Asia East Poor, Asia South Central, North Africa – Middle East, Asia South East, Africa Middle, Africa West, Africa East, Africa South, Latin America – Caribbean

[1] The definition of the IFs regions is included in the Appendix 1.

Infrastructure	non OECD countries, Middle Africa	**Infrastructure**	Asia East Poor, Asia South Central, North Africa – Middle East, Asia South East, Africa Middle, Africa West, Africa East, Africa South, Latin America - Caribbean
Production of renewable energy	non OECD countries	**Production costs of renewable and fossil fuel energy**	Asia East Poor, Asia South Central, North Africa – Middle East, Asia South East, Africa Middle, Africa West, Africa East, Africa South, Latin America - Caribbean
R&D expenditures	non OECD countries	**ODA %**	Asia East Poor, Asia South Central, North Africa – Middle East, Asia South East, Africa Middle, Africa West, Africa East, Africa South, Latin America - Caribbean
Trade protection	non OECD countries	**Government expenditures on education, health, pensions and other categories**	Asia East Poor, Asia South Central, North Africa – Middle East, Asia South East, Africa Middle, Africa West, Africa East, Africa South, Latin America - Caribbean
Domestic social transfers to unskilled workers	Southern Africa, South America, Central America, Caribbean, Middle Africa, Oceania Poor, Asia East Poor, Western Africa, Eastern Africa and Western Asia	**Domestic social protection transfers for skilled and unskilled workers**	Asia East Poor, Asia South Central, North Africa – Middle East, Asia South East, Africa Middle, Africa West, Africa East, Africa South, Latin America - Caribbean

Each parameter manipulated in this exercise shows an impact on development and poverty levels (Table 2). I use the above parameters to build an analysis by assuming 4 scenarios: ‘optimistic’, ‘on the right road’, ‘missed opportunities’, and ‘pessimistic’. I adopt the Global International Futures (IF) model, 6.18 online version. I compare these scenarios to a base case implemented by IFs modellers (baseline scenario). Table 3 summarises my assumptions. I build my scenario analysis by attaching optimistic or pessimistic values for each parameter, displayed in Table 3 below. The two extreme cases are the ‘optimistic’ and the ‘pessimistic’ scenarios. The optimistic scenario is built by considering favourable hypotheses for every parameter. In contrast to this scenario, ‘pessimistic’ assumes the worst hypotheses for each parameter.

Table 2: Transmission channel from policy intervention to poverty reduction

Parameter/s		**Transmission channel**
YLM	**Agricultural productivity**	An increase of agricultural productivity increases agricultural output
QEM	**Production costs of renewable and fossil fuel energy**	A decrease of QEM makes it less costly to exploit domestic natural resources by enhancing profitability. Resources are oil, gas, coal, hydro and renewable resources
Mfpadd	**Total factor productivity**	This parameter is an additive component of the growth rate representing output enhancing technological change
Infraelecm, infranetm, infraroadm, infratelem	**Infrastructure**	An increase of infrastructure parameters boosts economic growth and development
Aiddon	**ODA %**	International aid of OECD countries in terms of % GDP enhances development in developing countries
govexpm	**Government expenditures on education, health, pensions and other categories**	An increase of this parameter generates an increase of aggregate public expenditures that stimulates economy
goveffectm	**Effectiveness of government expenditures**	An increase of this parameter increases effectiveness of national governance that improves development
Numwpgrm	**Social capital**	An increase of the social relations in each country increases knowledge and output
govhhtrnwelm	**Domestic social protection transfers for skilled and unskilled workers**	Government to household welfare transfers to skilled and unskilled workers improve demand, growth and capabilities of individuals.
TFRM	**Fertility rate**	An increase in the fertility rate increases food demand and prices but can increase labour supply and output
Edseclowrsuvgr, edscecuppsuvgr, edtergragr	**Secondary and tertiary education survival rate (higher effectiveness of education expenditure)**	Higher education levels (lower secondary, upper secondary, tertiary) enhance productivity and development

Table 3: IFs scenarios design

	BASE	**OPTIMISTIC**	**ON THE RIGHT ROAD**	**MISSED OPPORTUNITIES**	**PESSIMISTIC**
Total factor productivity	Reference	+	+ (but less than optimistic)	-	-
Production costs of renewable and fossil fuel energy	Reference	+	+ (but less than optimistic)	-	-
Agricultural productivity	Reference	+	+ (but less than optimistic)	-	-
ODA %	Reference	+	+ (but less than optimistic)	+ (but less than optimistic)	-
Government expenditures on education,	Reference	+	+ (but less than optimistic)	+ (but less than optimistic)	-
Infrastructure	Reference	+	+ (but less than optimistic)	+ (but less than optimistic)	-
Governance effectiveness	Reference	+	+ (but less than optimistic)	+ (but less than optimistic)	-
Social capital	Reference	+	+ (but less than optimistic)	+ (but less than optimistic)	-
Government transfers for social protection	Reference	+	+ (but less than optimistic)	+ (but less than optimistic)	-
Total fertility rate	Reference	+	+ (but less than optimistic)	+ (but less than optimistic)	-
Secondary and tertiary education survival rate	Reference	+	+ (but less than optimistic)	+ (but less than optimistic)	-

Table 4 explains more in detail the shifts I imposed for each parameter.

Table 4: Value of the coefficients assigned for each parameter. IFs model.

		BASE	OPTIMIS-TIC	ON THE RIGHT ROAD	MISSED OPPOR-TUNITIES	PESSIMIS-TIC	Interpretation
Total factor productivity	YLM	1	1.2	1.1	1.1	0.8	0 is no change, 0.01 represents 1% increase and -0.01 represents a 1% decrease of productivity growth rates
Production costs of renewable and fossil fuel energy	QEM	1	0.5	0.75	0.75	2	1 is no change, 0.5 represents 50% reduction, 2 represents doubling of invested capital per barrel of oil equivalent
Agricultural productivity	MFPADD	0	0.01	0.005	0.005	- 0.01	A value of 1 represents no change, 1.2 represents 20% increase and 0.8 a 20% decrease of agricultural yields
ODA %	AIDON	App.0.2% of GDP	App. 0.7%	App. 0.45%	0	0	OECD donations as % GDP
Government expenditures on education,	GOVEXP	1	1.2	1.1	0.8	0.8	1.2 represents 20% increase and 0.8 is 20% decrease of government expenditures
Infrastructure	Infrastructure parameters	1	1.5	1.250	0.5	0.5	1 is no change, 1.5 represents a 50% increase, 0.5 represents a 50% decrease of the World Economic Forum infrastructure quality indicator
Governance effectiveness	GOVEFFCTM	1	1.2	1.1	0.8	0.8	1 is no change, 1.2 is a 20% increase and 0.8 a 20% decrease of the World Bank five – point scale indicator.
Social capital	NUMWPGRM	1	1.5	1.250	0.5	0.5	1 is no change, 1.5 represents a 50% increase and 0.5 a 50% decrease of the number of networking people relationships

Government transfers for social protection	govhhtrnwelm	1	1.2	1.1	0.8	0.8	1 is no change, 1.2 represents 20% increase and 0.8 and 20% decrease of social protection transfers to workers
Secondary and tertiary education survival rate	Education parameters	0	1	0.5	0	0	0 is no change, 1 is 1% increase of the secondary and tertiary education survival rate
Total fertility rate	TFRM	1	0.8	0.9	1.2	1.2	1 is no change, 0.8 represents a 20% decrease and 1.2 a 20 % increase of the fertility rate

Simulations are run on the basis of the above scenarios to outline the path of relevant economic (GDP), social (poverty) and environmental (CO2 emissions) variables for regions and for a set of meaningful countries. In particular I choose those countries showing the highest levels of poverty.

Scenarios are run from 2005 (first period) to 2030 according to the following procedure:

(1) Changing the parameter values represent shifts from a baseline scenario that is set by IFs modellers.

(2) Coefficients variations are taken from the IFs modellers that indicate for each parameter those values that can be reasonably considered ‘high’ or ‘low’. In any case I acknowledge that the magnitude of parameters shifts is very subjective. In this paper I am just interested in shaping ‘very good’ and ‘very bad’ scenarios rather than providing information about plausible future paths of poverty drivers.

(3) There is a smooth path towards a parameter value target. In 2005 each parameter still matches the one calibrated by IFs modellers and scenarios do not change. From 2005 to 2015 there is a smooth shift towards optimistic or pessimistic values. From 2015 to 2030 each parameter value remains constant at a fixed value.

As a further check I will also investigate representative policy levers which will be evaluated individually. Whereas in the previous exercise I am just considering a combined set of policies to obtain illustrative ‘extreme’ scenarios explaining very optimistic or pessimistic paths towards poverty reduction, in the second exercise I will identify a set of representative interventions to investigate the individual impact of single actions. Inspired by the Chronic Poverty Report 2008-09 published by the Chronic Poverty Research Centre, I will focus on specific actions contained in the previous exercise: social protection, infrastructure, GDP growth that are indicated by the document as relevant levers to escape from poverty traps.

The Chronic Poverty Report 2008-09 also indicates gender equality as a crucial factor to reduce poverty levels. To express gender equality in a modelling exercise I select the female work participation parameter to implement this exercise. Female participation is not included in the experiment described in Table 2, but was used by Hughes *et al.* (2008) to set up their experiment. For this second exercise I will run an optimistic scenario for each of the four relevant parameters and also a second slot of simulations by assuming a smoother transition towards the target (2030 rather 2015). In the first exercise I build ‘illustrative scenarios’ and for this reason my approach is to compare a scenario where many parameters improve very fast (optimistic) with a pessimistic scenario where a wide set of parameters worsen very fast (pessimistic) to understand a plausible range where poverty levels can fluctuate. With the second exercise I try to understand the effectiveness of single policies and the impact of different implementation time profiles.

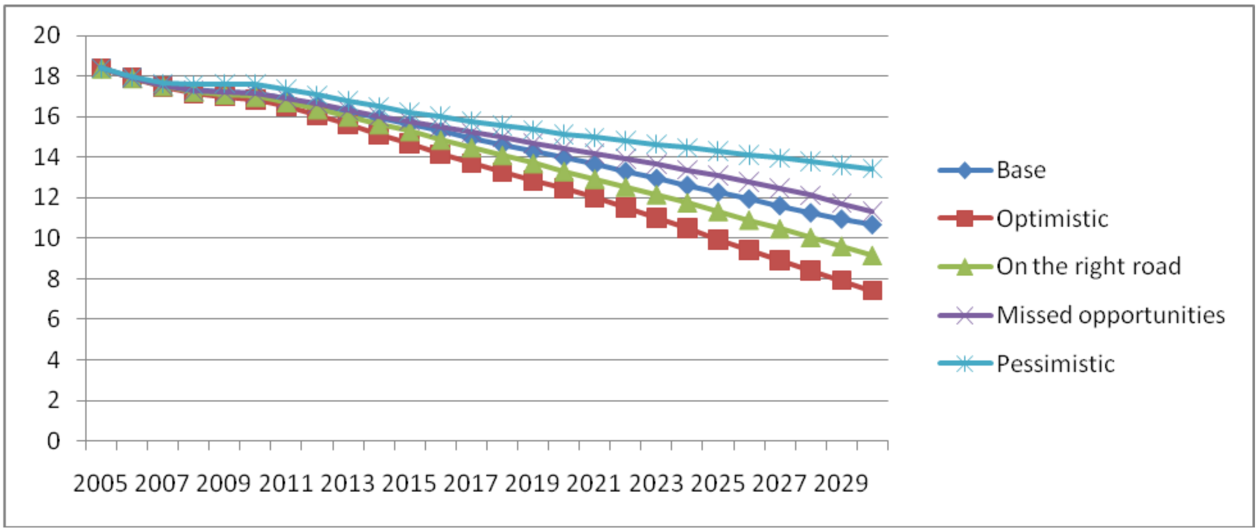
In any case I support completely what Hughes *et al.* (2008) claim in chapter 7: ‘In interpreting tables on domestic interventions and all other forecast results in this volume, it is essential to remember once again the first rule of forecasting: always distrust results. Models (mental or computer based) are oversimplification of reality, sometimes brutally so. They are always prone to various errors of construction and use...We should still view results a further input into a thinking process, not as a substitute for it. Within these limits, the analysis of individual and combined domestic interventions supports several conclusions’ (Hughes *et al.,* 2008: 102).

Bearing these warnings in mind, I am ready to illustrate scenario analysis results for both exercises: the first one investigating contextually a set of policy interventions and the second one dealing with the impact of single policy interventions.

3 An exercise on a combined set of domestic policies: results

Interestingly, the gap between a pessimistic and an optimistic scenario in terms of poverty is relevant. In 2030 the incidence of poverty in the pessimistic scenario is about twice than in the optimistic scenario (13.44 percent vs. 7.42 percent). In other words the pessimistic scenario is the one in which poverty is stable and countries are deeply stacked in the poverty trap. The optimistic scenario generates rapid and fast poverty levels reductions. As expected, the 'on the right road' and the 'missed opportunities' scenarios lie between the two extreme scenarios.

Figure 2. Poverty incidence (% less than 1$) in World Bank developing economies. Cross country formulation.



The huge discrepancy between the cross sectional and the lognormal distribution formulation of poverty incidence levels through the IFs models is a finding in line with the previous literature (see Figures 2 and 3). Hughes (2007) implements an exercise with the IFs model by comparing a 'Worst Case' and a 'Best case scenario' on the basis of different levels of economic growth. As outlined in Table 5 poverty incidence for non OECD countries is very different according to the two different methodologies.

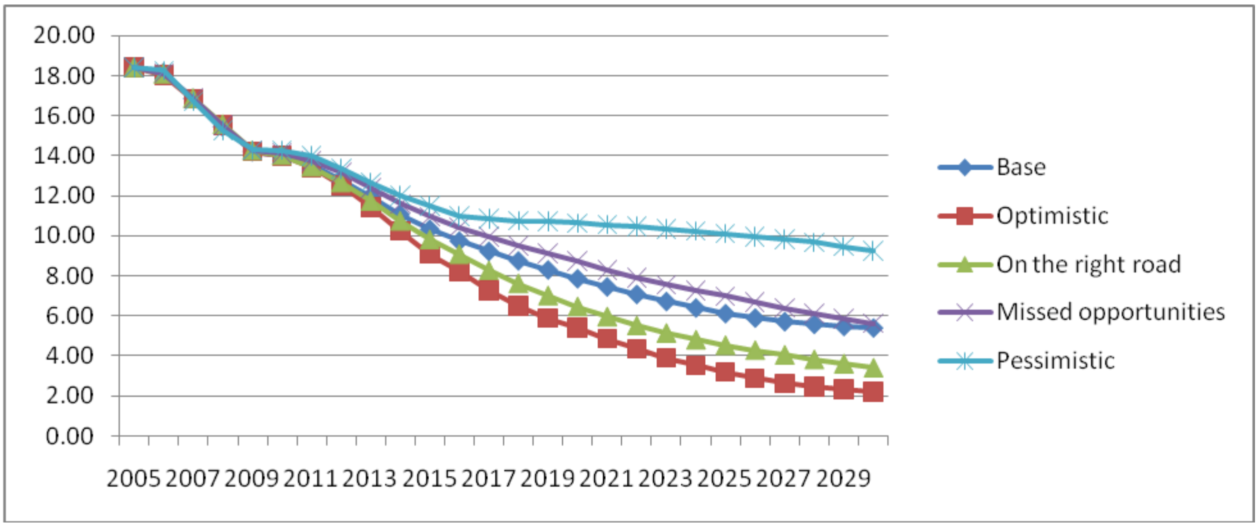
Table 5: Poverty incidence for non OECD countries. IFs 5.29 version forecast

%	Worst case		Base case		Best case	
	2015	2050	2015	2050	2015	2050
Lognormal	13.6	16.1	10.5	3.8	6.2	0.2
Cross sectional	18.7	18.3	16.8	7.4	13.5	1.9

Source: Hughes (2007)

A first message coming from simulations is that the calculation of poverty incidence levels strongly varies according to the adopted methodology. As it is clear from Figures 2 and 3 the poverty path behind the five scenarios is similar (decreasing) if I use both the cross sectional and the lognormal distribution methodology. The ranking of scenarios in terms of poverty incidence does not change over time, but I observe huge variations about values. In 2030 in the optimistic scenario the incidence of poverty with the lognormal formulation is about three times lower than with the cross country formulation. In other words the lognormal formulation provides more ‘conservative’ estimations of poverty in developing countries.

Figure 3: Poverty incidence in WB developing regions (% less than $1) in World Bank developing economies. Lognormal formulation.



The heterogeneity of estimations can also be noticed if I compare values deriving from the relevant literature. I find a wide range of results according to the adopted methodology. In Table 6 I compare results of estimation for three relevant world regions in different studies from published contributions.

Table 6: Poverty incidence in developing world regions according to different estimations methodologies. CC = Cross country methodology. LN = lognormal distribution methodology

	SIDA 2015	Hanmer and Naschold	World Bank 2005	White and Blondal	IFs baseline CC	IFs baseline LN	Cantore – optimistic – CC	Cantore– optimistic – LN	Cantore-pessimistic - CC	Cantore-pessimistic – LN
S. Sahara Africa	32.4	33.2	38.4	30.0	40.37	26.72	38.03	25.35	41.16	29.07
South Asia	18.6	23.3	12.8	16.8	19.66	13.65	18.58	11.58	20.42	15.08
Latin America - Caribbean	14.3	15.7	6.9	16.1	7.01	6.02	6.30	5.52	7.55	6.50

This table is very important to understand two important features that I should consider in evaluating data:

(1) The 'optimistic' and 'pessimistic' scenario should be evaluated in the context of the IFs results within the relevant literature. A 'pessimistic' poverty incidence forecast of poverty in Latin America may represent an 'optimistic' estimation within the relevant literature. The Hanmer and Naschold (2000) estimation of poverty in Latin America (15.7 percent in the Table 5) is well above estimates of poverty with the pessimistic scenario in IFs (about 6.5 percent to 7.5 percent).

(2) Elaboration of IFs output data to obtain poverty estimates greatly varies according to the adopted methodology. For Sub Sahara Africa, the cross country estimation method provides poverty incidence levels above those of many contributions in the literature, whereas the lognormal distribution methodology provides the lowest levels of poverty incidence.

Within this context and these limitations, this exercise involving a shift of many parameters provides a second interesting message: the wide gap between the optimistic and the pessimistic scenarios numbers shows that coordinated and widespread domestic policy packages can make a relevant difference in developing countries in terms of poverty reduction. This finding shows the real value added by exercises implemented with integrated assessment models. Models are powerful tools to understand directions and magnitude of policy impacts rather than forecasting tools.

However as I have emphasised in the previous paragraph results deriving from simulations 'optimistic' or 'pessimistic' paths towards poverty reduction should be analysed on the basis of a wider context of policy targets including new emerging challenges such as environment and climate change. This is particularly evident if I analyse the path of relevant economic, social and environmental variables for single countries rather than for macro – regions as I have done until now. I consider the countries showing the widest number of poor people with population below 1.25$ day: India, China, Nigeria, Bangladesh, and Democratic Republic of Congo. For each of these countries I show:

(1) The poverty incidence path

(2) The MDG 1 gap with a particular focus on poverty and malnutrition

(3) The path of GDP per capita

(4) The level of CO_2 emissions

This analysis in key countries fighting poverty will allow me to verify to what extent a contextual fulfilment of multiple policy targets is feasible together with poverty reduction. Figures below are very interesting because they tell a story that only partially represents good news for poor and emerging countries. Graphs included in Appendix 2 show a situation in which poor countries have wide margins to intervene through appropriate actions to reduce poverty as the gap between the optimistic and the pessimistic is very relevant. This is true especially for those countries showing high levels of poverty incidence. The extent of this gap is very uncertain according to the adopted methodology to estimate poverty. An emblematic example is the Democratic Republic of Congo where an optimistic scenario could bring a 50 percent poverty incidence reduction by a lognormal formulation and 20% reduction with a cross country formulation.

However the bad news is that except China, all countries are not unambiguously following a path that will enable them to reach the MDG 1 targets for both poverty and hunger by 2015. Only China is unambiguously following a growth path that will allow economic system to reach MDGs even if ‘bad policies’ will be implemented in the following years as represented by the pessimistic scenario. On the other hand other poor countries such as Democratic Republic of Congo and Bangladesh are less likely to reach MDGs targets even if a wide set of pro poor actions will be implemented in the near future as represented by the optimistic scenario. Hence a third relevant message arising from my results is that countries following a strong growth path alone like China are more ‘resilient’ to negative policy or market shocks. Conversely a recent study from te Velde *et al.* (2010) shows that Bangladesh and Nigeria were exposed to severe poverty increases from the global financial crisis.

In any case I stress that results once again vary according to the adopted methodology for poverty accounting. As the reader can observe in the graphs contained in the Appendix 2 Nigeria is more likely to reach MDG1 goals for poverty when I adopt a lognormal formulation rather than a cross country formulation.

Another bad news is that unfortunately, the world that I have described in the ‘optimistic’ and ‘on the right road’ scenarios, even if it is a world created by ad hoc assumptions through the modelling exercise is still not the best possible world. A fourth relevant message arising from results is that policy makers could face a trade off poverty – environment over time. As showed by the figures presented in Appendix 2, the scenarios involving the lowest carbon emissions are those in which GDP per capita is lower and poverty is higher. The trade off is impressive especially for big emerging economies like China and India. Results strongly depend on the assumptions I am implementing for the scenario analysis. I assume that production costs for both fossil fuel and fossil free sources of energy will decrease over time with the same proportion and time path. In other words I am implicitly assuming that fossil free sources of energy will not become more competitive over time if compared to carbon sources of energy. Are poverty reduction and environment compatible? Are policies addressed to improve the penetration of fossil free sources of energy pro poor? These are the new fascinating challenges that literature calls to investigate and that will be useful to analyse with further relevant research. In the next paragraph I will focus on the analysis of specific policy interventions to identify the most effective one from a poverty reduction point of view.

4 An exercise on the impact of specific domestic policies: results

In the previous paragraph I implemented a scenario analysis on the basis of a wide package of policy interventions in different world regions. I point out that my pessimistic and optimistic scenarios are unlikely to happen, as it seems not plausible to assume that a wide set of parameters will vary over time in the same direction and with the magnitude I have assumed in my experiment. However my study describes the potential impact of a wide and coordinated set of policy interventions. Unfortunately not many countries will have the opportunity to implement contextually more actions. I know that economic and institutional weaknesses do not allow developing countries to implement effective policies for poverty reduction. Where the capability of policy implementation is weak, it is crucial to concentrate efforts on the most effective actions.

For this reason I implement a second exercise on the impact of individual interventions focussing on growth rate productivity, infrastructure, social protection (transfers to skilled and unskilled workers) and female labour participation. For agricultural productivity, infrastructure, social protection and economic productivity I will use the optimistic scenario coefficients as specified in table 4. For female labour participation I assume an additional (20 percent) increase in female labour participation for each world region. As I acknowledge that developing countries may be slow in reaching a specific target, I will run simulations for these five parameters by assuming that countries face a smooth transition towards target values of parameters in 2015 and in 2030 to test the relevance of my results when I assume a different time horizon for policy implementation. I assume that parameters shifts are applied to all developing countries (World Bank classification) and I present aggregated results and again results for the 5 countries with the highest number of poor people.

Hughes *et al.* (2008) implemented a similar experiment for parameters contained in table 2 with the IFs 5.29 version, but does not include a sensitivity analysis on the time horizon for implementation. They find that the impact of single parameters improvements is relatively small. In this paper I implement the same exercise with a smaller set of parameters but by including growth productivity (which is not included in the Hughes *et al.* 2008 exercise) and with different hypotheses about policy implementation time horizon.

Table 7: Poverty incidence (less than 1 $) from single policy interventions in 2030. Cross sectional formulation.

	Developing economies	Bangladesh	China	Congo	India	Nigeria
Baseline	11.03	24.12	0.64	54.99	11.12	49.27
Total factor productivity	9.56	22.16	0.00	53.46	8.09	46.10
Total factor productivity delayed policy	10.01	22.95	0.00	54.13	9.28	47.55
Domestic social protection transfers for skilled and unskilled workers	10.90	24.01	0.64	54.37	11.02	48.35
Domestic social protection transfers for skilled and unskilled workers delayed policy	10.91	24.02	0.64	54.44	11.03	48.32
Infrastructure	10.71	23.98	0.12	54.84	10.53	49.13
Infrastructure delayed policy	10.91	24.07	0.43	54.95	10.92	49.24
Female work participation	10.99	24.10	0.58	54.97	11.10	49.27
Female work participation delayed policy	10.99	24.10	0.59	54.97	11.11	49.28

Table 8: Poverty incidence (less than 1$) from single policy interventions in 2030. Lognormal formulation.

	Developing economies	Bangladesh	China	Congo	India	Nigeria
Baseline	6.12	5.70	0.12	49.84	2.34	4.34
Total factor productivity	4.77	3.73	0.05	48.37	1.22	3.41
Total factor productivity delayed policy	5.26	4.36	0.07	48.95	1.58	3.80
Domestic social protection transfers for skilled and unskilled workers	5.98	5.57	0.12	49.34	2.29	3.90
Domestic social protection transfers for skilled and unskilled workers delayed policy	5.98	5.59	0.12	49.18	2.29	3.88
Infrastructure	5.94	5.53	0.09	50.01	2.06	4.18
Infrastructure delayed policy	6.06	5.64	0.11	49.89	2.24	4.29
Female work participation	6.09	5.67	0.12	49.84	2.34	4.34
Female work participation delayed policy	6.10	5.68	0.12	49.83	2.34	4.34

While observing data for the whole set of developing economies I find that an increase of total factor productivity (TFP) is the most effective tool in reducing poverty. However I acknowledge that results strongly depend on the magnitude of the parameters shifts. Infrastructure, social protection transfers and female work participation parameters show a very small impact on poverty reduction. This finding is in line with Hughes *et al.* results (2008). Especially the social protection variable is very interesting in the light of the recent Chronic Research Centre proposal to introduce social protection in the list of MDGs 1 targets. These numbers show that the social protection MDG 1 target may be effective mainly in a broader package of policy intervention that is perfectly consistent with the UN Millennium Development project spirit.

Moreover at country level I observe heterogeneity across countries. With the highest level of poverty in the baseline by 2030, the case of the Democratic Republic of Congo is an interesting one. The Democratic Republic of Congo shows poverty reductions deriving from single interventions generally lower than other developing countries such as India and always below three percent by 2030 if compared to a baseline. In the Democratic Republic of Congo, an increase in infrastructure does not even decrease poverty if I consider the lognormal formulation. This can be explained by the fact that with a lognormal formulation, income distribution beyond GDP per capita matters and just ‘inclusive’ growth involving all the society generates a decrease of poverty.

From my results contained in Table 7 and 8 I can extract two further important messages representing bad news and good news for developing countries. A fifth important message of this paper is that the delay of interventions generally increases poverty, but the increase is not dramatic. The lack of capability of developing countries to implement pro poor policies is negative, but delayed actions can still be useful to reduce poverty significantly over time.

A sixth message represents bad news. Individual actions seem to be more effective in growing economies rather than in fragile states. In other words individual policies are less effective in those countries which are less likely to implement policy packages. An implication of this finding is that international institutions should encourage government capacity building beyond domestic policy actions in fragile states. This implication appears very challenging but early action can promote the transition towards pro poor growth.

5 Conclusions

In this paper, I have used a very sophisticated and integrated assessment model to investigate future scenarios assuming different paths of poverty reduction levers. I have implemented two distinguished exercises. In the first exercise I analyse the impact of a package of policies including social and economic factors, in the second exercise I study the impact of individual policies. I find a number of findings that are very interesting for policy discussion:

(1) There is a wide heterogeneity of poverty estimates according to the adopted methodology for accounting.

(2) When I assume shifts of values for a wide set of parameters there is a wide discrepancy between optimistic and pessimistic scenarios and this finding shows that the role of policy in affecting the future path of poverty in fragile states is crucial.

(3) Countries like China showing an impressive growth path prove to be 'more resilient' to negative policy and economic negative shocks, whereas fragile states face great difficulties to reach a virtuous growth path even in case policy makers implement a series of effective domestic policy packages. In other words I find a high importance of path dependency effects for poor countries in terms of poverty levels.

(4) Pro-poor policies are likely to generate a trade off poverty reduction – environment if opportune policies aimed at improving the competitiveness of renewable sources of energy will not be implemented.

(5) Delays in policy implementation for single interventions do not generate huge poverty increases, and this is a positive finding for countries showing lack of governance capability. However policy packages are more relevant than single interventions in affecting poverty and this is a finding that is worrying for fragile states which often do not have resources and capability to implement a coordinate set of interventions.

Much more work is needed to confirm this finding by model comparison, further sensitivity analyses on parameters and by analysing different parameters. However, this work represents a preliminary starting point for policy discussion.

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Appendix

Appendix 1: IFs regional aggregation

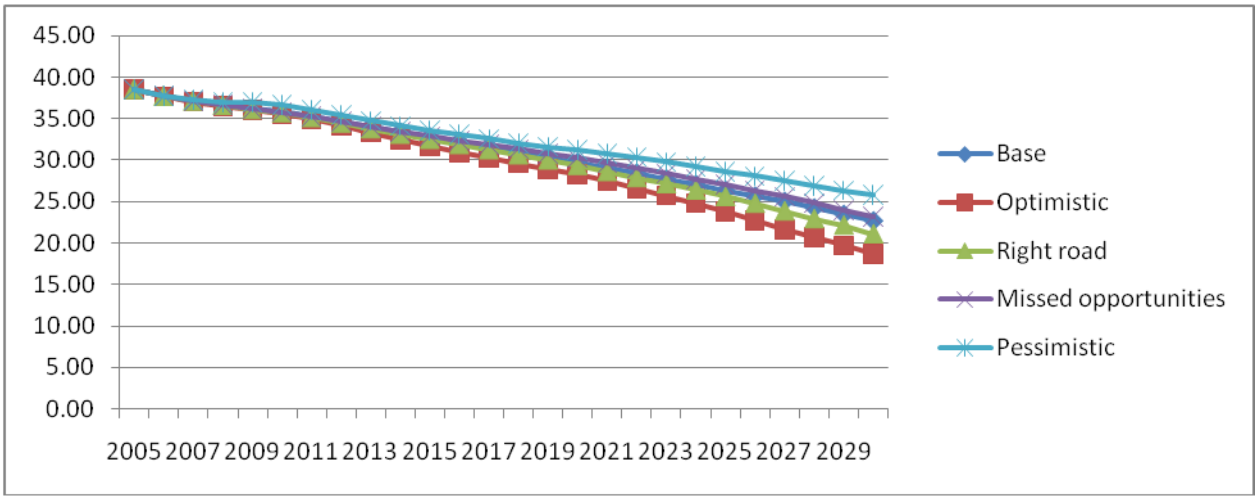
REGION	IFS MODEL
Asia East Poor	China, Democratic Republic of Korea, Mongolia
Asia South Central	Afghanistan, Bangladesh, Bhutan, India, Iran, Kazakhstan, Kirgizstan, Maldives, Nepal, Pakistan, Sri Lanka, Tajikistan, Turkmenistan, Uzbekistan
North Africa – Middle East[2]	Algeria, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Syria, Tunisia, Yemen.
Asia South East	Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor Leste, Viet Nam
Africa Middle	Angola, Cameroon, Central Africa Republic, Chad, Congo Democratic Republic, Republic of Congo, Equatorial Guinea, Gabon, Sao Tome and Principe
Africa West	Benin, Burkina Faso, Cape Verde, Cote Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leo, Togo
Africa East	Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Somalia, Tanzania, Uganda, Zambia, Zimbabwe
Africa South	Botswana, Lesotho, Namibia, South Africa, Swaziland
Latin America Caribbean	Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay , Peru, St Lucia, St Vincent & Grenadine, Suriname, Trinidad and Tobago, Uruguay, Venezuela

[2] This group includes Iran and Djibouti, countries also included respectively in the Asia South Central and the Africa East Region. To avoid double counting problems we exclude this group from the calculation of aggregated levels in the next sections.

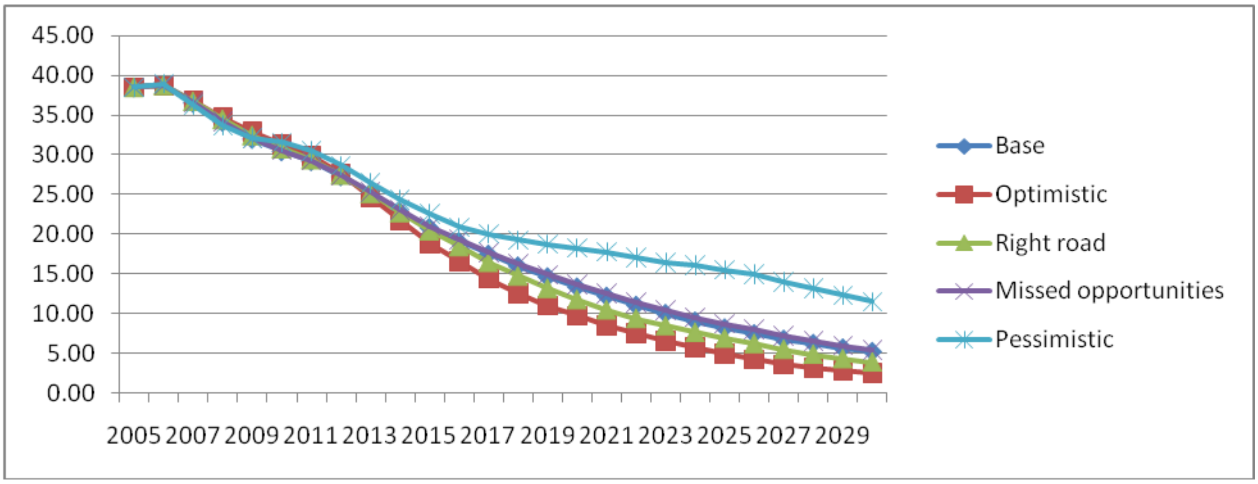
Appendix 2: Poverty incidence (Cross section and lognormal), GDP per capita (thousands of 1995 PPP $), CO_2 emissions (Gigatons) and MDG1 gaps (poverty and malnutrition for Bangladesh, China, Democratic Republic of Congo, India, Nigeria.

1 Bangladesh

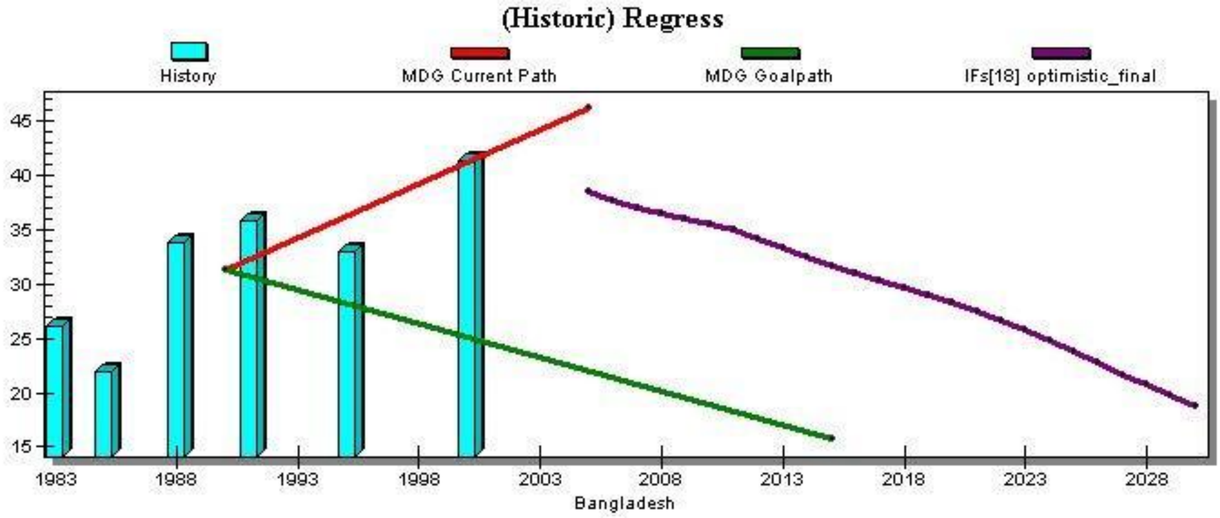
Poverty incidence cross section

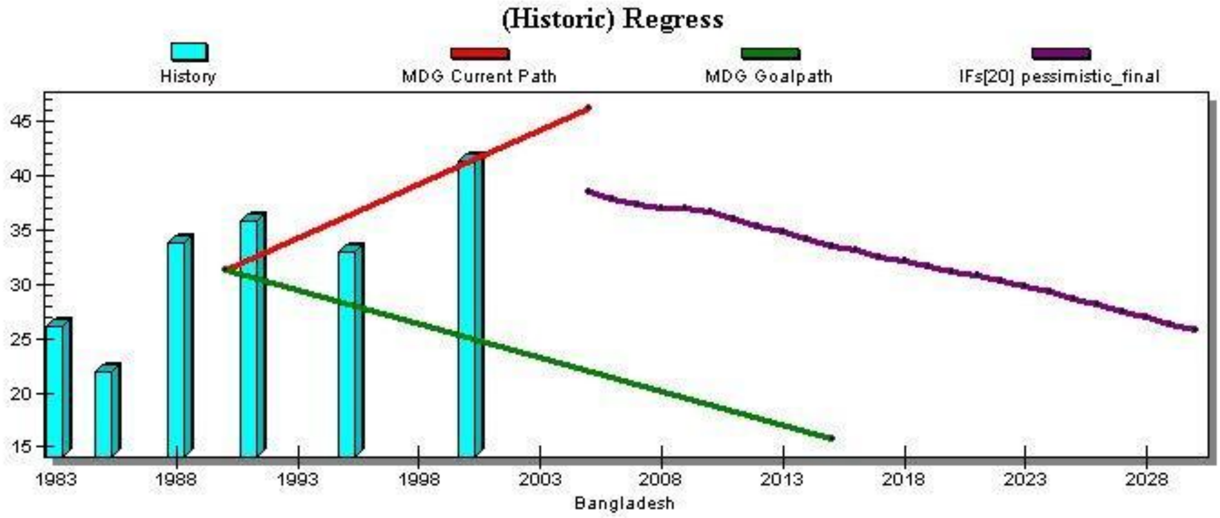


Poverty incidence lognormal

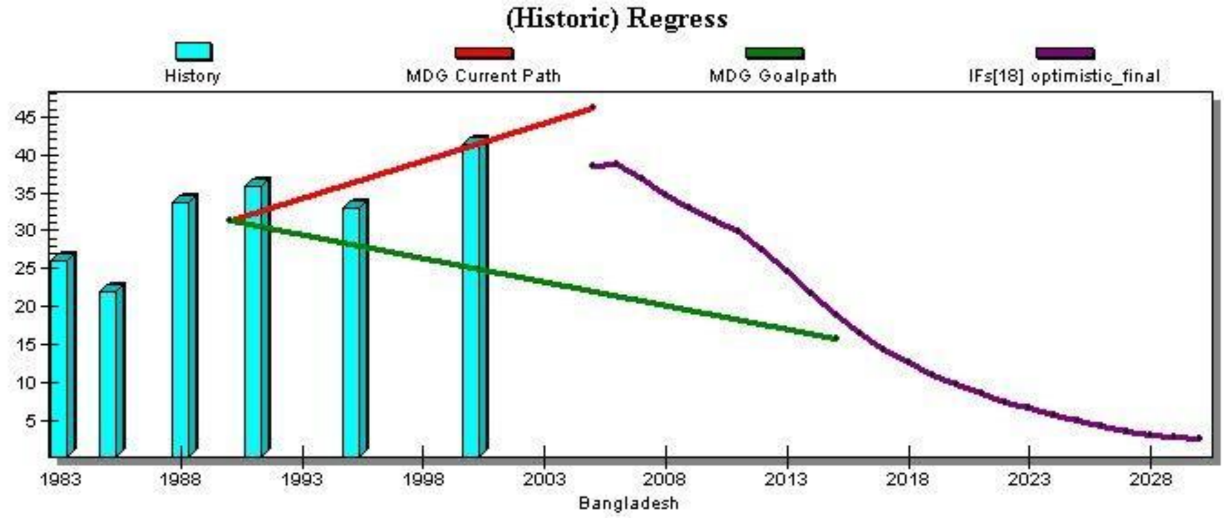


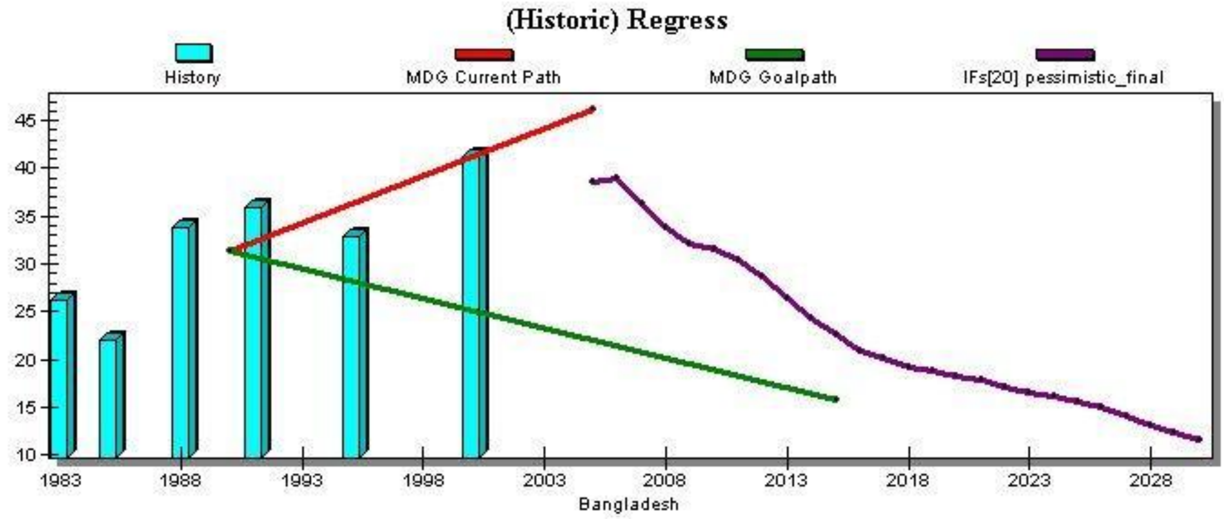
1.1 MDG1. Target 1. Halve the proportion of people whose income is less than dollar a day. CS formulation.



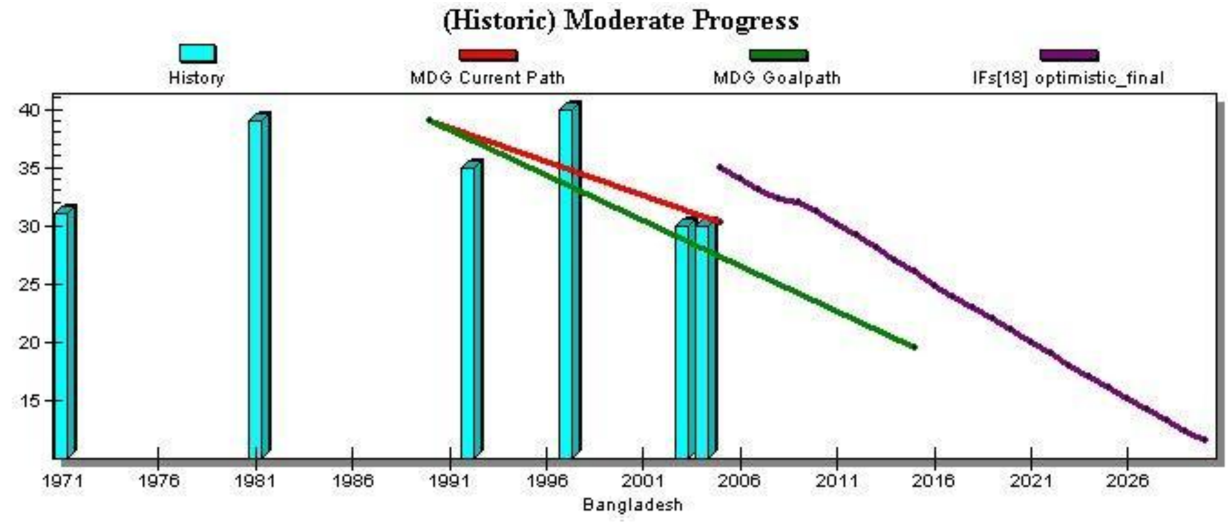


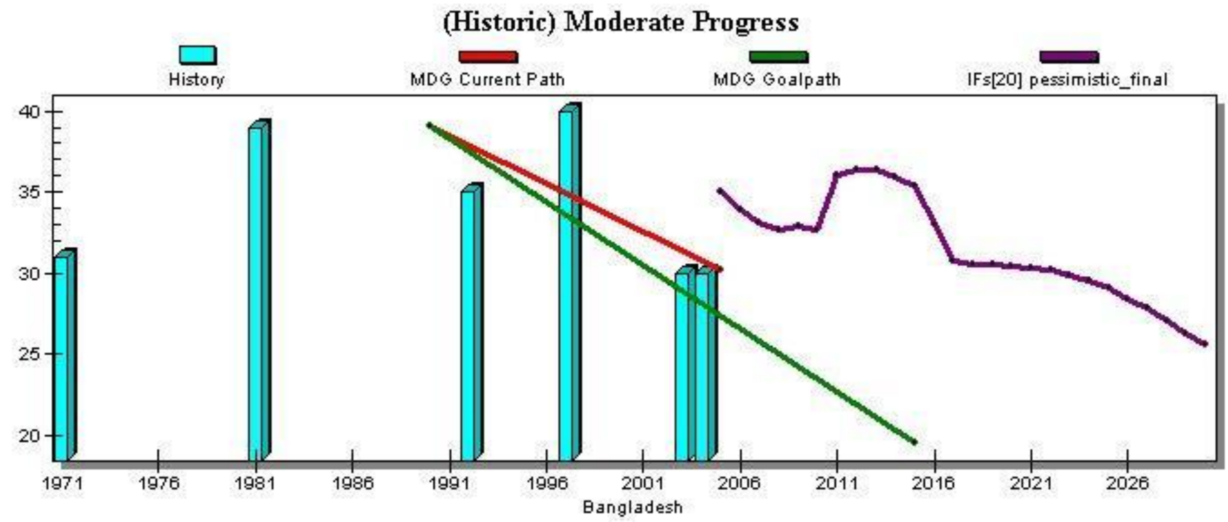
1.2 MDG1. Target 1. Halve the proportion of people whose income is less than dollar a day. Lognormal formulation.



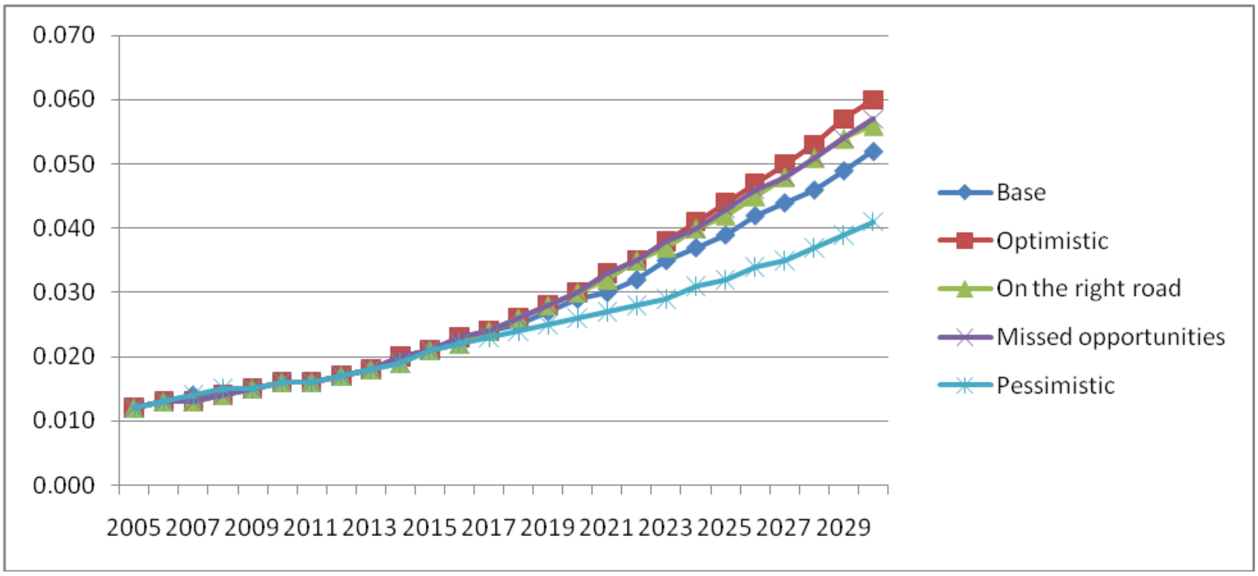


1.3 MDG1. Target 2. Halve the proportion of people who suffer from hunger.

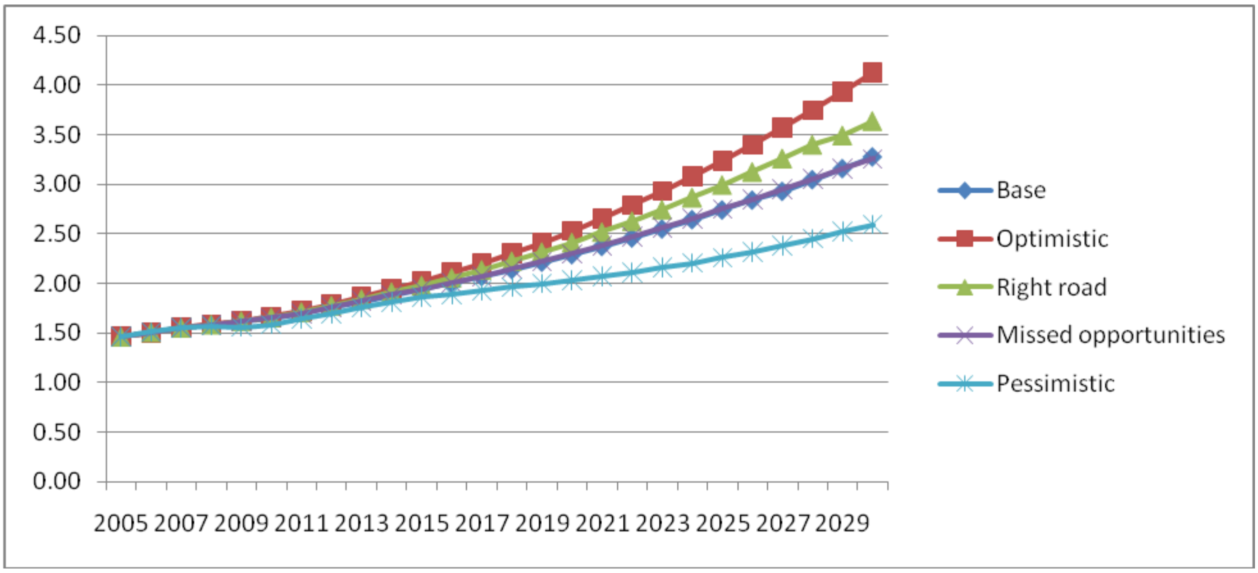




CO2 emissions (gigatons)

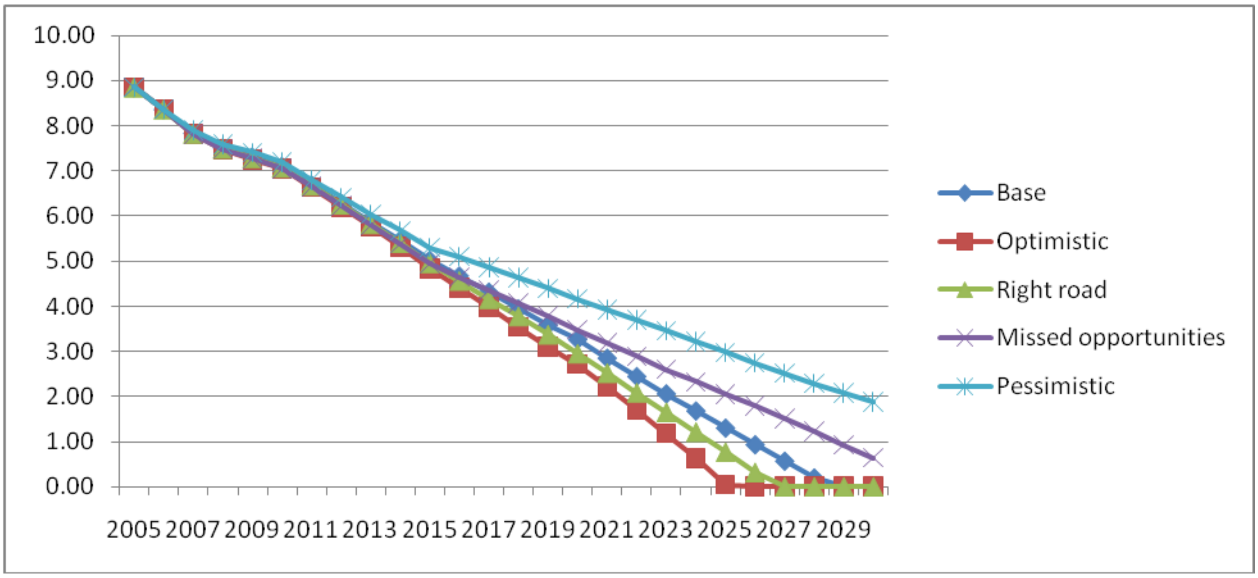


GDP per capita (thousands of 1995 PPP $ per capita)

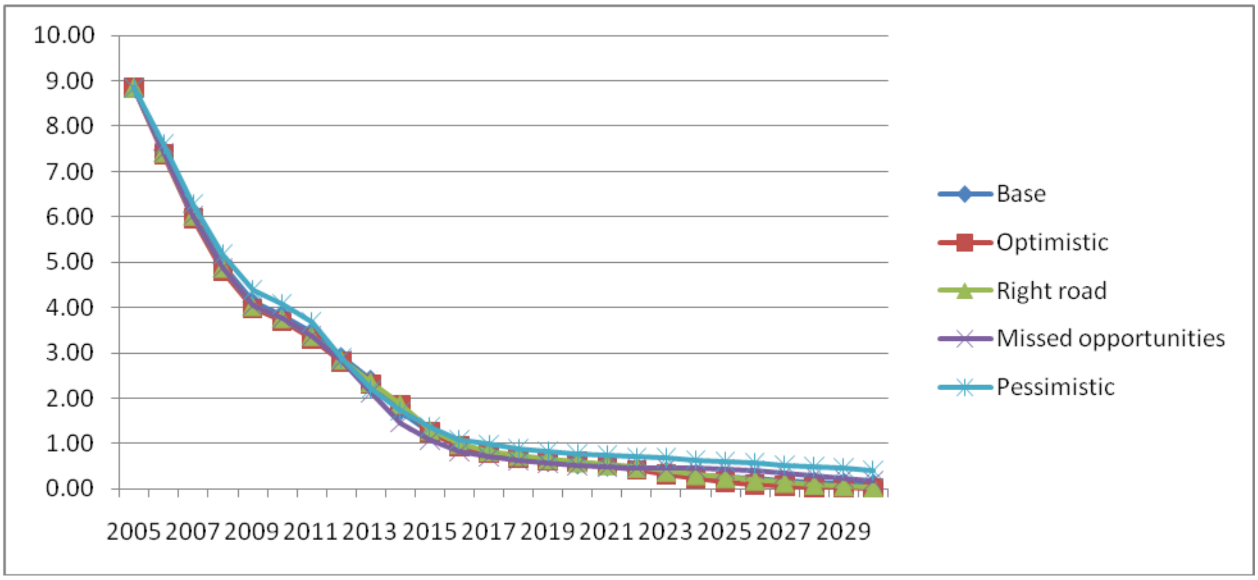


2 China

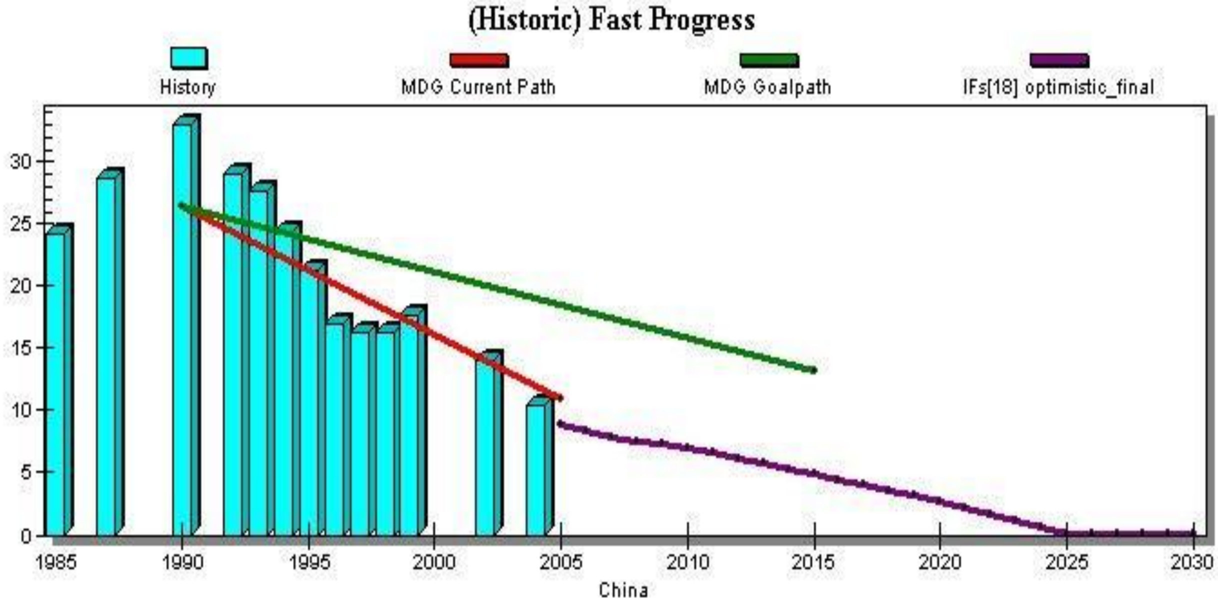
Poverty incidence cross section

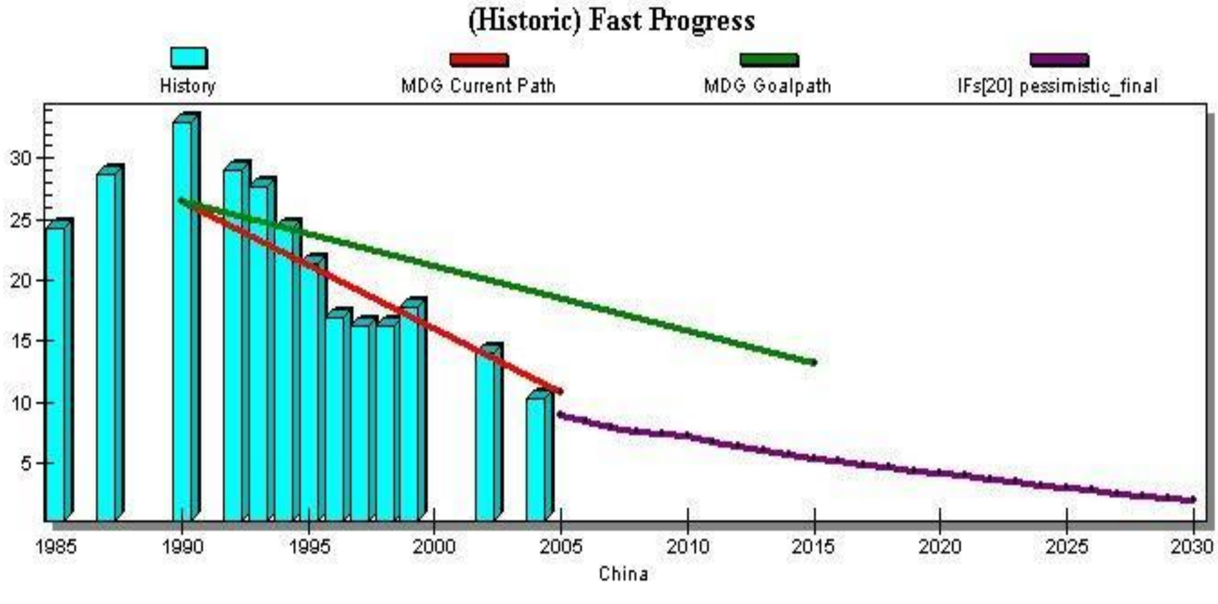


Poverty incidence lognormal

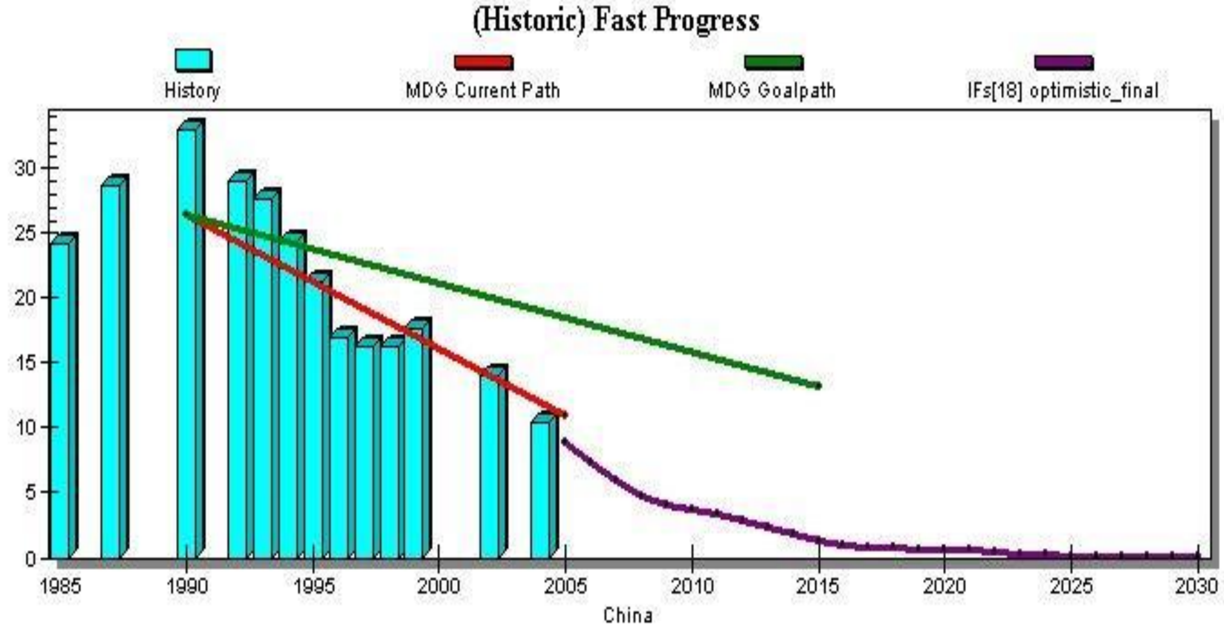


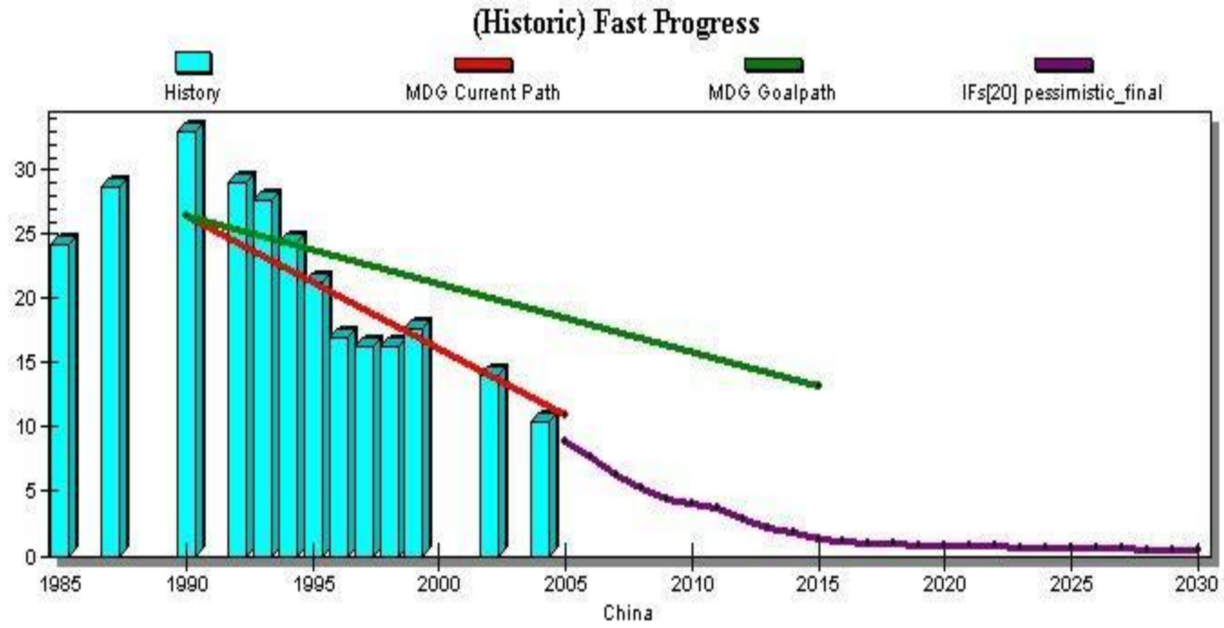
2.1 MDG1. Target 1. Halve the proportion of people whose income is less than dollar a day. CS formulation.



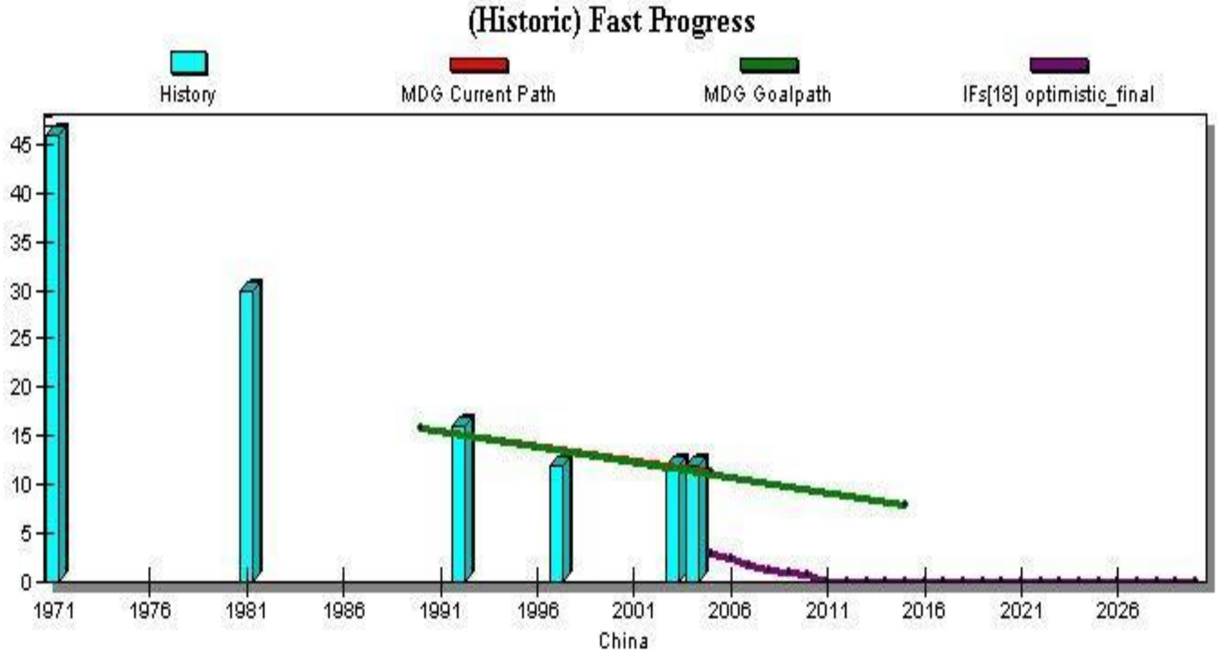


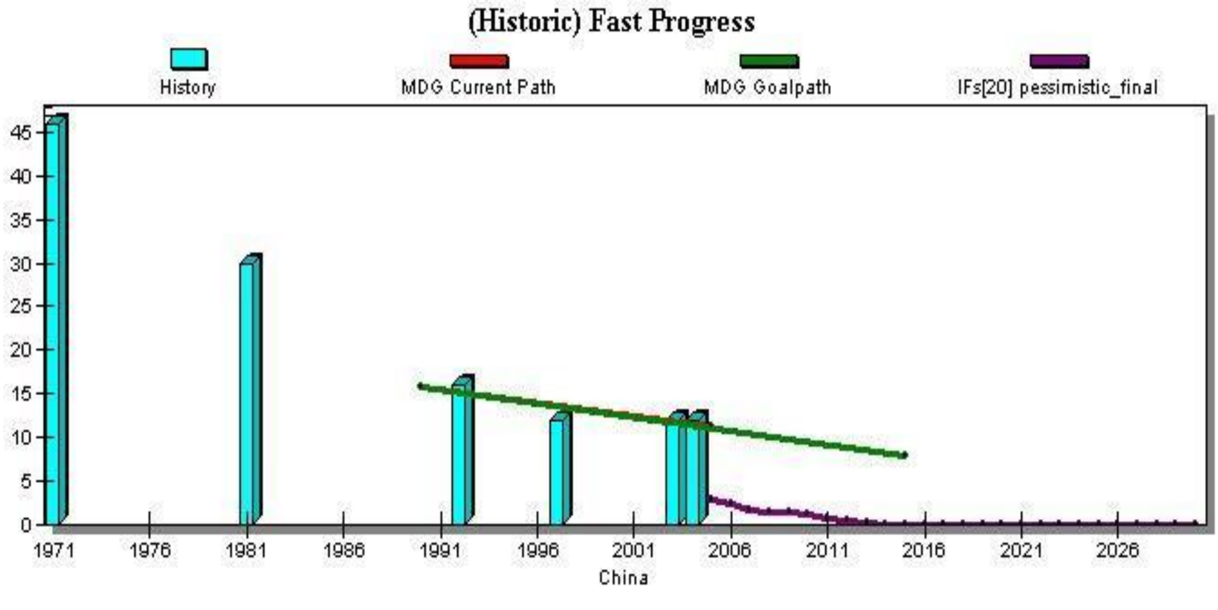
2.2 MDG1. Target 1. Halve the proportion of people whose income is less than dollar a day. Lognormal formulation.



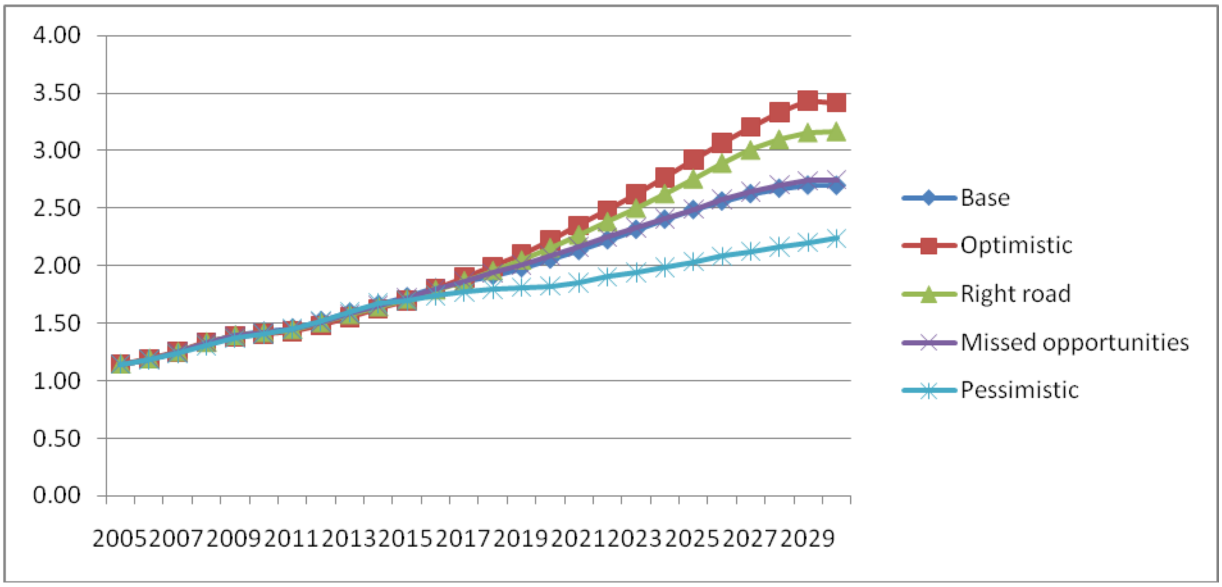


2.3 MDG1. Target 2. Halve the proportion of people who suffer from hunger.

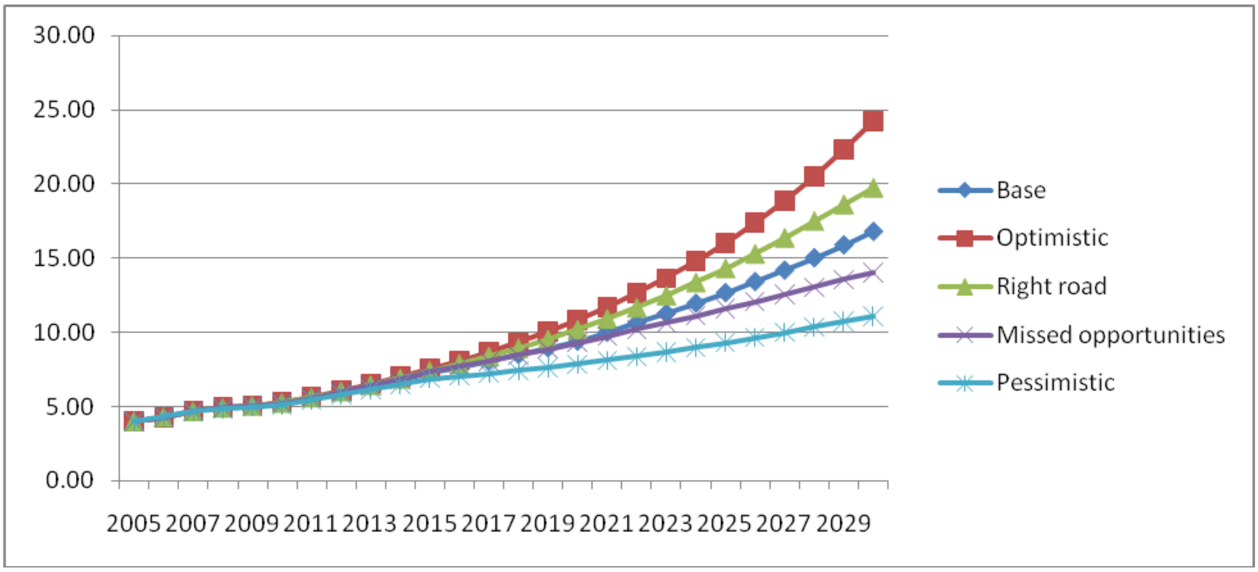




CO2 emissions (gigatons)

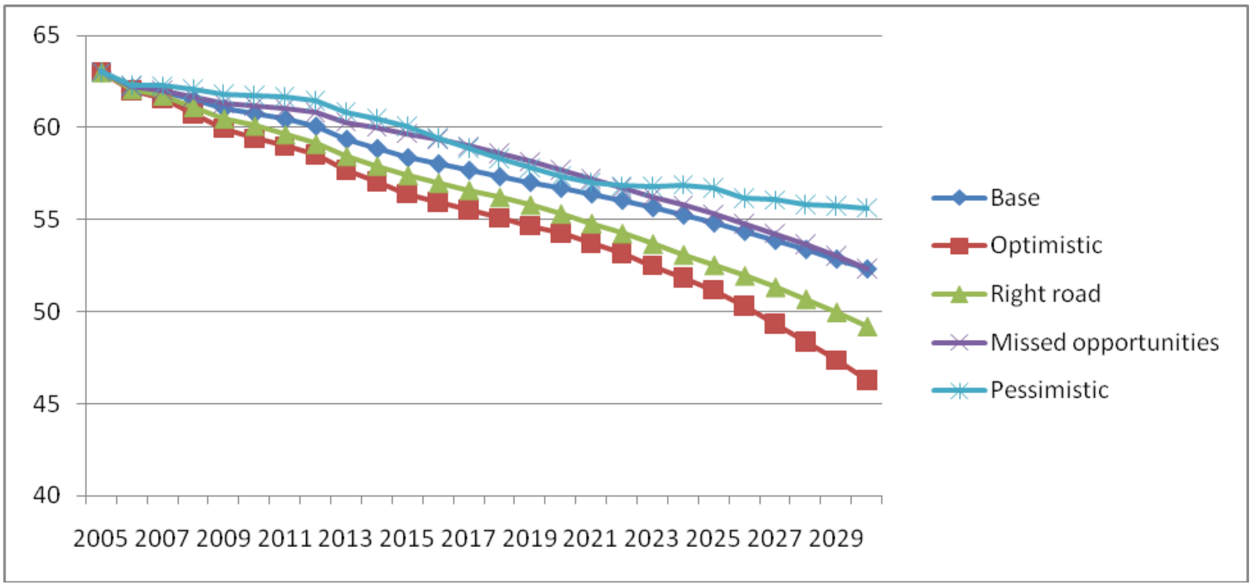


GDP per capita (thousands of 1995 PPP $ per capita)

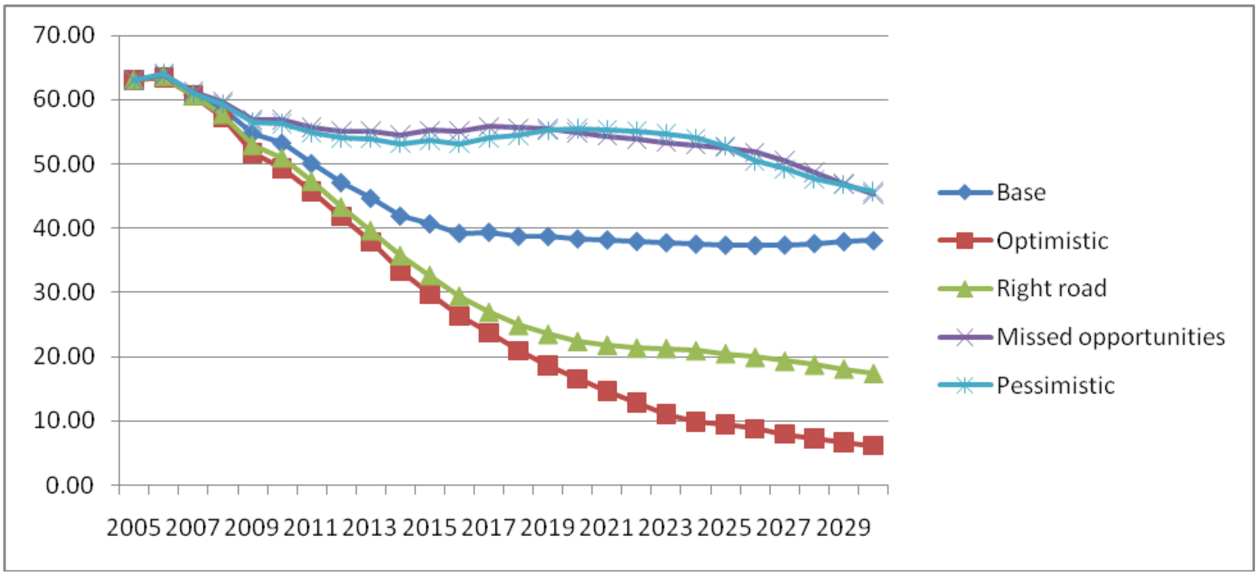


3 Democratic Republic of Congo

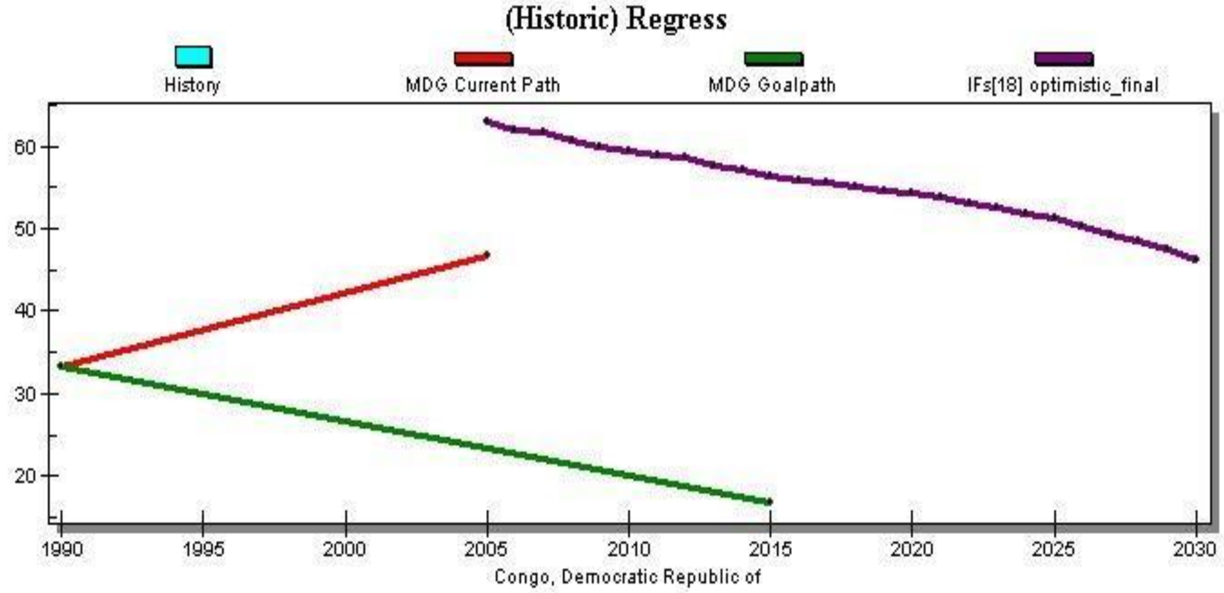
Poverty incidence cross section

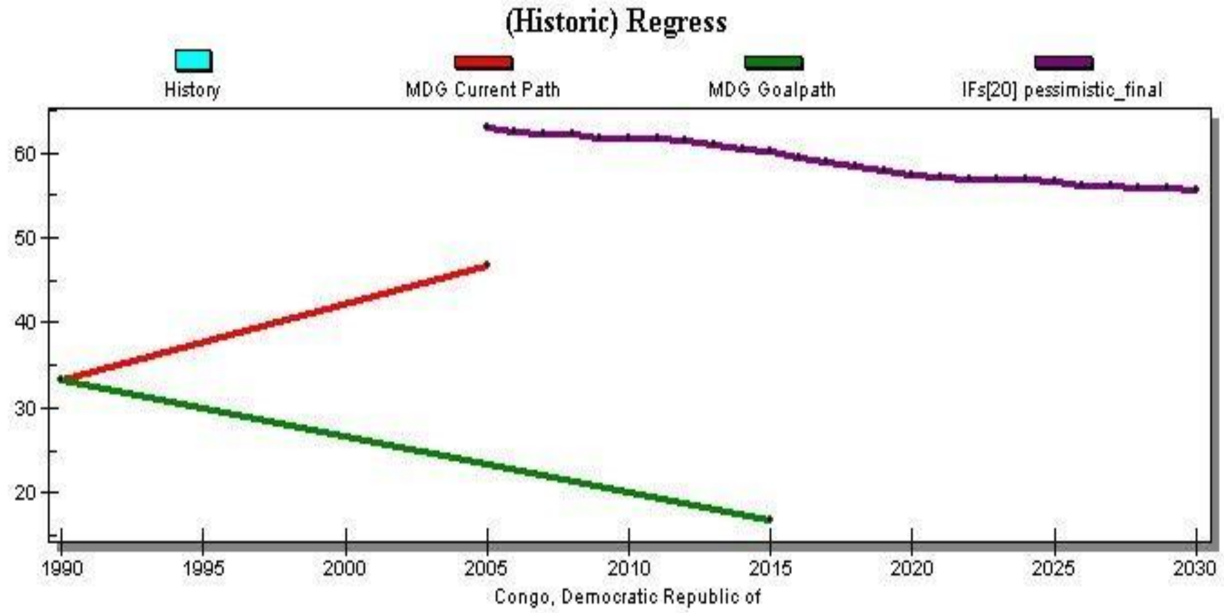


Poverty incidence lognormal

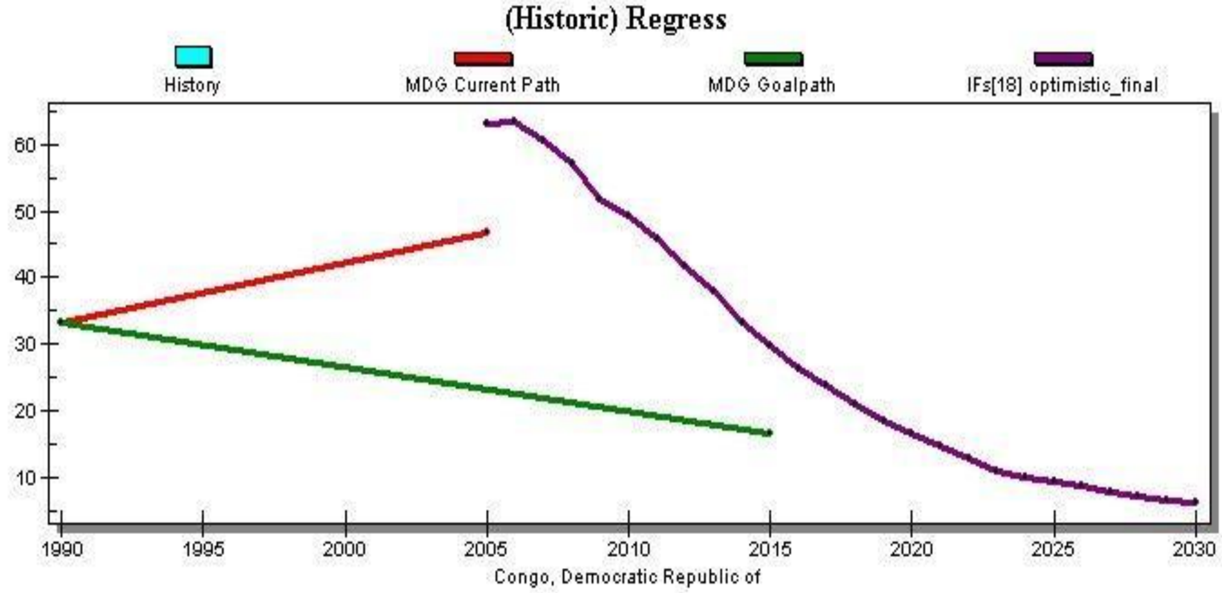


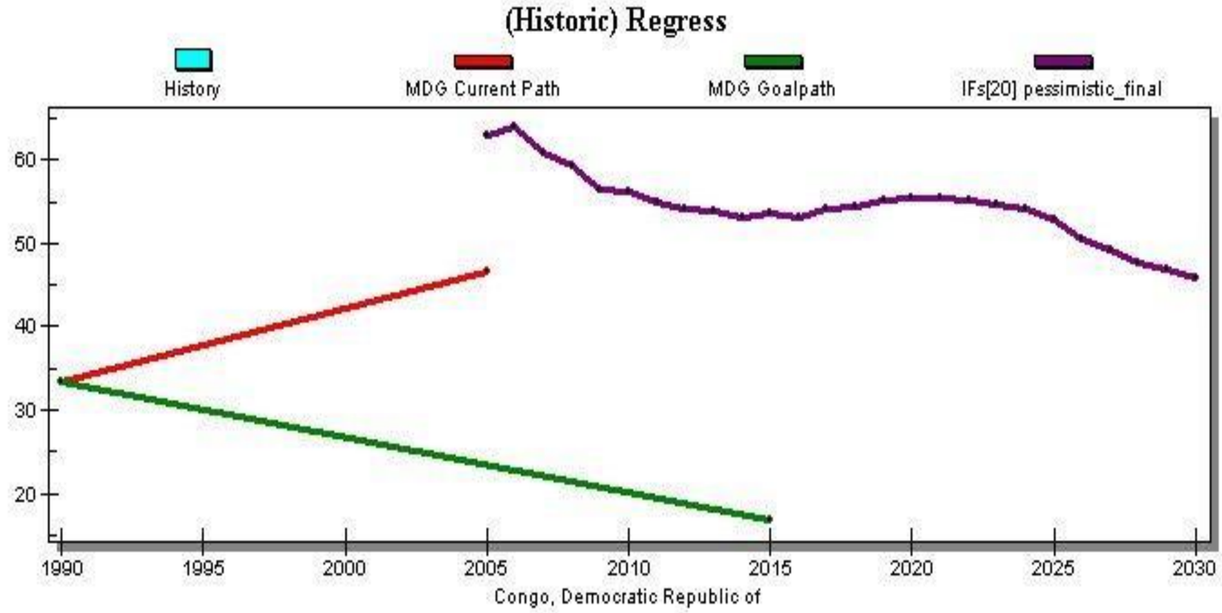
3.1 MDG1. Target 1. Halve the proportion of people whose income is less than dollar a day. CS formulation.



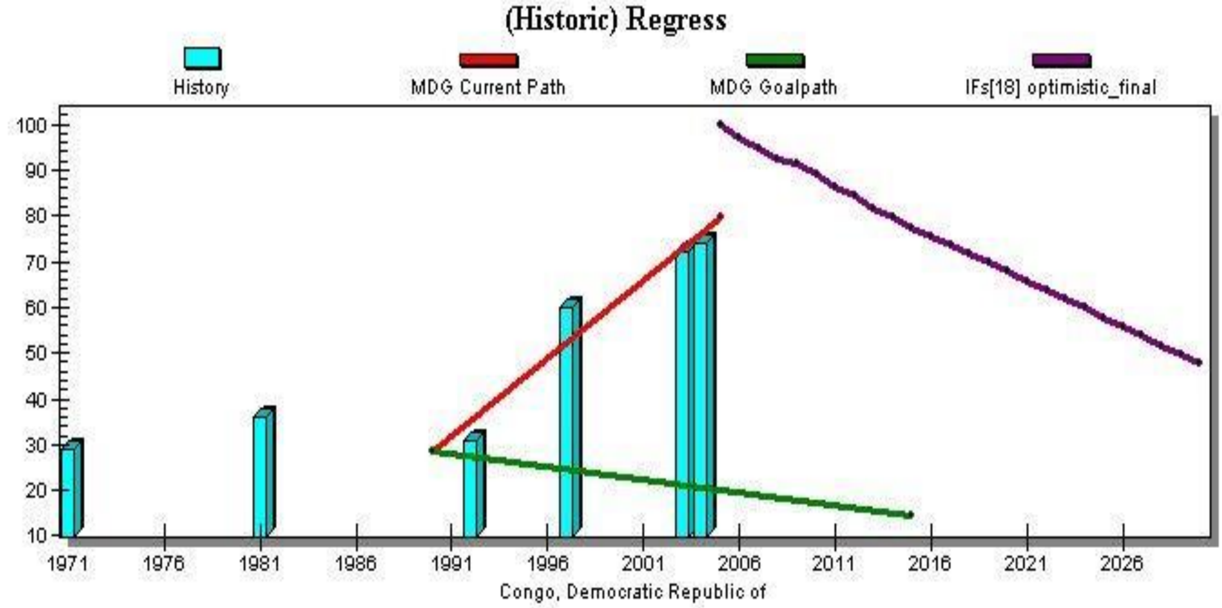


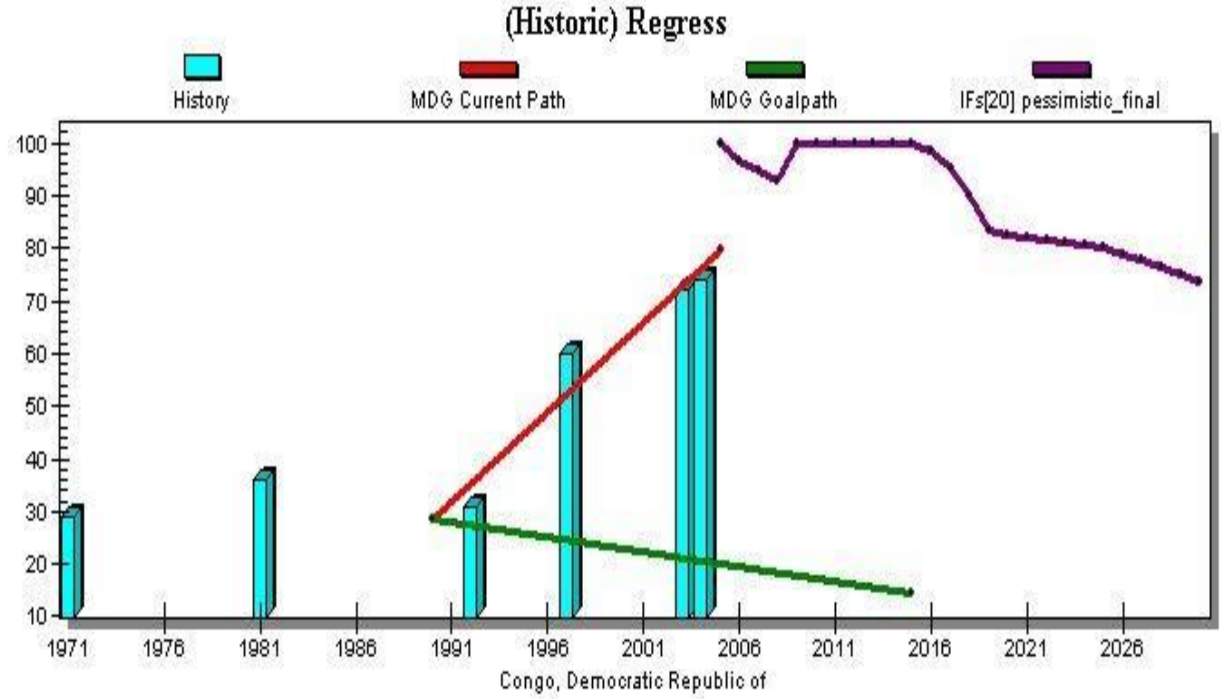
3.2 MDG1. Target 1. Halve the proportion of people whose income is less than dollar a day. Lognormal formulation.



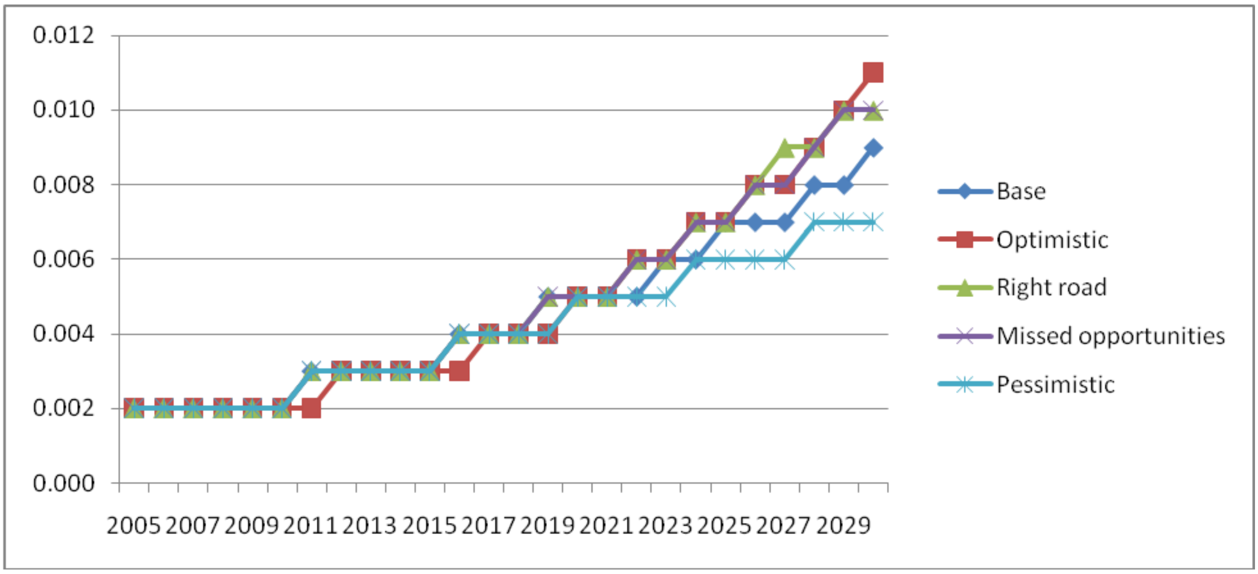


3.3 MDG1. Target 2. Halve the proportion of people who suffer from hunger.

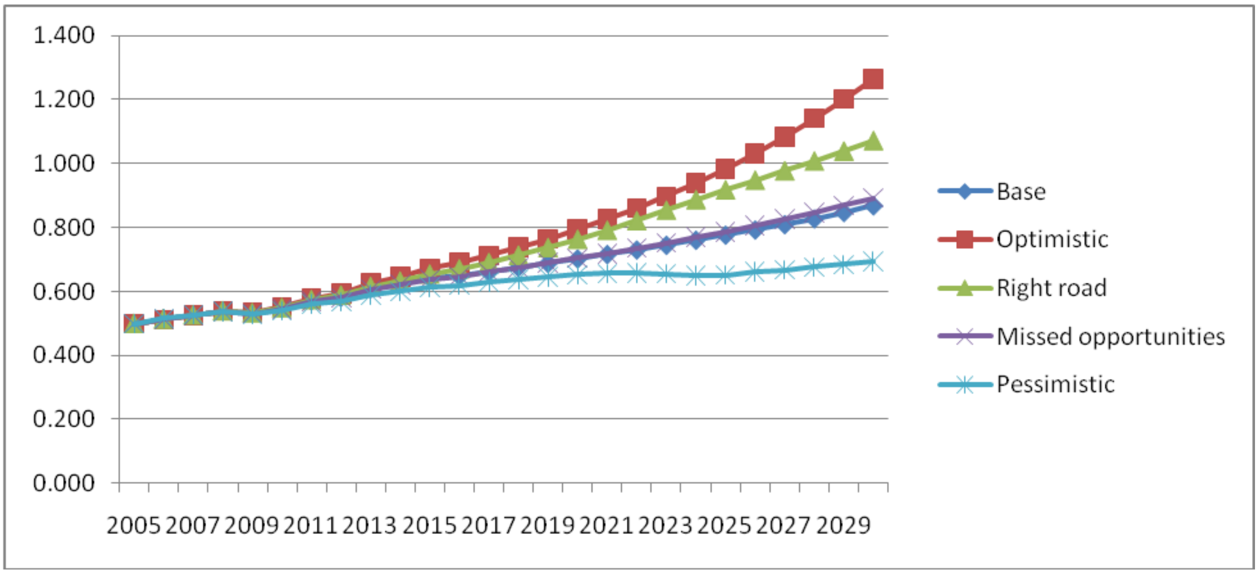




CO2 emissions (gigatons)

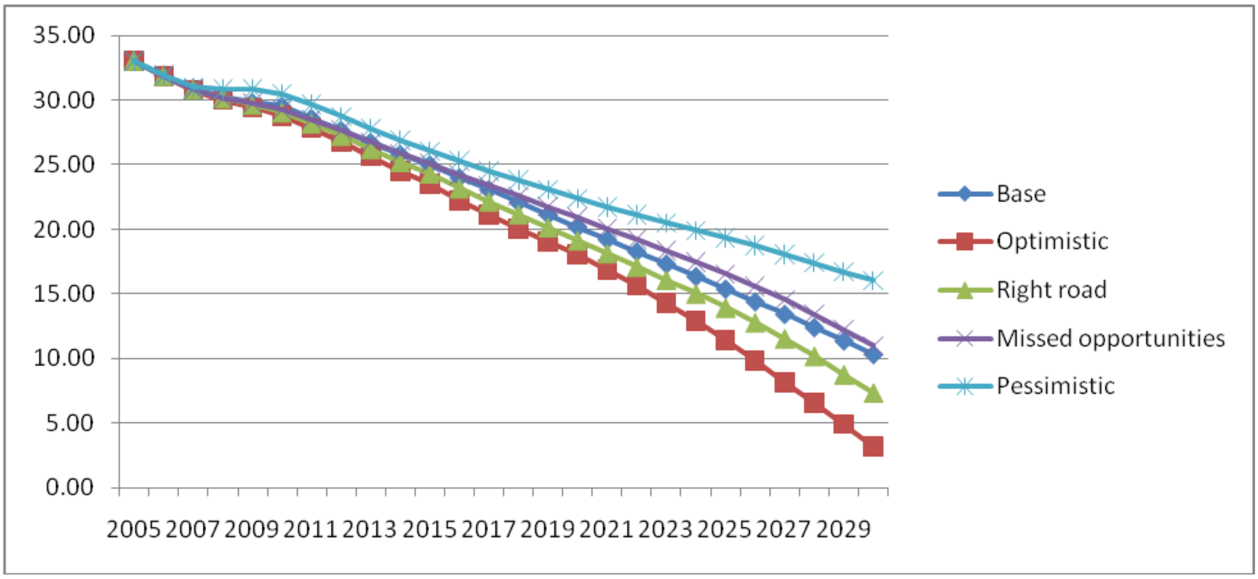


GDP per capita (thousands of 1995 PPP $ per capita)

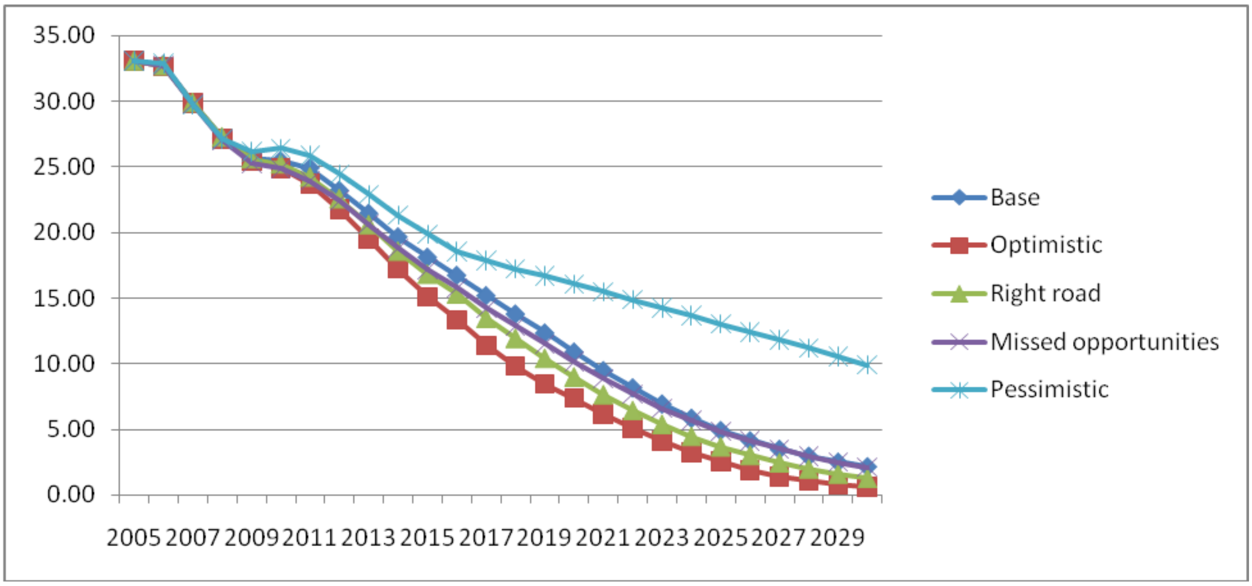


4 India

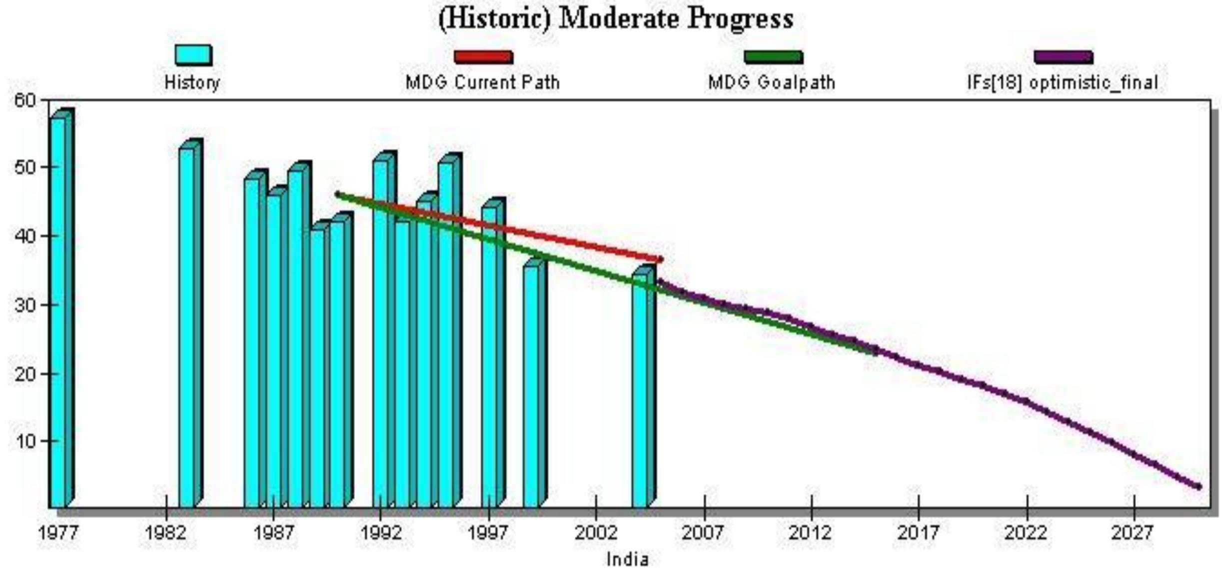
Poverty incidence cross section

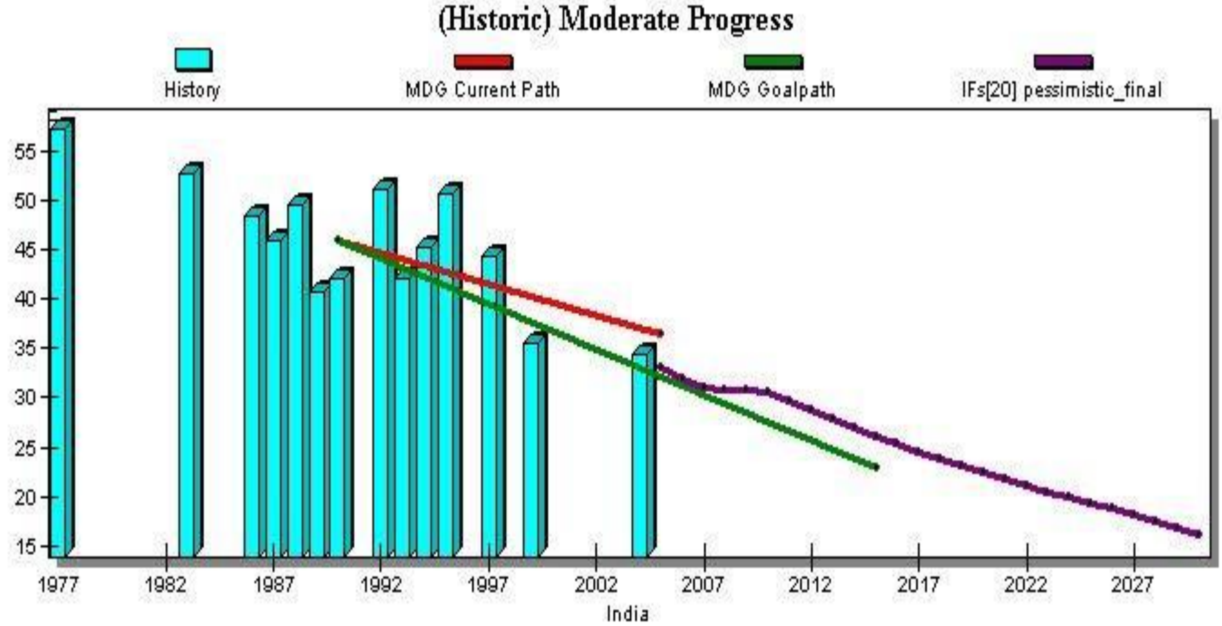


Poverty incidence lognormal

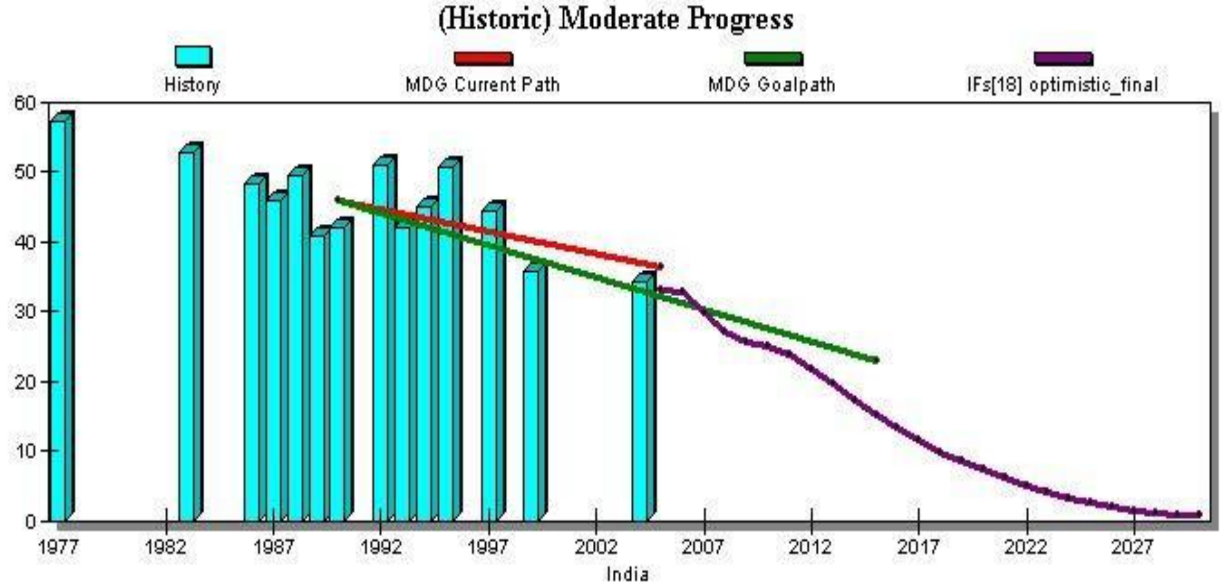


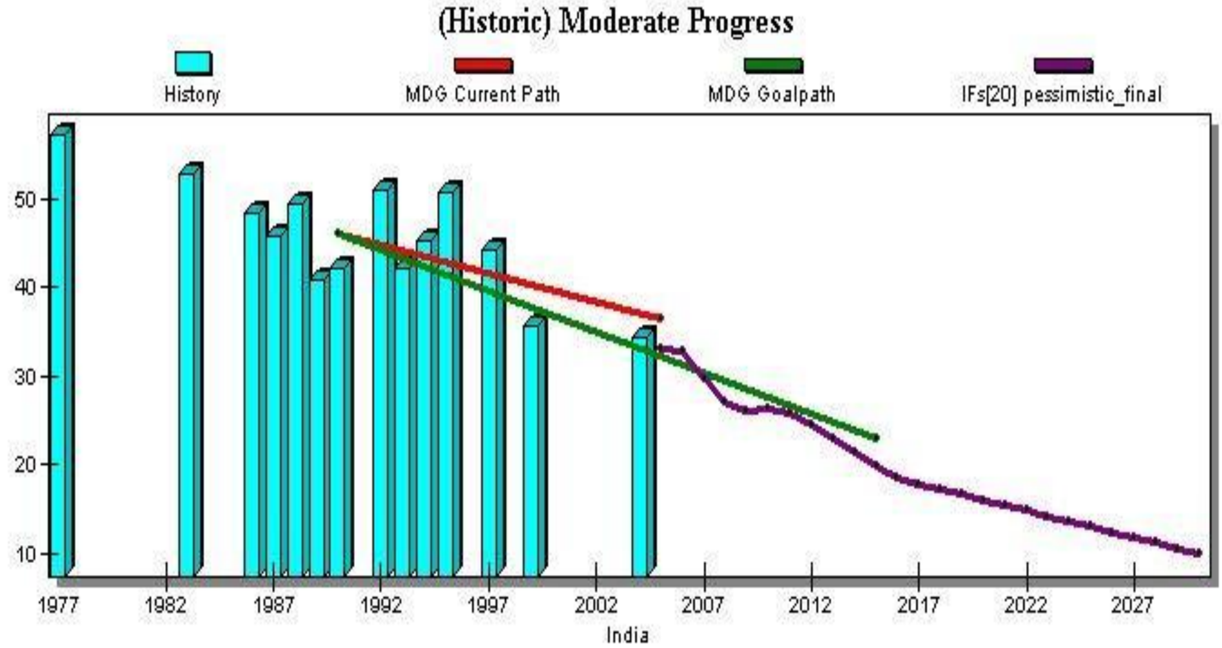
4.1 MDG1. Target 1. Halve the proportion of people whose income is less than dollar a day. CS formulation.



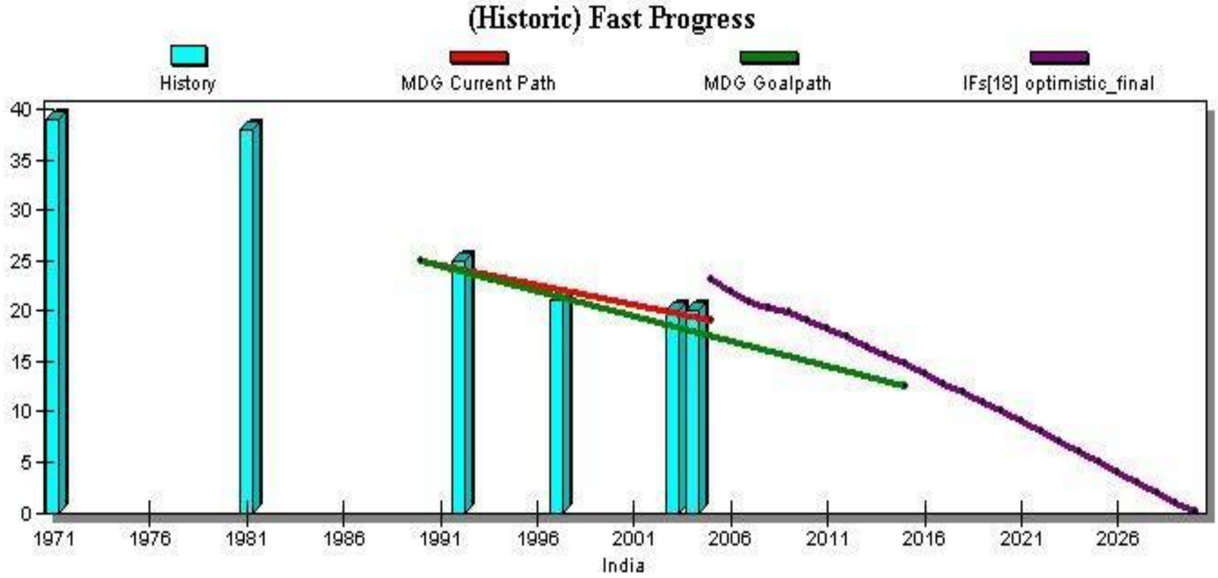


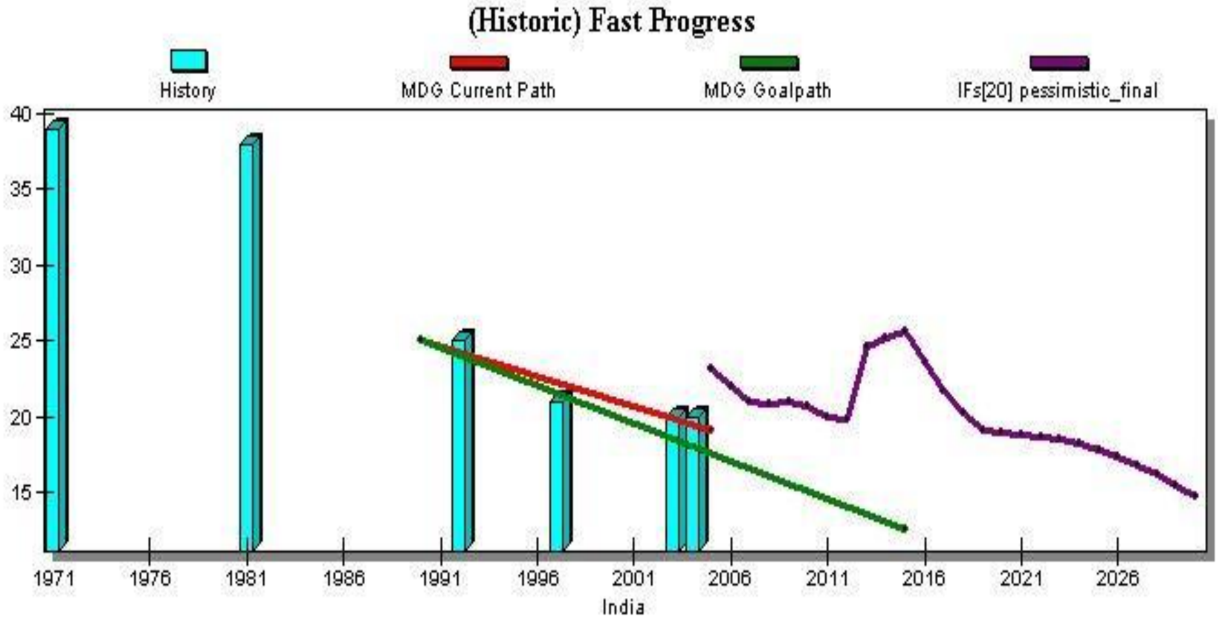
4.2 MDG1. Target 1. Halve the proportion of people whose income is less than dollar a day. Lognormal formulation.



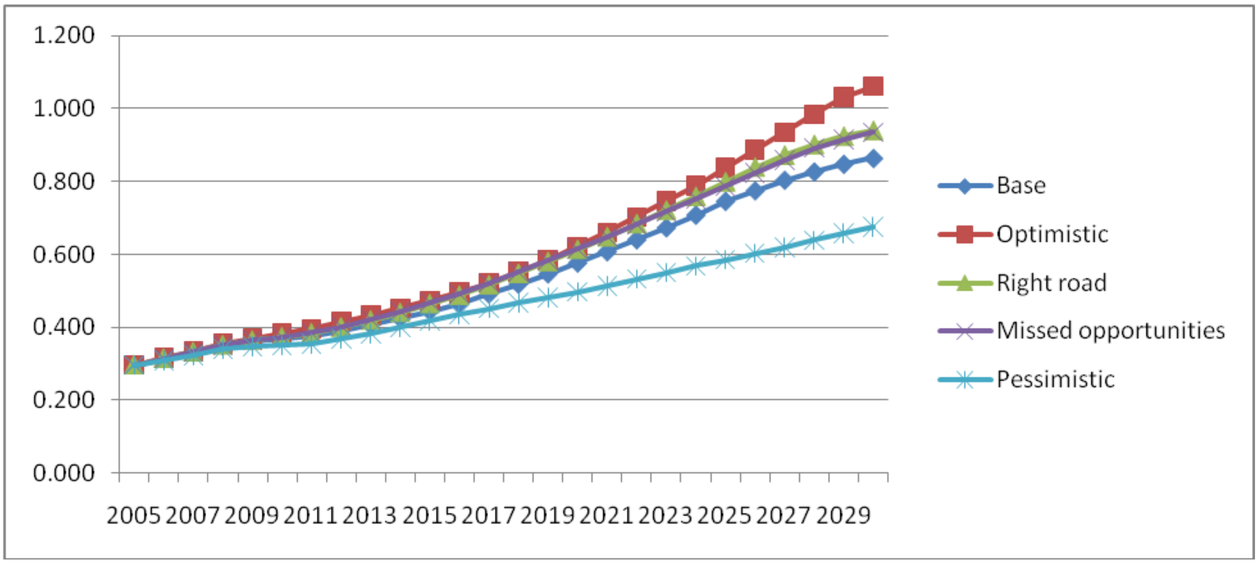


4.3 MDG1. Target 2. Halve the proportion of people who suffer from hunger.

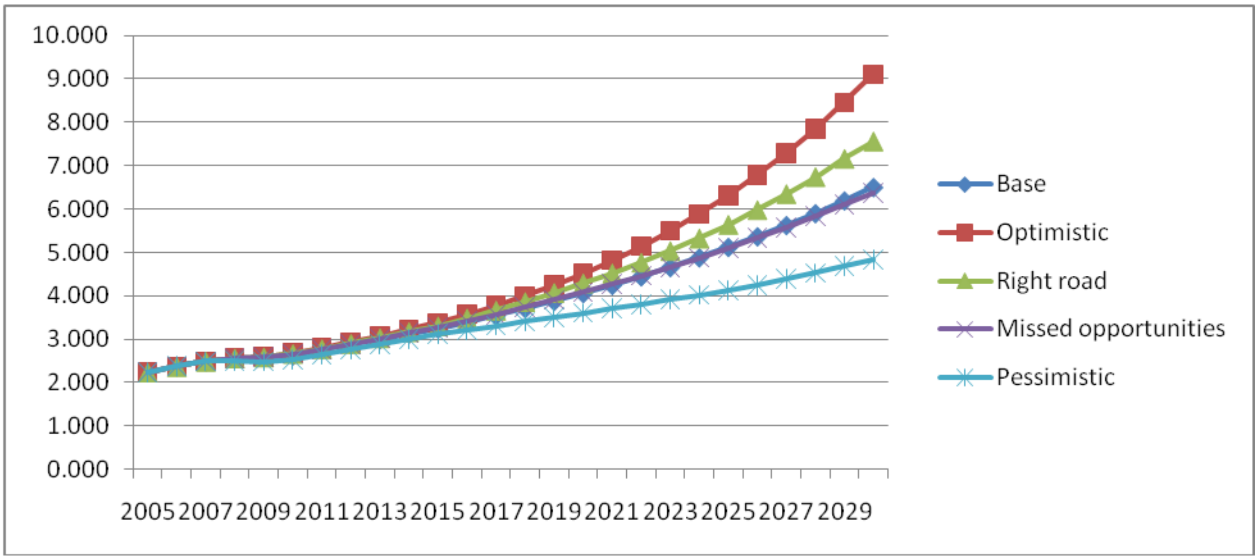




CO2 emissions (gigatons)

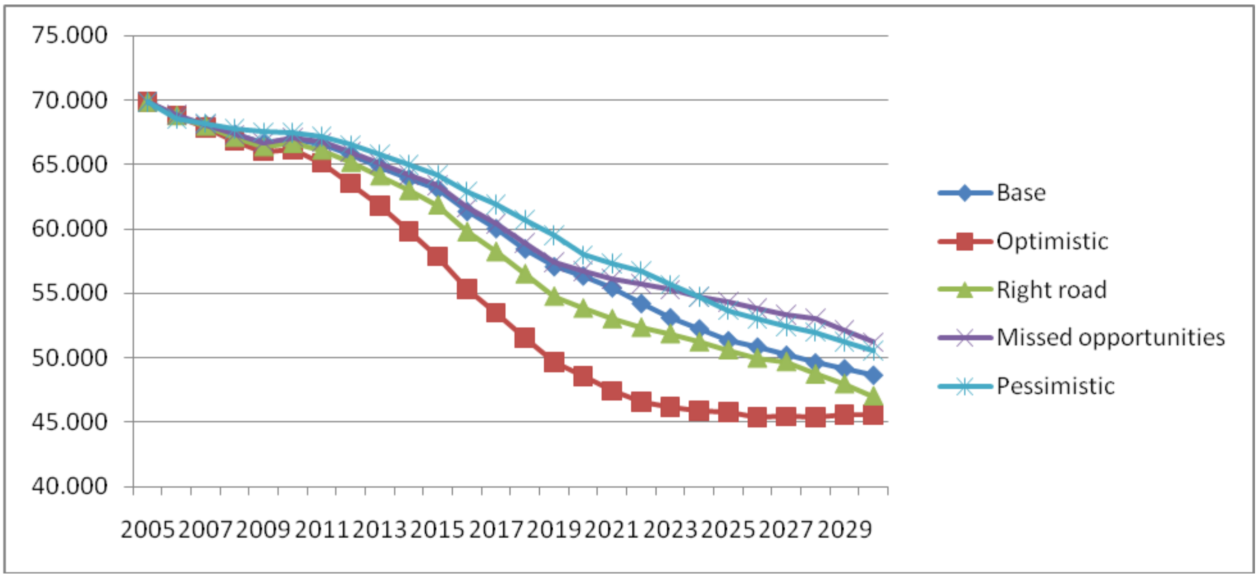


GDP per capita (thousands of 1995 PPP $ per capita)

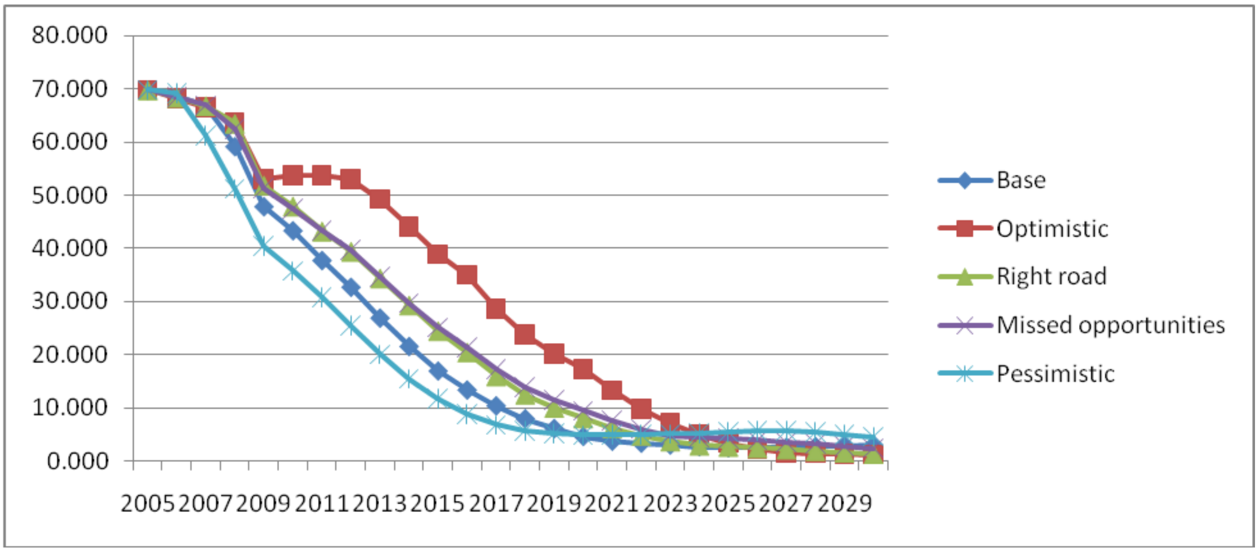


5 Nigeria

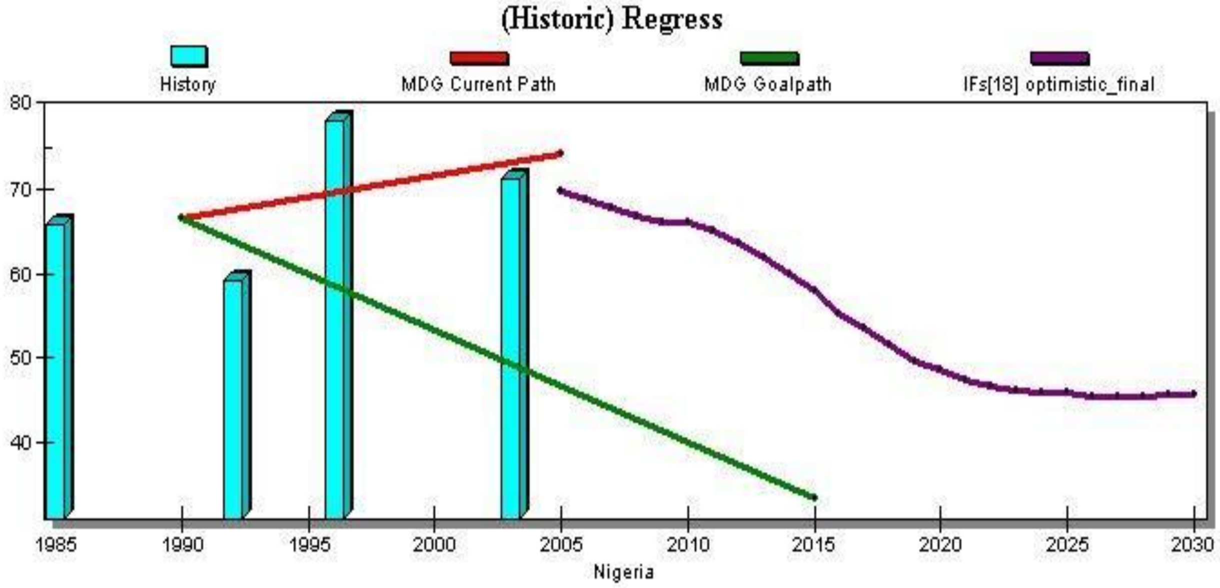
Poverty incidence cross section

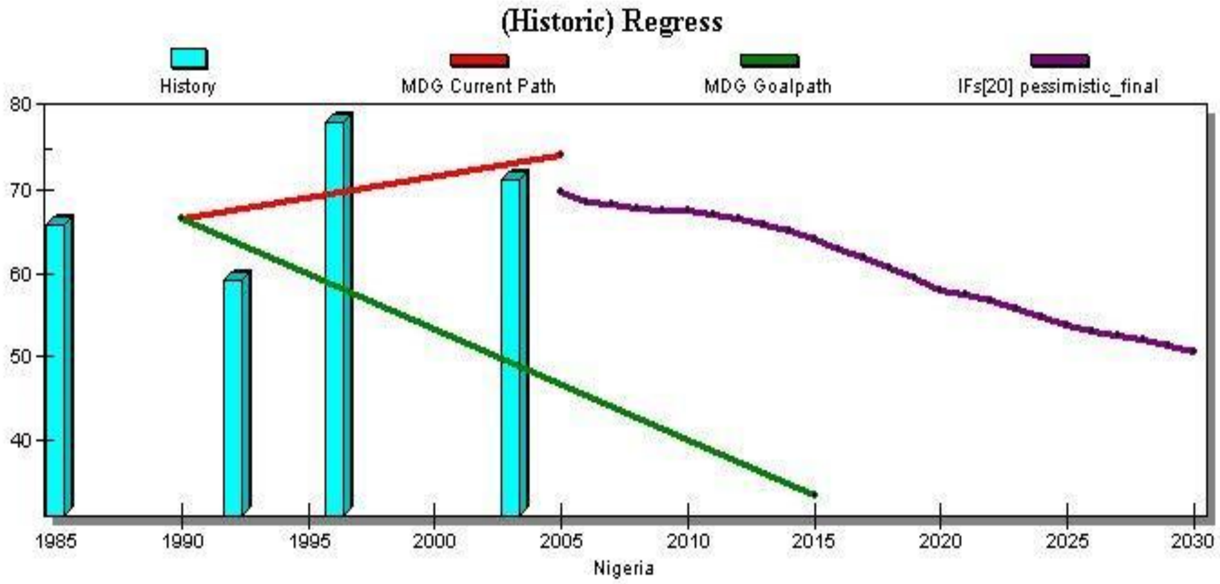


Poverty incidence lognormal

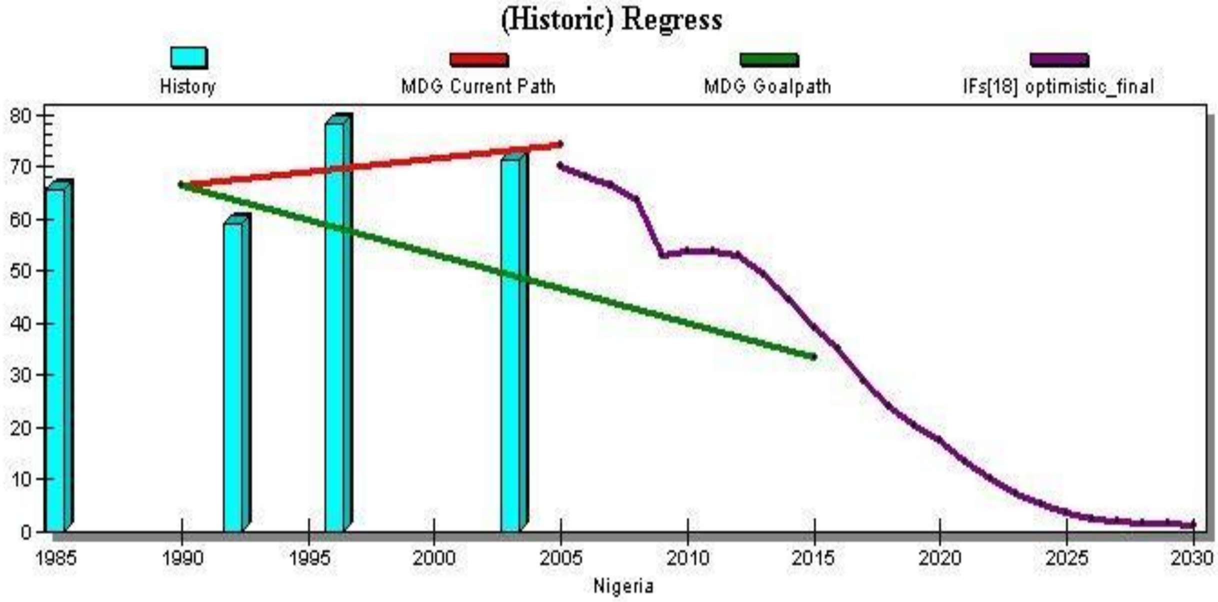


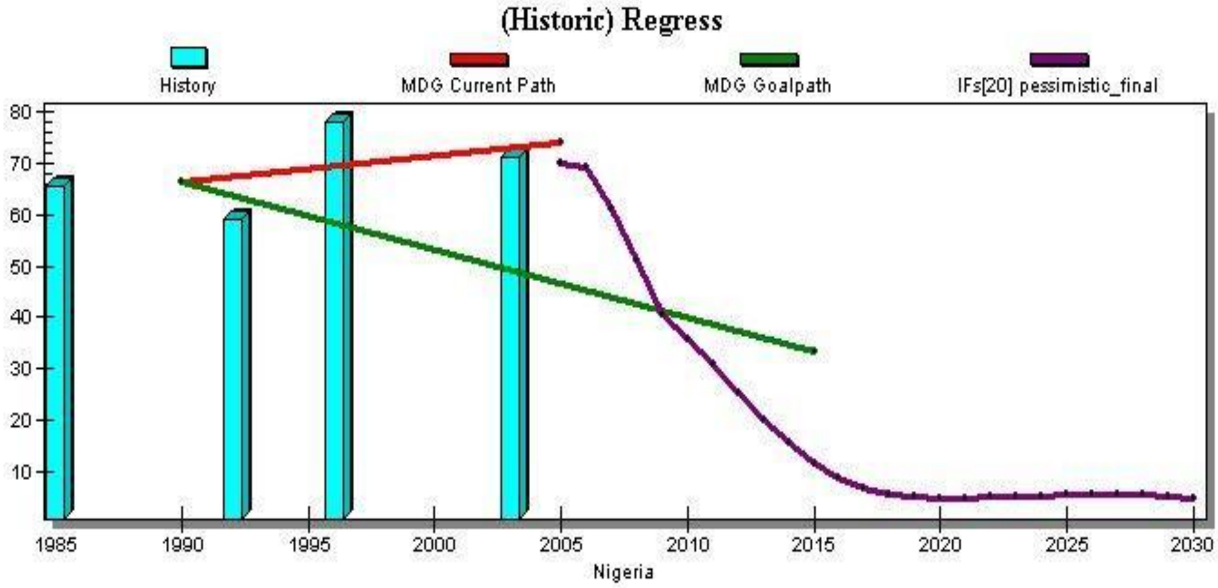
5.1 MDG1. Target 1. Halve the proportion of people whose income is less than dollar a day. CS formulation.



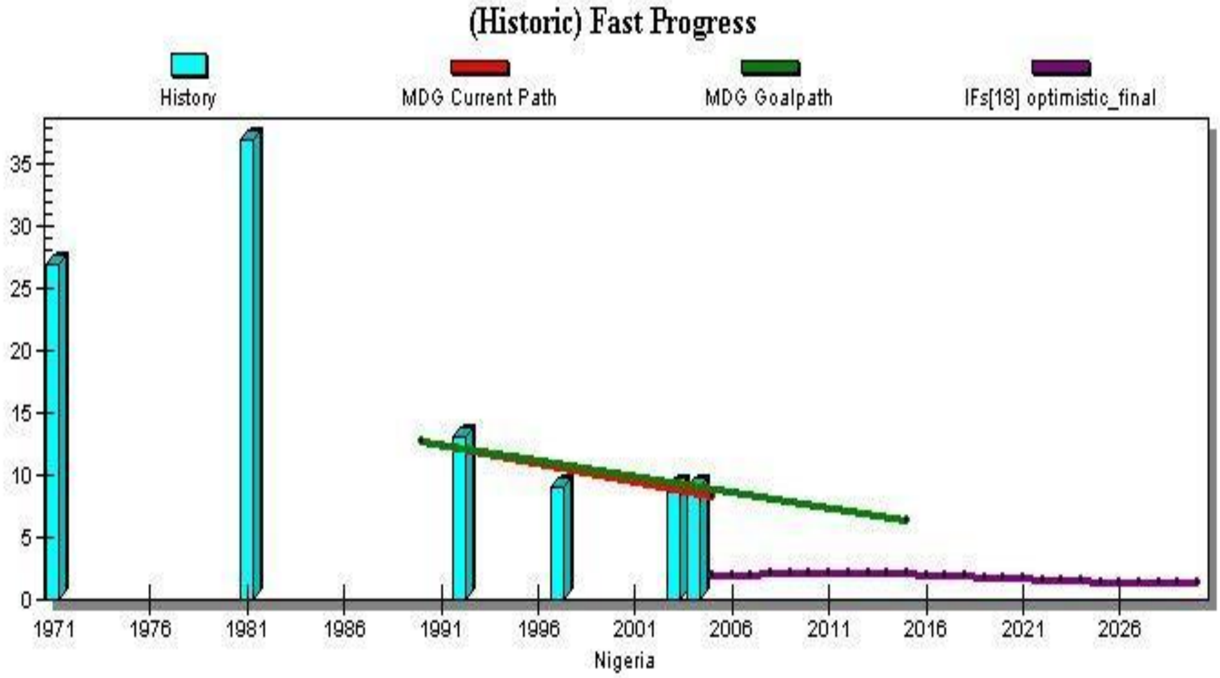


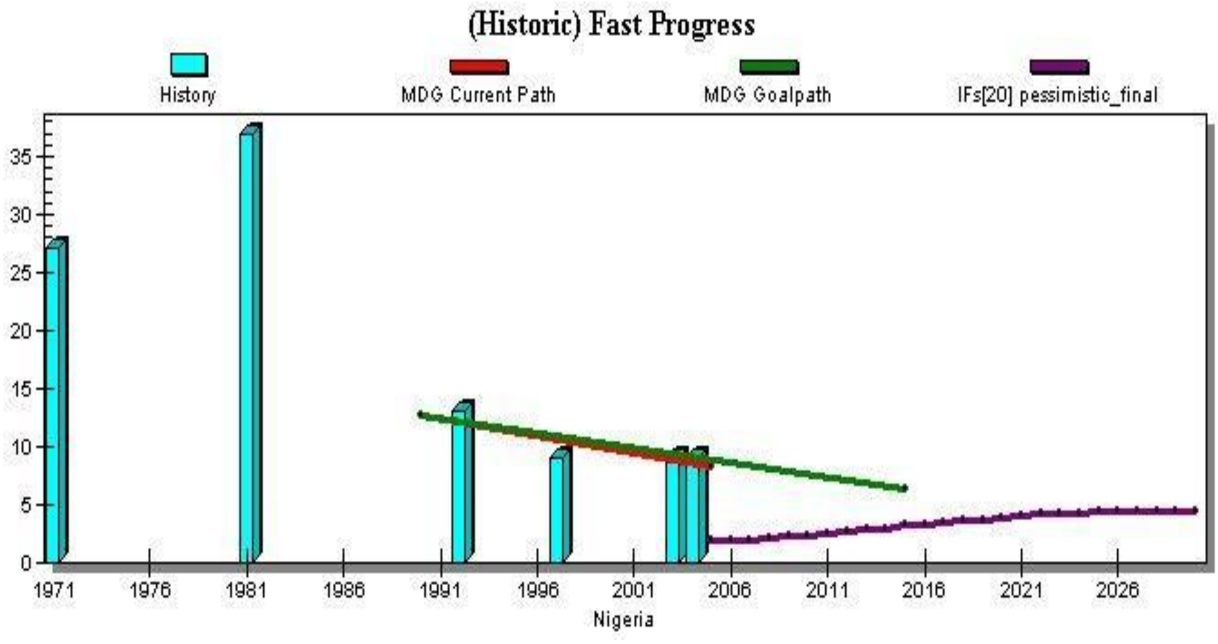
<u>*5.2 MDG1. Target 1. Halve the proportion of people whose income is less than dollar a day. Lognormal formulation.*</u>



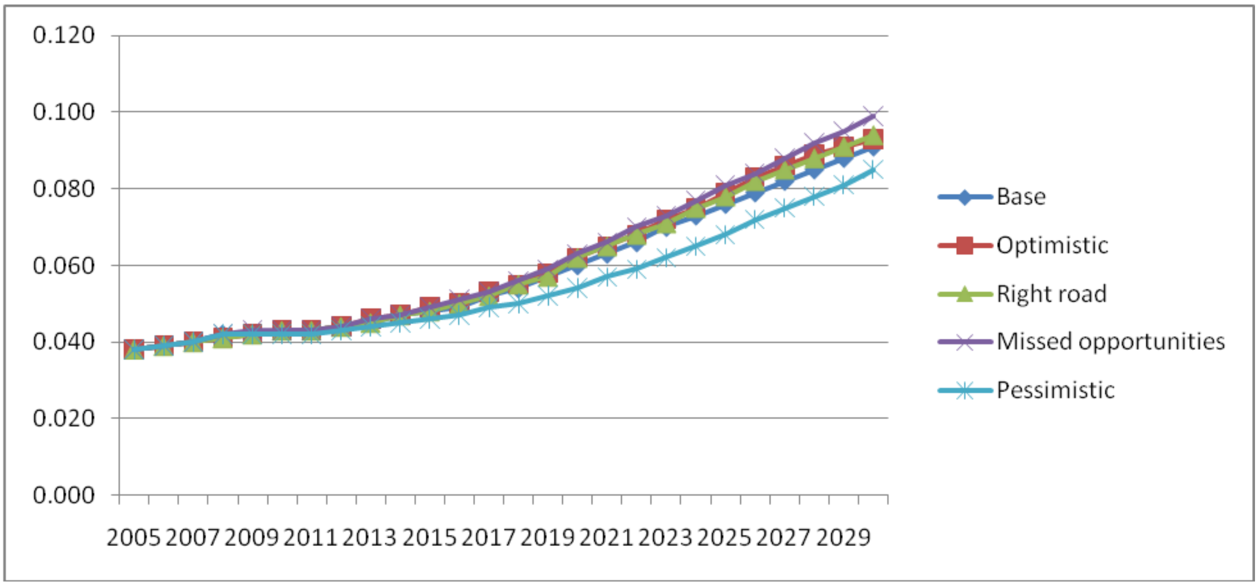


5.3 MDG1. Target 2. Halve the proportion of people who suffer from hunger.

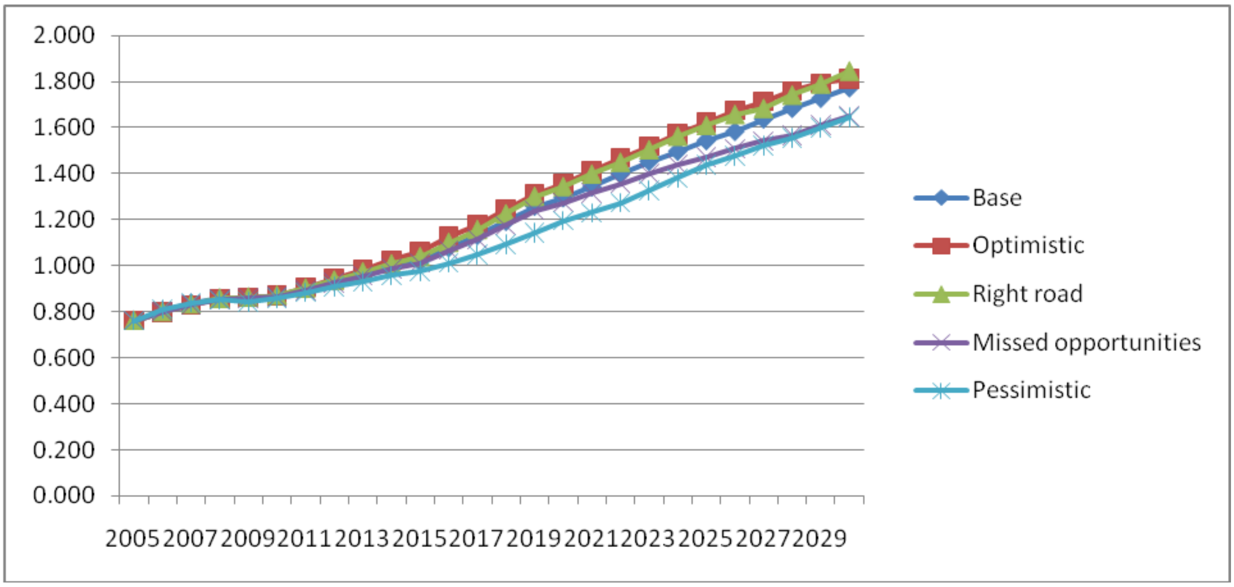




CO2 emissions (gigatons)



GDP per capita (thousands of 1995 PPP $ per capita)



Chronic Poverty Research Centre

www.chronicpoverty.org

The **Chronic Poverty Research Centre** (CPRC) is an international partnership of universities, research institutes and NGOs, with the central aim of creating knowledge that contributes to both the speed and quality of poverty reduction, and a focus on assisting those who are trapped in poverty, particularly in sub-Saharan Africa and South Asia.

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