BOEC (Back Of the Envelope Calculations) Working Paper Series: for USL1 (1.0)

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These papers will provide the easily digestible & short explanations and mechanisms about USL1 primarily targeted to the policy-makers and –shapers (in governments, NGOs, & the UN).

(BOEC Working Paper Series No. 2)

Why and how USL1 can halve the GDP growth doubling time (or double the growth rates)? (Version 1)

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ABSTRACT

In this paper, as the second paper of BOEC series, we show why and how USL1 can induce the (Real) GDP per capita growth rates as well as the (Real) GDP growth rate by halving the GDP (per capita) growth doubling time. An equivalent statement to this is roughly doubling the GDP growth rates. The presentations in each part will become increasingly more detailed or sophisticated in this paper. We present this by first simply estimating by adding 1% (after USL 0.5) or 2% (after USL1) etc. on the baseline growth rates. We first demonstrate that the USL doubling the GDP growth rates for the average world GDP, OECD average, the U.S.A., and Sub-Saharan Africa. They are the rough estimations, but they seem to fit reasonably well. Secondly, we use a bit more sophisticated algorithm adapted from the paper by Hanushek-Woessmann to visually demonstrate that USL1 roughly halving the (Real) GDP growth doubling time. Then we project the various scenarios for the baseline (Real or nominal) GDP (per capita or not) growth rates from 0.5% up to 7%. We didn´t include beyond the 7% because the USL1´s halving the doubling time error bars will be too big after then in most cases.

CONTENTS

INTRODUCTION

USL1 roughly halving the doubling time of the Growth rates

Here, we will demonstrate that the USL1 roughly double the GDP growth (per capita) rates for both the Real and Nominal GDP growths with the increasing sophistications.

Firstly, we will demonstrate that halving the growth doubling time is equivalent to double the growth rates.

PART 1: USL1 doubling the economic growth rates (from the fundamental observations on the global economic growth rates)

1) As the majority of countries – for the growths of a long period of time – have the (Real) GDP per capita growth rates between 1-2.5%, **USL1 roughly claims that it can halve the (Real)** **GDP growth rates per capita** although for the growth rates below 1% or above 3.5%, it diverge rather fast (for the BOEC Working paper series).
2) **For the Real GDPs**, the majority of countries grow between 1-3%; so USL1 roughly halving the Real GDP growth rates work reasonably well as well.
3) **For the (Nominal) GDPs,** the world average growth rates seem about 3.2-3.5% annually and diverge faster, but due to the population growth factors (typically between 0.5%-2.5%) that add to the GDP growth rates, in the majority of countries, USL1 roughly halve the GDP growth rates in general as well in most cases..

How USL1 halves the GDP per capita doubling time:

- Between the growth rates of the annual 0.5% and 1%, the USL1 roughly 3x-4x the doubling time.
- Between the growth rates of the annual 1% and 3%, the USL1 roughly halve the doubling time pretty well.
- For around the growth rates 3.5%, it reduces the doubling time by about 60-70%.
- For around the growth rates 5%, it reduces the doubling time by about 50%.
- For around the growth rates 7%, it reduces the doubling time by about 40%.

PART 2: USL1 doubling the GDP growth rates for the average world GDP, OECD average, the U.S.A., and SSA

Here, we will demonstrate that the USL1 doubling the GDP growth rates for the average world GDP, OECD average, the U.S.A., and Sub-Saharan Africa. They are the rough estimations, but they seem to fit reasonably well as you can see.

The world average (Real) GDP per capita growth rate is about 2-2.5% annually. So if you add 2% on top of this, then they become 4-4.5% annually after USL1 reforms, which is roughly 2x larger than before as growth rates.

If you focus on **GDP growths, not per capita, then the world average growth rates** currently are roughly about 3.2%-3.5%. Then if you add 2% on top of this and then the world population growth rate which is about 1.2%; so you have to add about 2% + 1.2% = about 3.2% extra on top of the baseline GDP per capita growth rates. The world average GDP growth rates then will become about 3.2-3.5% + 3.2% = about 6.4-6.7%, which is pretty close to the doubling of 3.2-3.5, which is supposed to be about 6.4%-7%.

For **the OECD average** growth rates, the annual growth rates of GDP per capita are currently about 2.4%. Their average population growth rates are about 0.4-0.8% (say 0.6%). So after USL1, if you add 2% (by USL1) + 0.6% (by population growth rates) together, then 2.4% + 2.6% = about 5%. Compared to the original 2.4% whose doubling will give about 4.8%, 5% is again very close.

For the **average or U.S.A. GDP growth** rates, the annual growth rates of GDP per capita are currently about 1.5% while its nominal GDP growth rate is about 2.5%. Their average population growth rates are about 0.6%. So after USL1, if you add 2% (by USL1) + 0.6% (population growth rate) to the baseline 1.5%, then the original GDP growth rates of the USA of about 2.5% by adding 2.6% becomes about 5.1%, very close to doubling the growth rate.

For **the SSA (Sub-Saharan Africa),** the current average Real GDP per capita growth is about 2-2.4% (say 2.2%) and GDP growth rate is about 4.5-6% (say about 5.2%). Their population growth rate average is about 2.6%. So, from their baseline Real GDP per capita growth of 2.2%, if you add the USL1-induced 2% then their Real GDP per capita growth rises from 2.2% average to 2.2% + 2% = about 4.2%, which is almost the doubling the Real GDP per capita growth rate. For the GDP growth rate average, fro, 5.2% + 2% (by USL1) + 2.6% (population growth rate) = 9.8%, which is very close to doubling their baseline 5.2%.

Part 3: simplified estimations to show that the USL1 will roughly halve the GDP doubling time

As the USL1 will roughly boost Real GDP per capita by 2%, the nominal GDP boosts will be slightly more than adding 2% to each country (at least Real and a bit more for the nominal) GDP growth rates in general.

For the USA and most of the OECD countries, will be about adding 2.5%, for the South Asian countries, a bit more than adding 4%, and for SSA it will be adding a bit more than 4.5% due to the population growth rates need to be taken into account. Having said so, the following rough estimations demonstrate that the USL1 can actually roughly halve the GDP growth rates.

Notice that the yellow color shows the growth rates are roughly halved by USL1 and other colors are for more deviations for more or less.

HWU1 rule to halve the GDP doubling time

Countries, regions or Economic clusters	Growth rate ^ (years) without USL reforms (at the current rates)	Halving time to double GDPs	Deviations from the halving by HWU1 rule
Sluggish EU countries	1.015^50 = 2.1	1.038^20 = 2.1	5 years less than (about 10% less) expected to 2x
Developed countries	1.02^35 = 2	1.045^17 = 2.1	Good enough
U.S.A.	1.025^30 = 2.098	1.05^15 = 2.08	Good enough
The World	1.035^20 = 1.99	1.07^10 = 1.97	Good enough
Latin America	1.04^18 = 2.03	1.075^9.5 = 1.99	Taking 0.5 yrs. more (about 5% off)
Sub-Sahara Africa	1.05^15 = 2.08	1.1^7.5 = 2.04	Good enough
South Asia	1.06^12 = 2.01	1.1^7.5 = 2.04	Taking 1.5 years more than expected to 2x (25% off)
high growth rate countries (SSA)	1.075^10 = 2.06	1.12^6.5 = 2.09	Taking 1.5 years more than expected to 2x (30% off)
Very high growth rate countries (SSA)	1.09^8 = 2	1.14^5.5 = 2.06	Taking 1.5 years more than expected to 2x (about 40% off)

TABLE 1 (Part 3): For most countries except those whose GDP grow below 1.5% or above 6% per year, the HWU1 rule for USL1 tend to approximate the time needed to halve the GDP doubling time.

PART 4: to show the halving of the growth doubling time visually

The simulation algorithm used here is taken from the first phase of the typical Hanushek-Woessmann GDP growth projections. Although 2% boost is the normal, we spread that out over 5, 10, 20 years. For instance, if the reforms take 20 years, then we divide 2% by 20 years; so each year, linearly add 0.1% to the growth rates so that in 20 years, it becomes 20 year x (0.1%/20 year) = 2%. We didn´t follow the rest of the Hanushek-Woessmann simulation algorithm.

In the following charts,

- The bottom projection curves (sky blue) are the growth rates without the USL 0.5 or USL1 involvements.
- The middle 3 clusters are the GDP per capita growth rates induced by the USL 0.5.
- The top 3 clusters are the GDP per capita growth rates induced by the USL1.
- For each clusters of 3 curves, each projection curve corresponds to the USL x reform times of 5 years (top), 10 years (middle), and 20 years (below).

As you can see for most cases, what really matters the most is the boosting of the average school math skills much more than the reform times, relatively speaking.

Comparisons of the GDP per capita growths induced by USL 0.5 vs. USL 1.0 with the 3 different USL x reform time scenarios (of 5 years, 10 years, and 20 years)

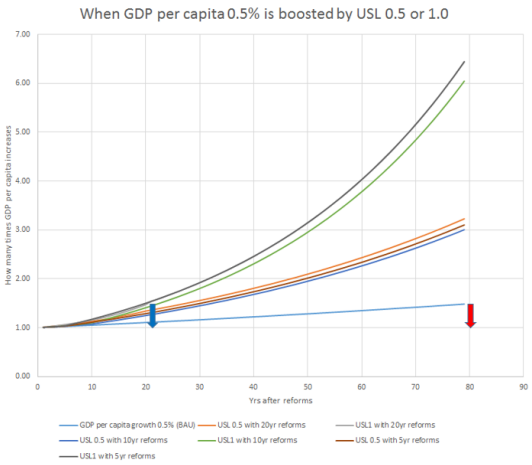
In the following charts, the thin blue color lines at the bottom are the baseline EAU (Education As Usual) that grow as they are expected to. The two clusters of curves above are: the middle ones with USL 0.5 reforms (that boost the national or state average school math by 1 year). The top 3 curves are the growths induced by USL1 reforms (that boost the national average school math by 2 years).

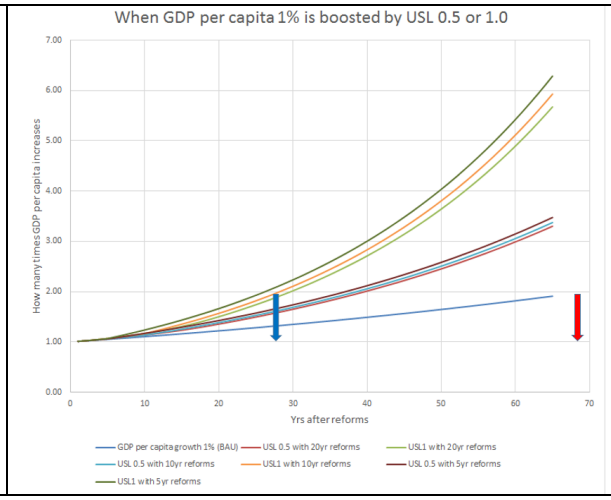
Also for each USL 0.5 or 1.0 clusters, the top ones are with the reforms in 5 years, middle curves are with the 10 years, and the bottom curves are with the 20 years (the typical projections that Hanushek-Woessmann have used.)

In this section, **red arrow bars are the original baseline for the doubling time**. The blue arrow bars facing down on the left are the growth rates (real or nominal) (per capita or not) after the USL1-induced reform started.

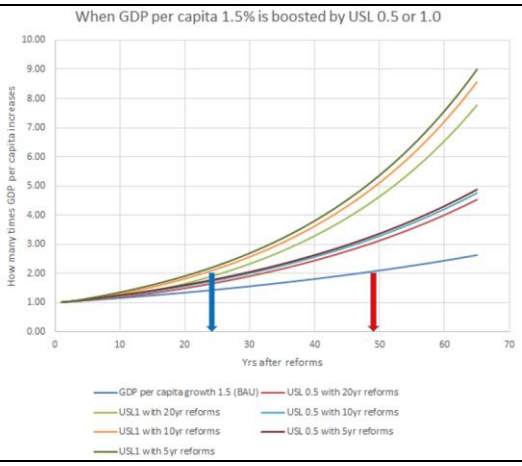
Notice that as years go by, how many times the GDP grows exponentially after the USL reforms compared to the EAU cases.

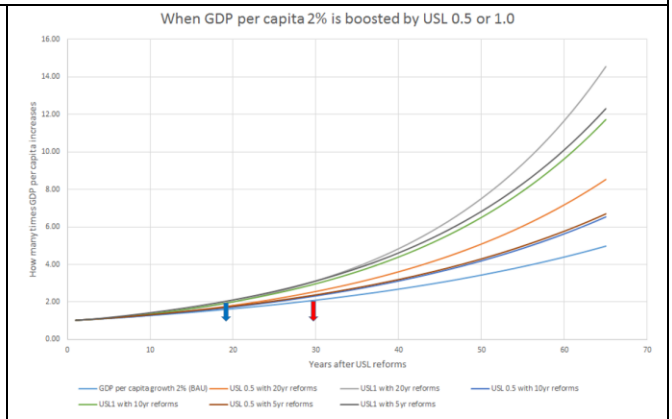
Between the growth rates of the annual 0.5% and 1%, the USL1 roughly 3x-4x shortens (not just halving) the doubling time.



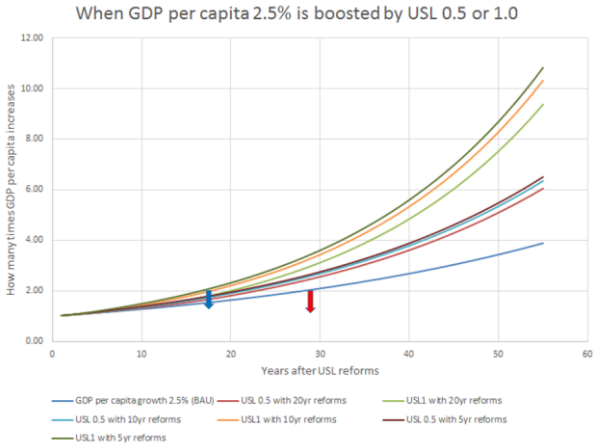


Between the growth rates of the annual 1% and 3%, the USL1 roughly halve the doubling time pretty well.



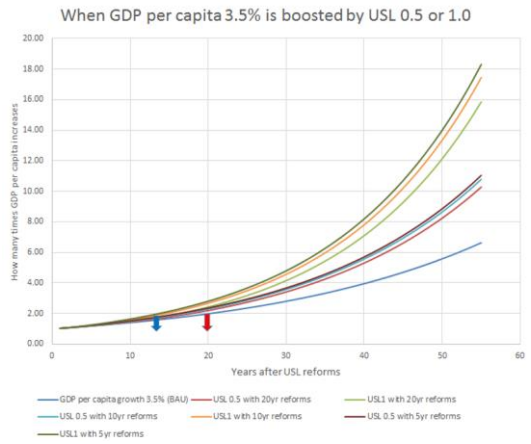


For both per capita GDP and GDP growth rates, the majority of countries fall into 1-3% growth rates. So you can see the differences here.



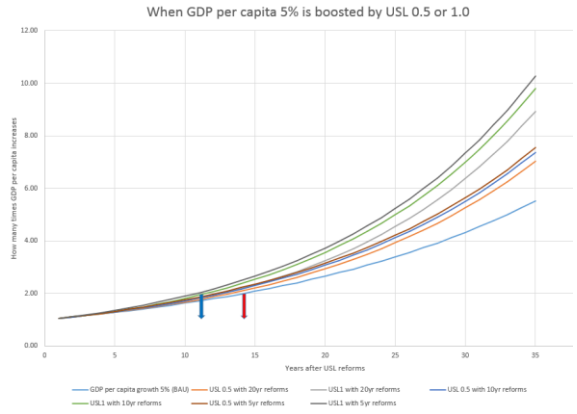
The world average GDP per capita growth rates are about 2.5%. So you can see that USL1 induce the halving of the world GDP per capita growth rates for the majority of the world.

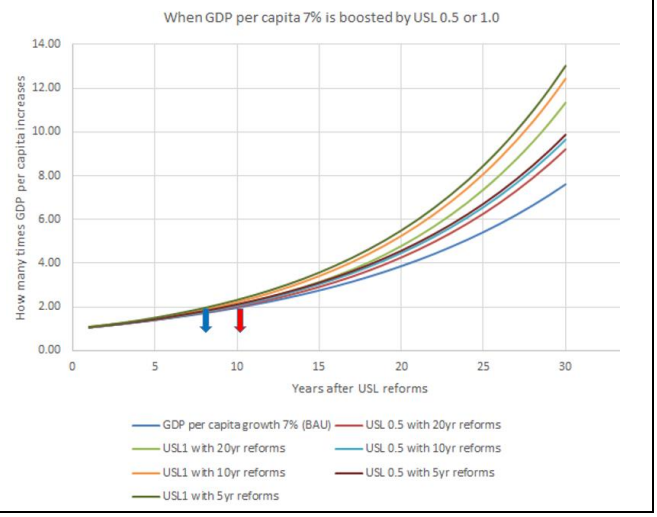
The U.S.A. or Canada´s (or many OECD countries) ´ average GDP growth rates are about 2.5%. So you can see that USL1 induce the halving of their GDP growth rates.



The world average GDP growth rates are about 3.5 or slightly less%. So you can see that USL1 induce the halving of the world GDP per capita growth rates for the majority of the world. Here, we didn´t take into account the population growth rate factors. If you do, it roughly halves the world GDP growth rates with USL1.

Over the growth rates of 3.5% annually, the USL1 reduce the doubling time by roughly 20-30% (as the deviations get large). Again, in this section, we didn´t take into account of the population growth rates at all, but if we do, errors reduce dramatically.



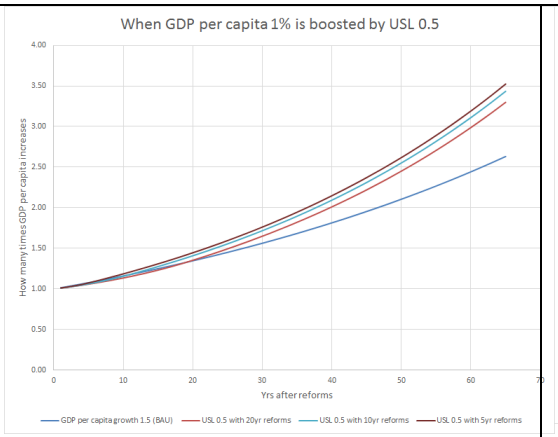
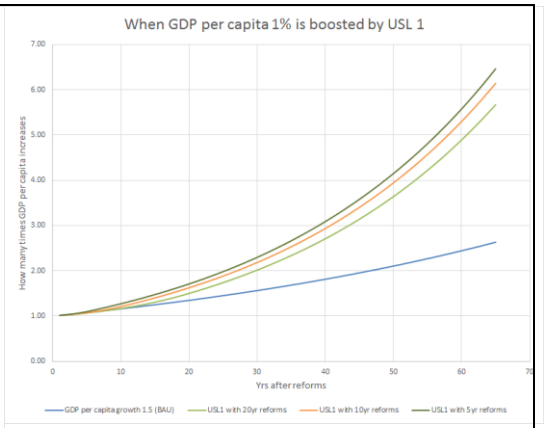
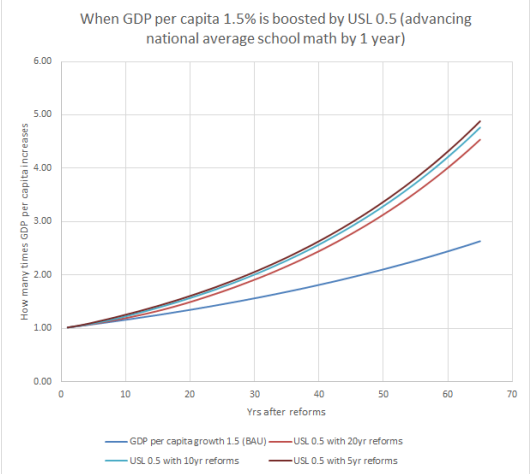
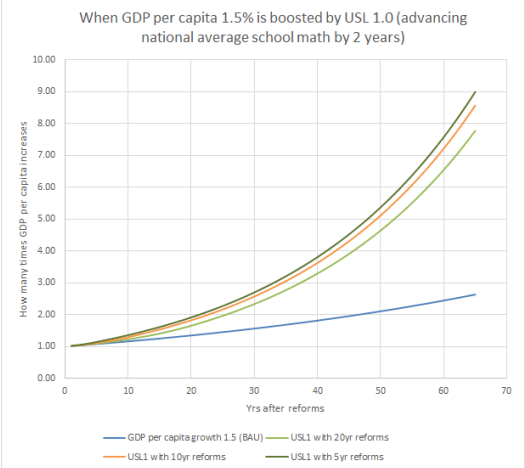
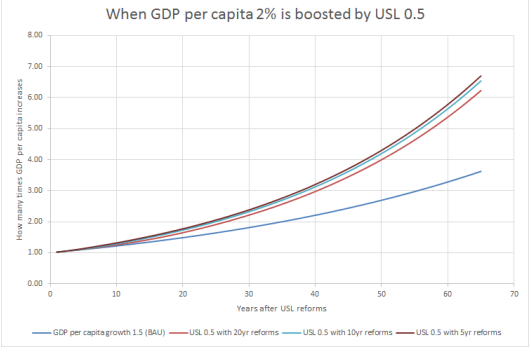
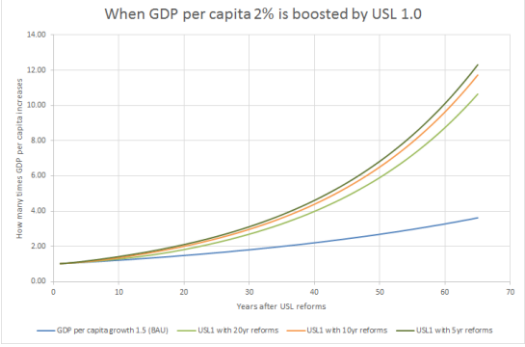


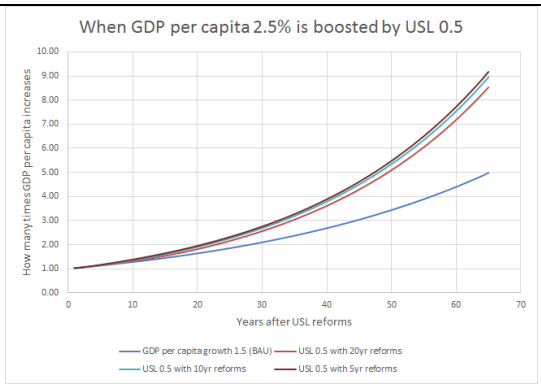
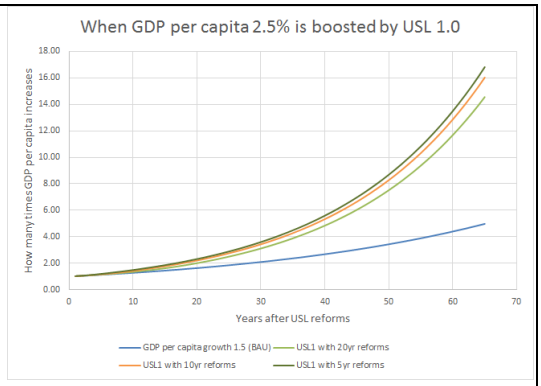
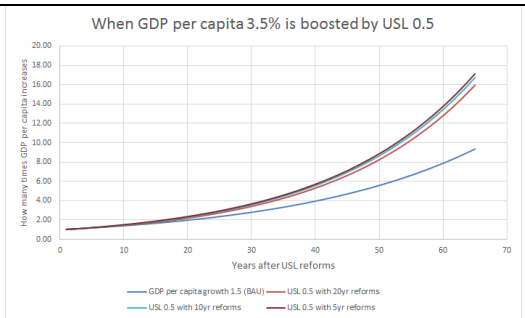
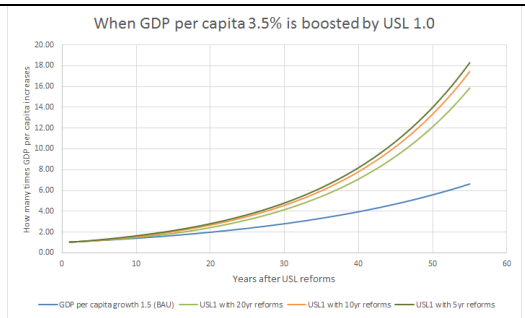
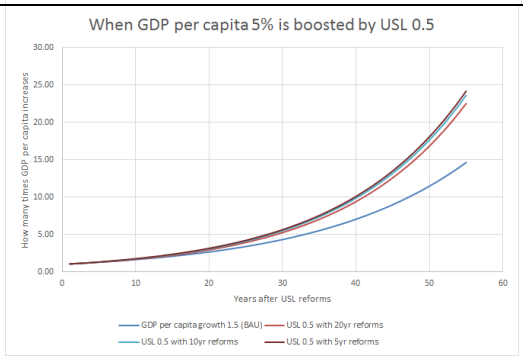
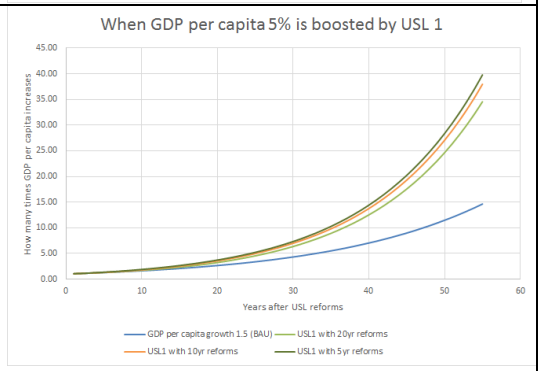
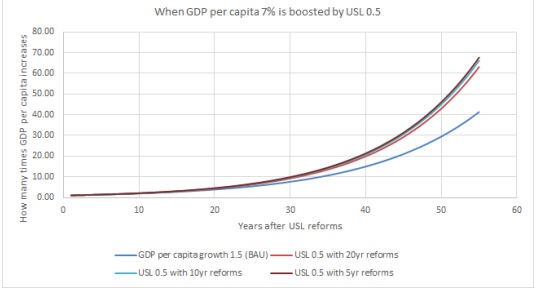
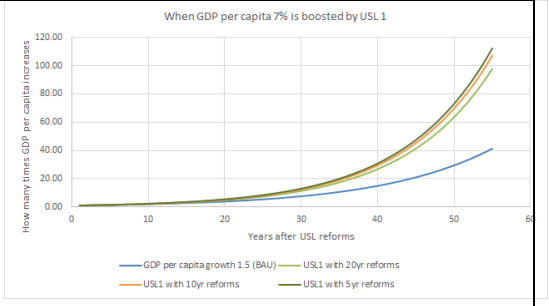
PART 5: Comparisons of the GDP (per capita) growths induced by USL 0.5 vs. USL 1.0 (5, 10 20 yr. reforms)

This part 5 is basically the same as Part 4, using the same algorithm except that we focus more on the GDP growths over the periods of time instead of halving the growth doubling time.

In the following, on the left column, we projected the GDP growth (per capita) after USL 0.5 reforms. On the right column, we projected the GDP growth (per capita) after USL 1 reforms.

	Boosted by USL 0.5	Boosted by USL 1

1%	 When GDP per capita 1% is boosted by USL 0.5 How many times GDP per capita increases Yrs after reforms GDP per capita growth 1.5 (BAU) USL 0.5 with 20yr reforms USL 0.5 with 10yr reforms USL 0.5 with 5yr reforms	 When GDP per capita 1% is boosted by USL 1 How many times GDP per capita increases Yrs after reforms GDP per capita growth 1.5 (BAU) USL1 with 20yr reforms USL1 with 10yr reforms USL1 with 5yr reforms
1.5 %	 When GDP per capita 1.5% is boosted by USL 0.5 (advancing national average school math by 1 year) How many times GDP per capita increases Yrs after reforms GDP per capita growth 1.5 (BAU) USL 0.5 with 20yr reforms USL 0.5 with 10yr reforms USL 0.5 with 5yr reforms	 When GDP per capita 1.5% is boosted by USL 1.0 (advancing national average school math by 2 years) How many times GDP per capita increases Yrs after reforms GDP per capita growth 1.5 (BAU) USL1 with 20yr reforms USL1 with 10yr reforms USL1 with 5yr reforms
2%	 When GDP per capita 2% is boosted by USL 0.5 How many times GDP per capita increases Years after USL reforms GDP per capita growth 1.5 (BAU) USL 0.5 with 20yr reforms USL 0.5 with 10yr reforms USL 0.5 with 5yr reforms	 When GDP per capita 2% is boosted by USL 1.0 How many times GDP per capita increases Years after USL reforms GDP per capita growth 1.5 (BAU) USL1 with 20yr reforms USL1 with 10yr reforms USL1 with 5yr reforms

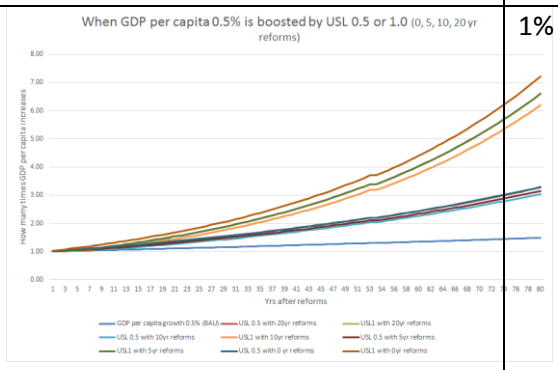
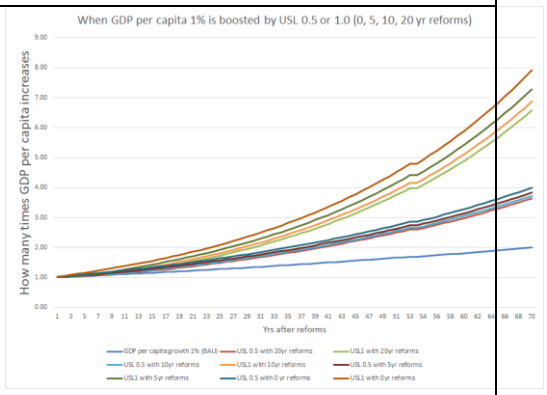
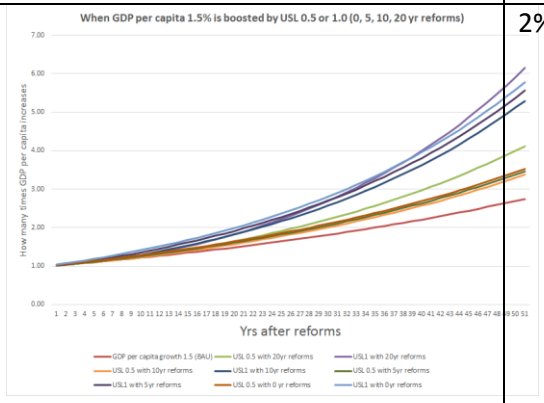
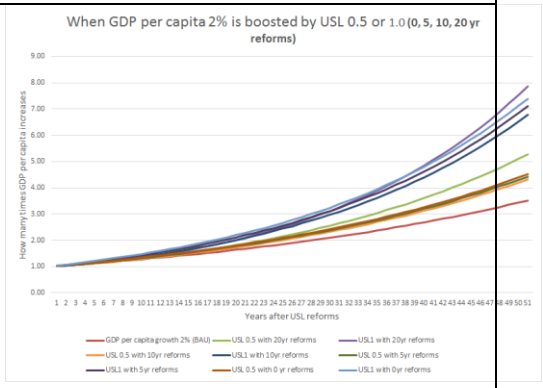
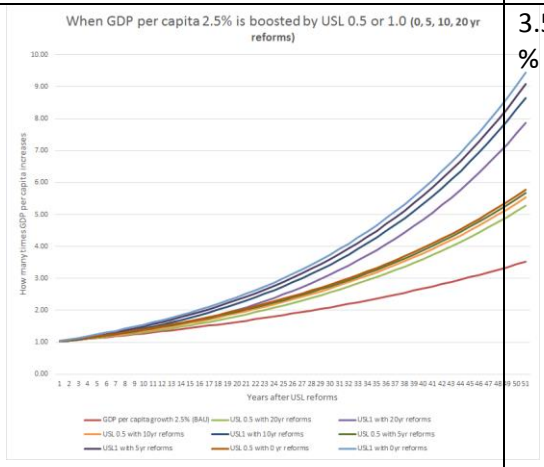
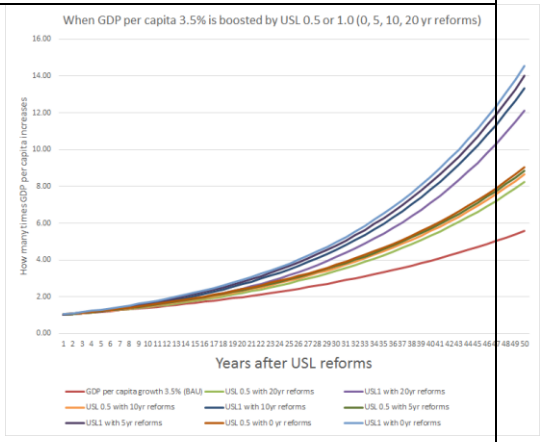
2.5 %		
3.5 %		
5%		
7%		

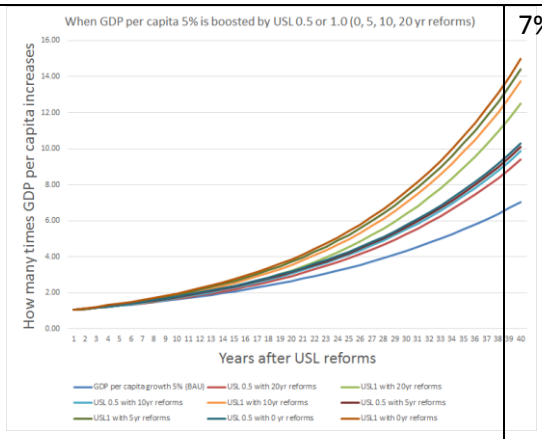
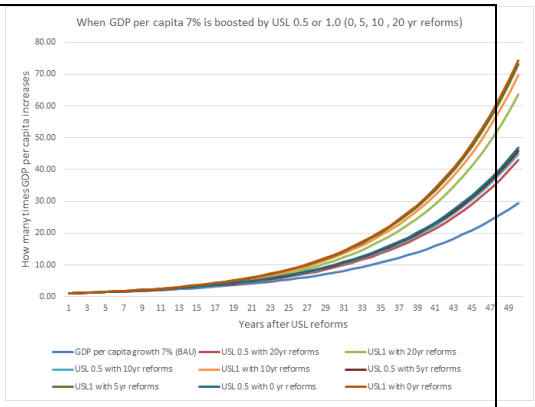
PART 6: Comparisons of the GDP (per capita) growths induced by USL 0.5 vs. USL 1.0

(Pretending as if it idealized case of 0 yr. reforms, 5, 10 20 yr. reforms)

Part 6 is the same as Part 5 except that for each chart the top curve is for the USL1-induced GDP growths pretending the impacts start immediately with the 0 reform time (which is very idealistic and oversimplified) just to see the differences of the growths as time goes on.

This is almost the same as the Appendix 2 except that you can see 4 curves in each cluster instead of 3 curves. The top of each curve is typically the idealized case as if there was no reform time necessary and the USL impacts the GDP growth rates immediately.

	Boosted by USL 0.5 & 1		(0, 5, 10, 20 yr. reforms)
0.5 %		1%	
1.5 %		2%	
2.5 %		3.5 %	

5%		7%	

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Hanushek, E. A., & Woessmann, L. (2011). *Education For All: Global Monitoring Report (2012/ED/EFA/MRT/PI/01).* Obtenido de http://www.unesco.org/: http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/ED/pdf/gmr2012-ED-EFA-MRT-PI-01.pdf