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A II. Rákóczi Ferenc
Kárpátjai Magyar Főiskola
tudományos évkönyve

Tartalom

Gazdaság

SZABOLCS PÁSZTOR: What Could the Future Bring for Africa's New Oil Exporting Countries?	9
SZPÁSSZKY GÁBOR: Beruházási folyamatok Ukrajna agrárpolitikája tükrében	19
ДНІСТРЯНСЬКИЙ МИРОСЛАВ СТЕПАНОВИЧ: Місце міжнародних регіональних об'єднань та транснаціональних корпорацій в сучасній територіально-політичній організації світу	31
SÁNDOR BERGHAUER – LÁSZLÓ GYURICZA: The Peculiarities of the Development of Tourism in Ukraine	37
BENYE JÁNOS: Tatabánya területfejlesztési koncepciója és a politika kapcsolata	45

Történelem

SIPOS MÓNICA: Kárpátalja etnikai arculatának változása 1945–2001 között	65
BARÁTH VIKTÓRIA: A donbászi munkaszolgálat a Beregszászi járás elhurcoltjainak emlékezetében	73
PALLAGI LÁSZLÓ: A „malenykij robot” a somi lakosok emlékezetében	87
BOROS LÁSZLÓ: Cserkészek és leventék Kárpátalján 1938–1941	93
BUJDOSÓ ISTVÁN: Az Ungvári Drugeth Gimnázium története (az alapítástól az 1880-as évek végéig)	101
DOBOS SÁNDOR: Levéltári források. Beregszász természetes és első mesterséges utcaneveiről	113

Egyház (történet)

SZENDREY ANITA: A beregszászi római katolikus egyház helyzete a szovjet rendszer kiépítésének kezdetén (1944–1949)	127
TÓTH ZSUZSA: A Kárpátaljai Református Egyházkerület megalakulása, egyházmegyéinek küzdelmei a Csehszlovák Köztársaság kötelékében (1920–1928)	135
МАНУРСЬКА АНЕТТ: Adalékok a beregszászi református temető történetéhez és jellemzéséhez	143

Nyelv, nyelvtanítás, pedagógia

- БЕРЕГСАСИ АНИКО–ЧЕРНИЧКО СТЕПАН: Образовательная и языковая политика Украины как фактор языковых конфликтов 149
- MÁRTA FÁBIÁN–ILONA LECHNER–ERZSÉBET BÁRÁNY–ILONA HUSZTI: Teaching English to young learners through stories: Implementing story-based language teaching methodology in pre-service teacher training 157
- KOMONYI ÉVA–LÉTAI BÉLA: Miért nem szeretik a diákok a kémiát? 165

Természet

- SZANYI SZABOLCS: Vándorló és terjedő nagylepkefajok (Lepidoptera, Macroheterocera) Kárpátalján 179
- ILLÁR LÉNÁRD–FÁBIÁN ZOLTÁN: Nappali nagylepkék élőhelyek közötti elterjedése Tiszakeresztúrban 185
- JEVCSÁK MELINDA–KOVÁCS GIZELLA–JÁMBORNÉ BENCZÜR ERZSÉBET: Az Ungvári Botanikus Kert fásnövény anyagának felmérése és értékelése 197
- КЛИМОВИЧ П. В.: Фізико-хімічні властивості як показник ландшафтно-меліоративної характеристики ландшафтів 209

Recenzió

- HIRES-LÁSZLÓ KORNÉLIA: Recenzió. Ukrajna nyelvi és etnikai sokszínűsége egy kötet tükrében MELNIK SZVITLANA – CSERNICKÓ ISTVÁN: Етнічне та мовне розмаїття України: аналітичний огляд ситуації 215
- LECHNER ILONA: Recenzió. HIRES-LÁSZLÓ KORNÉLIA: „Az öreg fát már nagyon nehéz kivágni” A nemzeti és lokális identitás faktorai az ezredfordulón a kárpátaljai magyar közösségben 219

What Could the Future Bring for Africa's New Oil Exporting Countries?

Rezümé Manapság kezdik felismerni a nemzetközi tényezőpiacok az afrikai kontinens olajtartalékainak jelentőségét. Az utóbbi években a GDP látványosan növekedett a Guineai-öböl országaiiban. Ebben a tanulmányban két kőolajexportáló ország (Gabon és Nigéria) kőolajkitermelésre alapozott fejlődési lehetőségeit vizsgáltam meg. Az elemzéseimhez módszertani alapot az összefüggés-vizsgálati módszerek nyújtottak, melyek közül a kétváltozós korreláció- és regresszióanalízist szeretném kiemelni. A jövőkép felvázolásakor pedig trendszámítást végeztem, melyeket később extrapolációval tettem még egzaktabbá. A kutatás végső következtetéseként megállapítottam, hogy a növekvő kitermelt kőolajmennyiségnek köszönhetően növekedhet a gazdasági teljesítmény, viszont a jólét eloszlása továbbra is rendkívül egyenetlen marad a hatalmon lévő katonai, félkatonai rezsimok miatt. Kiemeltem továbbá az ún. nyersanyagátok jelenségét, amely a nyersanyagban bővelkedő országokat fenyegetheti.

Abstract Recent days the world is recognising the importance of the Africa's oil reserves. The GDP growth is soaring in the countries of the Gulf of Guinea. In my study I analysed the trends of two (Nigeria and Gabon) new oil exporting countries using statistical methods. I tried to find the answers for some questions. In my study I found that the development is available for the new oil exporting African countries but the biggest troubles are the governments themselves. They and their narrow élite are blocking the development because they intend to keep an eye on the oil revenues and they also benefit from it. With their behavior the income gap will be wider and the wealth concentration will be higher in the future. So the level of development that these countries could reach will not be satisfactory and they will remain poor countries in the future and they will lose their only breakout: the crude oil. That is the real hard lesson for the countries of the Gulf of Guinea.

1. Introduction

Nowadays oil prices have been high and the political instability in the Middle East is obvious. So no wonder that Africa's oil reserves are more alluring than ever. By some estimates, Africa holds 10% of the world's reserves. Some countries and multinational enterprises recognised the importance of this. Foreign direct investments are flowing into the countries of the Gulf Guinea: Nigeria, Gabon, Angola, Sao Tomé & Príncipe etc. According to *Poisoned Wells*, the U.S. imported more oil from Africa than from the Middle East in 2005, and more from the Gulf of Guinea than from Saudi Arabia and Kuwait combined. Nigeria, the giant of the region, supplies 10-12 % of U.S. oil imports.

There are several reasons why the Gulf of Guinea is a key focus. African oil is high quality, with a low sulfur content that requires little refining to get it to the pump. The Gulf is relatively close to the U.S., cutting shipping costs to the world's biggest oil consumer, and most of the reserves are out to sea — which means there's no need to construct pipelines through different nations to get the stuff to market. Equally important: unlike some other oil-rich countries, African nations welcome foreign companies to their oil fields, as there are no indigenous African oil majors. The mentioned states intend to increase crude oil production in the hope of development. Will the oil-dollars lead to development and wealth or will it fuel corruption rather than development, and creates the same combustible mix of great wealth, relative poverty, grievance and instability. And is the future prosperous for the African countries, I try to find the answer for these questions in this study. In my hypothesis I say that these countries could step onto a stable development path and they could realize their dreams.

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2. The Method of the Analysis

To answer the occurring questions, consider the experience of two countries: Nigeria and Gabon. The oil industries in each are at markedly different stages. The OPEC (Organisation of the Petroleum Exporting Countries) member country: Nigeria is in its prime, ranking as the world's 12th largest producer in 2006. (Source: U.S. Dept. Of Energy's *Energy Information Administration, New York Mercantile Exchange*) Gabon's wells are slowly drying up. Gabon is a former OPEC country which quit in 1995. So we can get a good picture about what happens when the crude oil production is soaring and when decreasing.

To carry out my essay I choose the regression and correlation analysis which shows us how to determine both the nature and the strength of relationship between variables. Observing the data I find that the best fitting estimation would be the regression line so I also intend to draw a line to the data. To gain more information I use the correlation analysis which is a statistical tool that we can use to describe the degree to which are variable in linearly related to another. I also would like to define the coefficient of correlation and coefficient of determination. To justify the information I use the t-test and calculate the standard error of my estimate. After this I intend to make some forecasts analysing the situation where the crude oil production is doubled.

To analyse the time series I use the trend analysis and observing the data I fit the linear trend by the least squares method. The data give me the idea to use the linear trend because there were no significant differences between them. After calculating the trend line I also make some forecasts for the next years in the decade. I always intend to check the standard error of the trend line to prove that it remains below the crucial 10%.

3. Nigeria, The Biggest Exporter of The Gulf of Guinea

"Nigeria pumped its first barrel in the 1950s and has since set records for corruption. The government's own anticorruption watchdog, the Economic and Financial Crimes Commission, estimates that between independence in 1960 and 1999, the country's rulers stole \$400 billion in oil revenues — equal to all the foreign aid to Africa during the same period. And while a small élite became rich, its members fought one another for the spoils. In 47 years, Nigeria has suffered a civil war that killed a million people, 30 years of military rule and six coups. Meanwhile, two-thirds of the country's 135 million people remain in poverty, a third are illiterate and 40% have no safe water supply. Then there is the environmental cost: more than 1.5 million tons of oil have been spilled over 50 years, and the Niger Delta is one of the most polluted places on earth." (Source: *Time, 11 June, 2007*) Not surprisingly, disenchantment with the nation's political leaders runs deep. Nigeria has been a normal democracy since 1999. Containing the people's anger at Nigeria's rulers and their unwillingness to share the wealth isn't easy, though. Nigeria is a key oil supplier of the U.S. and it increased the crude oil production rapidly and by the year of 2030 it will be doubled. From the oil revenues we can observe an increase in the GDP. In this part of the study I intend to reflect the relationship between the oil production and the GDP per capita in Nigeria.

Table 1. The Relationship Between The Crude Oil Production and The GDP Per Capita in Nigeria (1995-2006)

GDP (PPP) \$ per capita (y)	Crude oil pr. in th. of barrels per day (x)	(x - \bar{x})	(y - \bar{y})	(x - \bar{x}) · (y - \bar{y})	(x - \bar{x}) ²	(y - \bar{y}) ²	(\hat{y})	(y - \hat{y}) ²
779	1,965	-243.58	-182.42	44,433.86	59,331.22	33,277.06	732.07	2,202.42
793	1,975	-233.58	-168.42	39,339.54	54,559.62	28,365.3	741.56	2,646.07
806	2,098	-110.58	-155.42	17,186.34	12,227.94	24,155.38	858.26	2,731.11
833	2,218	9.42	-128.42	-1,209.72	88.74	16,491.7	972.12	19,354.37
795	2,079	-129.58	-166.42	21,564.7	16,790.98	27,695.62	840.24	2,046.66
882	2,030	-178.58	-79.42	14,182.82	31,890.82	6,307.54	793.75	7,788.06
896	2,285	76.42	-65.42	-4,999.4	5,840.02	4,279.78	1,035.7	19,530.06
955	2,150	-58.58	-6.42	376.08	3,431.62	41.22	907.6	2,246.76
1,061	2,345	136.42	99.58	13,584.7	18,610.42	9,916.18	1,092.6	998.56
1,154	2,348	139.42	192.58	26,849.5	19,437.94	37,087.06	1,095.5	3422.25
1,183	2,450	241.42	221.58	53,493.84	58,283.62	49,097.7	1,192.3	86.49
1,400	2,560	351.42	438.58	154,125.78	123,496.02	192,352.4	1,296.6	10,691.56
11,537	26,503	-	-	378,928.04	403,988.96	429,066.9	-	73,744.37

Source: My own calculations based on United Nations Statistics Division Common database

I calculate the coefficient of correlation based on the method of least squares.

$$\bar{x} = \frac{\sum x_i}{n} = \frac{26,503}{12} = 2,208.58 \text{ which is the arithmetical mean of the crude oil production}$$

$$\bar{y} = \frac{\sum y_i}{n} = \frac{11,537}{12} = 961.42 \text{ which is the arithmetical mean of the GDP per capita}$$

$$C = \frac{\sum (x - \bar{x})(y - \bar{y})}{n} = \frac{378,928.04}{12} = 31,577.34$$

We got a value number so I assume there is a positive relationship between the two variables. In other words the increase in the production results an increase in the GDP per capita.

The coefficient of correlation

$$r = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sum (y - \bar{y})^2}} = \frac{378,928.04}{\sqrt{403,988.96 \cdot 429,066.9}} = \frac{378,928.04}{416,339} = 0.91$$

As a result I got 0.91 which means really strong relationship between the two factors.

The coefficient of determination

$$r^2 = 0.8284 \text{ so } D = 82.84\%$$

The crude oil production determines the GDP per capita in 82.83 per cent.

I check the relationship by hypothesis test

H_0 : the value of r accidentally differs from zero

H_1 : the value of r not accidentally differs from zero

The proof function of the test is the t-test:

$$t = \frac{r}{\sqrt{1-r^2}} \cdot \sqrt{n-2} = \frac{0.91}{\sqrt{1-0.91^2}} \cdot \sqrt{12-2} = 6.94$$

which is our calculated value

And at 5 percent level of significance our critical value is the following:

$$t_{p5\%} = 2.288$$

As we can see $t > t_{p5\%}$, so I reject out null-hypothesis so the correlational coefficient not accidentally differs form zero. So there is a correlational relationship between the two variables.

Now I try to draw a regression line to the data and I also tried to make some predictions for the decade.

The general equation of the of the linalar multiplical regressional function is the following:

$$\hat{y} = a + bx$$

$$b = \frac{\Sigma(x - \bar{x}) \cdot (y - \bar{y})}{\Sigma(x - \bar{x})^2} = \frac{378,928.04}{403,988.96} = 0.938,$$

where b is the slope of the function

$$a = \bar{y} - b \cdot \bar{x} = 961.42 - 0.938 \cdot 2,206.72 = -1,108.48$$

I do not define the a because the curve reaches $X=0$ in this point.

So the equation of the linalar function:

$$\hat{y} = -1,108.48 + 0.938x$$

The standard error of estimate:

Measures the variability or scatter of the observed values around the regression line.

$$S_{\hat{y}} = \sqrt{\frac{\Sigma(y_i - \hat{y}_i)^2}{n-2}} = \sqrt{\frac{73,744.37}{10}} = 85.87$$

Comparing with the mean we get the relative error of the estimate:

$$S_{\hat{y}\%} = \frac{S_{\hat{y}}}{\bar{y}} \cdot 100 = \frac{85.87}{961.42} \cdot 100 = 8.93\%$$

Our value is below the crutial 10 per cent so the data can be described by a line.

The elasticity:

$$E(x, y) = b \cdot \frac{x}{a + bx} = 0.938 \cdot \frac{2,206.72}{-1,108.48 + 0.938 \cdot 2,206.72} = 2.153\%$$

This 2.153% means that if the crude oil production increases by 1% the GDP per capita increases by 2.153%.

Forecast

I assume that the crude oil production will be doubled in the future and will reach the level of 5120 thousand barrels per day.

So x will be = 5120

$$\hat{y} = -1,108.48 + 0.938x$$

$$\hat{y} = -1,108.48 + 0.938 \cdot 5120$$

$$\hat{y} = 3,694.08$$

So when the crude oil production doubles the GDP per capita will reach 3,694.08 \$.

So in case of Nigeria I found that there is a really strong correlation between the GDP per capita growth and the crude oil production ($r=0.91$) Observing the coefficient of determination ($r^2= 0.8284$) we can see that the almost just oil production defines the GDP growth. From this point we can see that the key breakout from the poverty in Nigeria which is the oil. According to my forecast when the crude oil production doubles, the GDP per capita also doubles. When the production increases by 1%, the GDP increases by 2.153%!

Table 2. The GDP (PPP) \$ Per Capita in Nigeria in The Last 12 Years

Year	GDP(PPP) \$ per capita(y)	X	x·y	x ²	\hat{y}	(y - \hat{y}) ²
1995	779	-11	-8,569	121	684.33	8,962.41
1996	793	-9	-7,137	81	734.71	3,397.72
1997	806	-7	-5,642	49	785.09	437.23
1998	833	-5	-4,165	25	835.47	6.1
1999	795	-3	-2,385	9	885.85	8,253.72
2000	882	-1	-882	1	936.23	2,940.89
2001	896	1	896	1	986.61	8,210.17
2002	955	3	2,865	9	1,037	6,724.0
2003	1,061	5	5,305	25	1,087.37	695.38
2004	1,154	7	8,078	49	1,137.75	264.06
2005	1,183	9	10,647	81	1,188.13	26.32
2006	1,400	11	15,400	121	1,238.51	26,079.02
Σ	11,537		14,411	572		65,997.02

Source: My own calculations based on United Nations Statistics Division Common database

The equation of the linear trend by the least squares method:

$$\hat{y} = a + bx$$

$$a = \frac{\sum y_i}{n} = \frac{11,537}{12} = 961.42$$

I do not define the a because the curve reaches $X=0$ in this point.

$$b = \frac{\sum x_i \cdot y_i}{\sum x_i^2} = \frac{14,411}{572} = 25.19, \text{ where } b \text{ is the slope of the function}$$

So the equation of the linear trend:

$$\hat{y} = 961.42 + 25.19 \cdot x_i$$

The standard error of estimate:

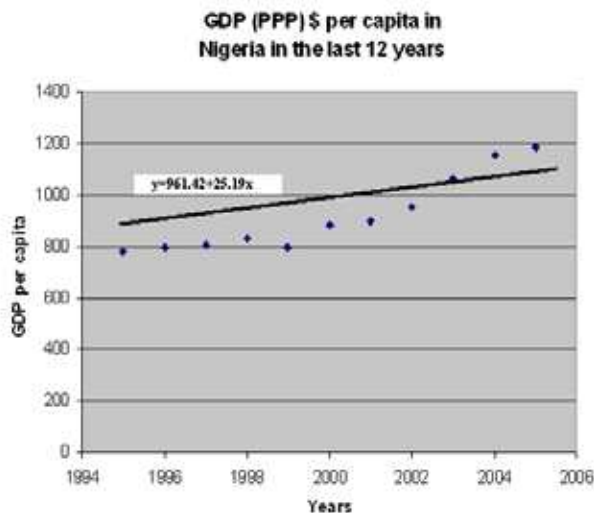
Measures the variability or scatter of the observed values around the regression line

$$S_{\hat{y}} = \sqrt{\frac{\sum (y - \hat{y})^2}{n - 2}} = \sqrt{\frac{65,997.02}{10}} = 81.24$$

Comparing with the mean we get the relative error of the estimate:

$$S_{\hat{y}\%} = \frac{S_{\hat{y}}}{\bar{y}} \cdot 100 = \frac{81.24}{961.42} \cdot 100 = 8.45\%$$

As a result I got 8.45% which is under the crucial 10 per cent so the data can be described by a line. This can be seen in my first chart.



Source: My own calculations

Figure 1. GDP (PPP) \$ Per Capita in Nigeria

Forecasts

$$2007: \hat{y} = 961.42 + 25.19 \cdot x_i = 961.42 + 25.19 \cdot 13 = 1,288.89\$$$

$$2008: \hat{y} = 961.42 + 25.19 \cdot x_i = 961.42 + 25.19 \cdot 15 = 1,339.27\$$$

$$2009: \hat{y} = 961.42 + 25.19 \cdot x_i = 961.42 + 25.19 \cdot 17 = 1,389.65\$$$

$$2010: \hat{y} = 961.42 + 25.19 \cdot x_i = 961.42 + 25.19 \cdot 19 = 1,440.03\$$$

After setting the linear trend and making the forecast for the next years we could see that Nigeria could face a really prosperous future. Studying the history and society of the country we could see that a really narrow élite is leading the country and corruption is obvious. From the oil revenues they do not spend on health and education and infrastructure but they use it to get richer and richer.

Now I can declare that the oil revenues could increase the GDP but the leading élite is blocking the development process with its own behaviour.

4. Gabon, where the wells are running dry

Several years ago the former OPEC member state, Gabon exported much more oil than now. And we can see the example what happened: "At a hypermarket in downtown Libreville, a box of eggs from France costs \$11, a small bunch of carrots \$10, and a bottle of St. Emilion Château Ausone 1er Grand Cru Classé 1999 goes for \$312. But it's a short drive from here to Mindwube I, the smoking mountains of garbage on the capital's eastern edge, where the hypermarkets throw out meat and vegetables that have passed their sell-by dates. Madeleine, a 60-year-old mother of 10, lives with several thousand others in the area around the dump. When the truck arrives, it's a ferocious feast. Hundreds of scavengers descend on the skip, elbowing their way into the trash and plunging their hands in deep. "The supermarkets are the best," says Madeleine. "It's in boxes, all arranged." Nor do the inhabitants of Mindwube just find food. There are "plates, dresses, jewelry, liqueurs, TVs, DVDs, fridges, children's toys and mobile phones," says André Boussougou, 40. His specialty is aluminum, which he sorts and sells to a pot manufacturer, and leather, which he hawks to a dealer who exports to Europe. "It's really two worlds in Gabon," says Ernst & Young's Watremez. "Rich, poor. There's nothing in the middle." (*Source: Time, 11 June, 2007*)

Gabon is at the beginning of the end of its life as an oil producer. Without new finds, output is expected — optimistically — to halve in the next 20 years and stop in 30. And oil's legacy? A country that ranks 124th on the human-development index. Libreville itself has ranked among the Top 10 most expensive cities in the world for most of the past 20 years. But beyond these privileged circles, there is little evidence of a trickle-down effect. According to Pierre Mamboundou who is the opposition leader says 15,000 people in Gabon hold 80% of the nation's wealth. (The population of Gabon is 1,344,436 in 2004.) In other words 1 per cent of the population holds the 80 per cent of the nation's wealth!

Even in a country that is four-fifths rain forest and has coastal waters full of fish, the government appears to lack a compelling vision of what industries might take over where oil leaves off. There is the additional economic burden of importing nearly all of the country's food from Europe. Entrepreneurial spirit has all but evaporated: while rich Gabonese may fund new businesses, most are set up and run by Europeans. And the nation is afflicted by a widespread sense of moral degeneration — from bureaucratic corruption to petty theft to sexual violence.

Now I intend to analyse the would be GDP increase in Gabon using GDP per capita data forecasting the future.

Table 3. The GDP (PPP) \$ Per Capita in Gabon in The Last 12 Years

Year	GDP (PPP) \$ per capita (y)	x	X · y	x ²	\hat{y}	(y - \hat{y}) ²
1995	5,928	-11	-65,208	121	5,956.34	803.16
1996	6,203	-9	-55,827	81	6,026.93	31,000.64
1997	6,307	-7	-44,149	49	6,097.52	43,881.87
1998	6,306	-5	-31,530	25	6,168.11	19,013.65
1999	5,889	-3	-17,667	9	6,238.7	122,290.09
2000	6,119	-1	-6,119	1	6,309.29	36,210.28
2001	6,253	1	6,253	1	6,379.88	16,098.53
2002	6,452	3	19,356	9	6,450.47	2.34
2003	6,471	5	32,355	25	6,521.06	2,506.0
2004	6,624	7	46,368	49	6,591.65	1,046.52
2005	6,528	9	58,752	81	6,662.24	18,020.38
2006	7,055	11	77,605	121	6,732.83	103,793.51
Σ	76,135		20,189	572		394,666.97

Source: My own calculations based on United Nations Statistics Division, Common database

The equation of the linal trend by the least squares method:

$$\hat{y} = a + bx$$

$$a = \frac{\sum y_i}{n} = \frac{76,135}{12} = 6,344.58$$

I do not define the a because the curve reaches X=0 in this point.

$$b = \frac{\sum x_i \cdot y_i}{\sum x_i^2} = \frac{20,189}{572} = 35.295, \text{ where } b \text{ is the slope of the function}$$

So the equation of the linal trend:

$$\hat{y} = 6,344.583 + 35.295 \cdot x_i$$

The standard error of estimate:

Measures the variability or scatter of the observed values around the regression line

$$S_y = \sqrt{\frac{\sum (y - \hat{y})^2}{n - 2}} = \sqrt{\frac{394,666.97}{10}} = 198.662$$

Comparing with the mean we get the relative error of the estimate:

$$S_{y\%} = \frac{S_y}{\bar{y}} \cdot 100 = \frac{198.662}{6,344.583} \cdot 100 = 3.13\%$$

As a result I got 3.13% which is under the crucial 10 per cent so the data can be described by a line. This can be seen in my second chart.

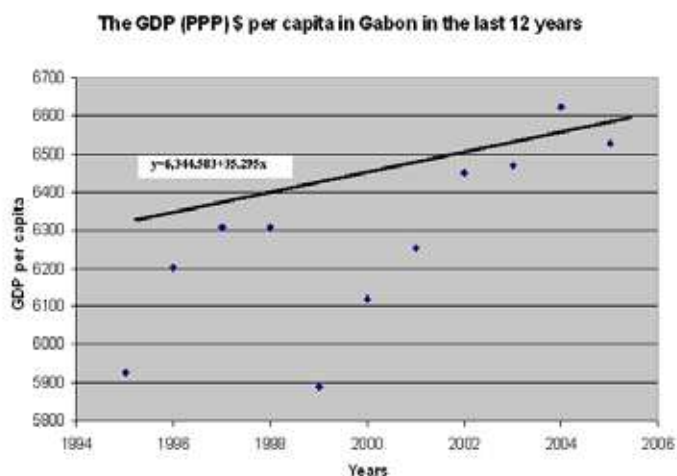


Figure 2. GDP (PPP) \$ Per Capita in Gabon

Source: My own calculation

Forecast:

$$2007: \hat{y} = 6,344.583 + 35.295 \cdot x_i = 6,344.583 + 35.295 \cdot 13 = 6,803.42\$$$

$$2008: \hat{y} = 6,344.583 + 35.295 \cdot x_i = 6,344.583 + 35.295 \cdot 15 = 6,874\$$$

$$2009: \hat{y} = 6,344.583 + 35.295 \cdot x_i = 6,344.583 + 35.295 \cdot 17 = 6,944.6\$$$

$$2010: \hat{y} = 6,344.583 + 35.295 \cdot x_i = 6,344.583 + 35.295 \cdot 19 = 7,015.19\$$$

After setting the linear trend and making the forecast for the next years we could see that Gabon could face a really prosperous future but I have to admit that the crude oil production will decrease in the following years. Studying the history and society of the country we could see that a really narrow élite is leading the country and corruption is obvious – like in Nigeria- and the concentration of the wealth is almost unimaginable. From the oil revenues they do not spend on health and education and infrastructure but they use it to get richer and richer.

Now I can declare that the oil revenues could increase the GDP but the leading élite is blocking the development process with its own behaviour.

5. Conclusions

The countries of the Gulf Guinea (for example: Nigeria and Gabon) with the rapid crude oil production show a really significant GDP growth nowadays. As the amount of the oil increases the GDP also increases in every case. From the oil revenues they could step onto a stable development path! Unfortunately, the economy and politics are ruled by a really narrow élite in every concerned country and this élite handles the revenues without any responsibility. The wealth concentration is extremely high in these countries!

They do not spend on the inevitable factors of the development: health, education, infrastructure etc. The leading élites are blocking the development with their own behaviour because they rule the countries for their own benefiction while a large number of people is starving and living under the poverty line. The income gap will be wider and the wealth concentration will be higher in the future. So the level of development that these countries could reach will not be satisfactory and they will remain poor countries and they will lose their only breakout: the crude oil. That's the real hard lesson for the countries of the Gulf of Guinea. So with quasi-dictatorial goverments the development is not available for these states. I reject my hypothesis: these countries will not be able to step onto a development path and they will not realize their dreams.

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