

Contemporary Issues in Business, Management and Education 2013

Estimation of economic development in Papua New Guinea: linear trend analysis or moving average model?

Ingrid Majerová^{a*}, Tomáš Pražák^b

^a*Silesian University in Opava, School of Business Administration in Karviná, Department of Economics,
Univerzitní nam. 1934, 73401 Karvina, Czech Republic*

^b*Silesian University in Opava, School of Business Administration in Karviná,
Univerzitní nam. 1934, 73401 Karvina, Czech Republic*

Abstract

A time series analysis is often used for estimation of economic development of countries. However, the prediction based on development of macroeconomic indicators might be analyzed by various models. This article aims to verify the hypothesis of differences in predictions using linear trend analysis and moving average model on the example of Papua New Guinea using the indicators such as gross domestic product, the growth of gross domestic product, inflation, merchandise trade balance and budgetary balance as percentage of gross domestic product. It was found out that these two types of analyses considerably diverge in their results

© 2014 The Authors. Published by Elsevier Ltd. Open access under [CC BY-NC-ND license](https://creativecommons.org/licenses/by-nc-nd/4.0/).

Selection and peer-review under responsibility of the Contemporary Issues in Business, Management and Education conference.

Keywords: linear trend analysis; ARIMA model; gross domestic product; inflation; trade balance; total debt.

1. Introduction

Almost every individual would like to know his own future and so it is with larger units, such as the national
Almost every individual would like to know his own future and this rule is valid among the larger units such as national economies, too. Over time, the estimations of development are becoming more sophisticated and they are

* Corresponding author. Tel.: +420596398256; fax: +420596398111.
E-mail address: majerova@opf.slu.cz

based on serious numbers supported with statistical methods. As one of the options to describe a future trend a time series analysis, that reflects dynamics of the variables over the time, is used.

Two methods of the above mentioned analysis were selected for the purposes of this article, namely the method of linear trend analysis and autoregressive integrated moving average model (ARIMA). These two methods are just some of the plenty of methods used for economic evaluation (other method - Analytic Hierarchy Process was used in Nevima & Kiszová, 2013 or panel regression in Chudárková & Verner, 2013). The methods for our researches were not selected randomly – the second method is used by forecasting portal Trading Economics (Trading Economics, 2013). The first method was chosen because of its clarity and possibility of comparison with the second method. The data used for linear trend analysis and description of the economic situation was drawn from the statistics of the World Bank (World Bank, 2013a-f), Asian Development bank (ADB, 2013), Bank of Papua New Guinea (Bank of PNG, 2012), International Monetary Fund (IMF, 2013) and UNCTAD (UNCTAD, 2010; UNCTAD, 2012; UNCTAD 2013). Regarding the fact that the analyses must be conducted on specific data, a rather untypical economy, but one of the most prosperous countries of the world, Papua New Guinea (PNG hereinafter) was chosen for the analyses. A prediction of five macroeconomic indicators was developed and applied, including GDP, GDP growth, inflation, merchandise balance of trade and budgetary balance as a percentage of gross domestic product in the years 2013–2015.

The aim of the article is to verify the hypothesis that both the methods determine different values of predicted variables. The article is divided into four parts - introduction, initial economic conditions, methodology and conclusion. Introduction is focused on a brief description of the nature of the article, the second part deals with initial conditions and the status of PNG economy in the years 2005–2012 in detail, which is a basis for understanding the future development of this Pacific island country. In the part devoted to methodology, a linear trend analysis is characterized, calculations of the estimation are made and subsequently compared with ARIMA model. In the last part, conclusion, the basic findings reached by the authors are summarized and the initial hypothesis is confirmed.

2. The initial economic Situation of Papua New Guinea

Papua New Guinea (PNG hereinafter) is currently one of the fastest growing economies in the world. Since the beginning of the reporting period PNG has disposed mainly with trade balance surplus, a low unemployment rate (to 2012 PNG it showed only 1.9% unemployed), good fiscal discipline and a high degree of export openness.

2.1. Development of internal economic situation

As it has already been mentioned, the economic growth in Papua New Guinea is one of the fastest in the world economy. Supporting the government program of this growth is the concept of economic development in PNG, the aim of which is to achieve the status of a middle income country by 2030. The primary instrument for achieving this goal is the realization of a project of natural gas liquefaction with a budget of more than USD 15 billion, planned from 2015 onwards. The PNG government involved in the project with less than 20% calculates with the creation of up to 8,000 new jobs and at least doubling GDP (World Bank Group, 2013). The financial resources obtained in this project will then be invested in improving infrastructure, education and health. From the perspective of the economic growth, tourism industry appears to be very promising.

Neither the global crisis influenced the positive development of the economic growth of PNG. It caused only a slight decline in GDP in 2009 (see Table 1). The high growth rates of GDP involved the high prices of raw materials and commodities exported from PNG (especially in 2011). For the next few years the growth of GDP is expected to continue, however, it should slow down due to completion of the implementation of the above mentioned project. After its launch, a reverse and a significant increase of GDP is expected due to exports of this commodity. The high inflation rate of the country has been the result of government supporting the large mining projects and high prices of imported commodities since 2008. Although the inflation was reduced in 2012 (see Table 1) due to the fact that the Central Bank of PNG responded by increasing interest rates and mandatory level of bank reserves (Bank of PNG, 2012), in the coming years its decline is expected.

Table 1. Economic Indicators of PNG in 2005–2012

Indicator	2005	2006	2007	2008	2009	2010	2011	2012
GDP (mil. USD)	4902	5599	6329	8010	7915	9480	12393	15654
GDP growth (%)	3.6	2.6	7.2	6.7	5.5	8.0	9.0	8.0
GDP per capita (USD in PPP)	804.1	896.5	989.5	1223.1	1180.7	1382.7	1844.5	2168.0
Inflation rate (%)	1.8	2.4	0.9	10.8	6.9	6.0	8.4	2.2

The indicators of the inherent stability of economy include, besides GDP growth and inflation rate development, fiscal discipline as well as the management of public resources. In the period monitored, the government of PNG managed almost balanced budget (see Table 2) and its ratio of budget balance to GDP can be envied by any developed economy. It is interesting that the funds resulting surpluses are placed in the so called trust funds, which are then used to finance priority spending and investment.

Table 2. State budget Balance of PNG in million PGK in 2005–2012

Indicator	2005	2006	2007	2008	2009	2010	2011	2012
Revenues	5326.7	6311.5	7006.6	7073.3	6651.3	8278.9	9304.9	9704.6
Expenditures	5313.7	5767.3	6552.4	7551.8	6687.2	8092.6	9370.6	10047.0
Budgetary balance	+13.0	+544.2	+454.2	-478.5	-35.9	+189.3	-65.7	-339.4
Budgetary balance as % GDP	0.1	3.2	2.4	-2.2	-0.2	0.7	-0.2	-1.0

2.2. Development of external economic Situation

The basic indicators of foreign trade were selected to characterize the external economic situation, such as trade balance, export and import, balance of payments (without foreign exchange reserves) and foreign debt. As a major exporter of commodities, Papua New Guinea consistently runs merchandise trade surpluses (see Table 3). Papua New Guinea exports mainly minerals (gold, oil, copper, coffee, cocoa, vegetable oils), which account for 52% of total exports, fish and wood. PNG is primarily dependent on the regular import of food for daily consumption and finished products. The highest value belongs to the import of manufactured goods (51% of total import), where import of building materials is the most evident, associated with the implementation of large investment projects. Other important import commodities are fuel and chemicals. The main trading partner of PNG is Australia, other important partners, particularly import partners, are the U.S.A., and Singapore (increased investments and the inflow of materials for implementation of large projects). The second largest export country is Japan, PNG also cooperates with countries of Europe, mostly Germany. Other major partners are China, the Philippines and Malaysia, Hong Kong and Vietnam (United Nations, 2012).

The current account balance as a percentage of GDP provides an indication on the level of international competitiveness of a country. Countries recording a strong current account surplus have an economy heavily dependent on exports revenues, with high savings ratings but weak domestic demand. On the other hand, countries recording a current account deficit have strong imports, a low saving rates and high personal consumption rates as a percentage of disposable incomes. Until 2008, PNG showed a positive balance, but in the post-crisis years the value started to decrease and reach negative numbers (see Table 3). The balance of payments is compiled both for monitoring cross-border flows of goods, services, capital and money, and for providing information to government institutions on the status of the economy in the world and support decision-making on monetary and fiscal policy. The balance of payments must always be balanced, which is an option of reserves items. For purposes of our analysis the payment balance account without the balancing items was used. PNG balance of payments showed a negative value in two years, in 2008 and 2012. In 2008, other investments in the financial account (bank lending to government sector or business loans abroad) were the main reasons for the negative value and in 2012 it was the high current account deficit (see Table 3). The reason for the negative current account balance was a global crisis, when the increasing deficit of the balance of services including tourism, transport or insurance, could not offset the

income from international trade in goods. According to the World Bank (2013e), the current account balance will reach positive values in 2015.

Table 3. Indicators of Foreign Trade of Papua New Guinea in 2005–2012

Indicator	2005	2006	2007	2008	2009	2010	2011	2012
Trade Balance (mil. USD)	819	931	526	1191	-133	-230	134	-1415
Merchandise Trade Balance (mil. USD)	1792	2214	2119	2665	1522	2216	2675	1723
Export growth (%)	20.6	26.4	9.6	11.4	-22.8	29.1	5.0	-22.1
Import growth (%)	0.6	28.7	28.2	8.8	-6.7	21.4	4.8	-8.6
Current Account to GDP (%)	13.3	8.0	2.9	9.9	-7.2	-6.5	-1.3	-12.4
Current Account (mil. USD)	647.5	443.0	185.5	794.4	-584.7	-632.9	-171.7	-1949.0
Overall balance of payment	94.4	640.6	536.9	-221.5	626.1	391.6	462.4	-407.7

3. Methodology

Time series analysis is a comparison of ratio indicators or any variables in time and is used mainly to detect negative trends (orientations) of indicators. In order to use the results of time series analysis to simple economic estimates of future economic development, a suitable form of functional dependence which best describes the revealed trend of the time series evolution must be found. For these reasons we have used statistical methods of regression and correlation relationships with the help of a few, previously identified and recommended functions for monitoring the economic development. One possible description of trends in time series is trend analysis, which belongs to one of the frequently used methods, as it allows a relatively simple estimate of future values of time series and analysis using moving average, which is used for longer periods of time, because unlike the first method it does not expect constant parameters.

For our analysis, two specific methods were selected and compared, linear trend analysis (hereinafter LTA) and an autoregressive integrated moving average model (ARIMA). This ARIMA model is applied in some cases where data show evidence of non-stationarity, where an initial differencing step (corresponding to the "integrated" part of the model) can be applied to remove the non-stationarity and is used in database of Trading Economics. The method of ARIMA model will not be analyze in detail, we will focus on the description of the first method according to which the below mentioned data were calculated.

The calculation of trend analysis is done using equation:

$$T_t = \frac{\sum y_t}{n} + \left[\left(\frac{\sum y_t * t'}{\sum t'^2} \right) * t \right] \quad (1)$$

where $\frac{\sum y_t}{n} = \beta_0$, $\frac{\sum y_t * t'}{\sum t'^2} = \beta_1$, n is the number of years of examined time series and t is a time coefficient for the predicted year.

Then the equation can be (according to Kozák, Hindls and Arlt, 1994) as follows

$$T_t = \beta_0 + \beta_1 * t \quad (2)$$

In the calculation it was necessary to choose a time series y_t , in this case the above mentioned economic indicators, and to determine the period of availability of data of yearly values for the period 1992-2012. Then, for each value of time series in individual year time coefficient t' is given, which takes values $\langle -t', +t' \rangle$ according to the time series length. This factor is firstly compounded by the square and then multiplied by a time series ($y_t * t'$). After performing these calculations separately for each year, sums of indicators are calculated $\sum y_t$, $\sum t'^2$ and

$\sum y_t * t'$. For the calculation of the first necessary coefficient into the equation trend analysis, which is β_0 , we needed to know $\sum y_t$ and the coefficient n . Then it can already be put into the equation $\beta_0 = \frac{\sum y_t}{n}$ and the value of β_0 could be calculated for predicted year. The second coefficient β_1 is a simple proportion of already determined values $\sum y_t * t'$ and $\sum t'^2$. The last unknown in the equation trend analysis is t , which is a time coefficient for the predicted year, which always achieves one higher value than the maximum value $+t'$. Finally, all of the previous values are put into the equation and T_t the resulting value of the trend analysis of time series predicted for the first year. By repeating the procedure, in which already the value of the time series for the preceding predicted year is subsequently incorporated, the value of the time series for the predicted following year can be calculated.

3.1. Linear Trend Analysis versus ARIMA model

For comparison of basic economic indicators (GDP, GDP growth, inflation rate, the state budget balance to GDP and trade balance) and for verification of the hypothesis, the data of Trading Economics portal are used and calculated by ARIMA model. These data are then compared with our own values calculated by linear trend analysis (LTA) in the years 1992 to 2012. The procedure of trend analysis calculation with specific dates is listed in the Annex A, B, C, D and E and the calculated values, together with them of the ARIMA model, are shown in Table 4. The years 2013-2015 were selected as a predicted period. A longer-term analysis is meaningless because of the processing time series of historical data that do not reflect current economic and political situation in the monitored economies. For an interest's sake, LTA method was used for the estimation of development of external debt, the prediction of which is missing in global statistical databases.

Table 4. Prediction of basic economic Indicators of PNG by LTA and ARIMA model

Indicator	Estimation	2013	2014	2015
GDP (mil. USD)	LTA	10341	10463	10638
	ARIMA	18810	20640	22752
GDP growth (%)	LTA	7.83	6.41	5.56
	ARIMA	10.78	9.73	10.23
Inflation rate in consumer prices (%)	LTA	4.20	4.49	4.79
	ARIMA	2.85	2.31	2.68
Budgetary Balance as % GDP	LTA	1.02	0.94	0.84
	ARIMA	-1.60	-4.00	-5.35
Merchandise Trade Balance (mil. USD)	LTA	2564	2676	2739
	ARIMA	1640	2219	2128

The first indicator compared in our research was the prediction of future GDP development. Among all of the monitored indicators, there is the biggest difference between the two predictions. While the method LTA calculates with a slight increase – based on historical data, ARIMA method estimates a sharp increase in GDP based on current investments. This fact is also reflected in the estimate of GDP growth – LTA method predicts a steady decline in GDP growth, ARIMA method expects further growth with a slight decline in 2014. As far as inflation rate is concerned, ARIMA method estimates its stable range between 2–3%, while trend analysis expects growing inflation rate of between 4-5%. Divergent results are also obvious in predictions of the budgetary balance to GDP. The prediction by ARIMA expects a continuation of negative result of this indicator as well as the deficit of general government budget. According to the trend analysis, PNG will achieve a balanced state budget balance, as well as its share of GDP. The merchandise trade balance reaches active values both during the reporting period and the period predicted. LTA method predicts much higher turnover in the account than ARIMA method. A positive trend

is that every year the value of exports and imports is increasing and shows a greater involvement of PNG in the international division of labor.

4. Conclusion

Despite of the fact that Papua New Guinea belongs to developing economies of the Pacific region, it has a high rate of economic growth and other economic indicators, which are adequate to development of the world economy. Recent global crisis has affected only PNG's external debt (similarly to other developing economies, see Majerová, 2011 or Majerová, 2012). The economic situation of the country as a base for further estimation was described in the first part of this paper. However, the situation in the future may be different. Though the prospects of PNG economy are very promising, we assessed, whether the results of estimation may vary if we use different statistical methods. The method of moving average, ARIMA, which is an available prediction used by portal Trading Economics was compared with the method of linear trend analysis LTA. We have chosen five macroeconomic indicators such as gross national product, its growth, as well as budget balance to GDP and merchandise balance of trade. These indicators are monitored in 2013-2015. We have set the hypothesis that the two methods used for the determination come to different values of variables and the purpose of the article was to verify the hypothesis.

By comparison of these two methods it was found out that there are differences not only in values, but also in the degree of the difference. LTA method was more pessimistic in predicting the first three indicators (GDP, GDP growth and inflation rate), but it was optimistic for the following two methods (budgetary balance and merchandise trade balance). As regards GDP indicator, the validity of trend analysis is the most noticeable. It is based on the fact that GDP has been growing recently, but considering the historical developments it should not reach such high numbers as ARIMA. While the trend analysis expects a big drop compared to 2012, and then a slight increase, the available prediction by ARIMA takes into account a potential positive impact of the investment project and mining. PNG would still continue to be one of the fastest growing economies in the world. A possible decline in GDP growth in the predicted period, according to the LTA, is associated with the completion of the construction of natural gas liquefaction project, which would bring a decline in mining of raw materials. After implementation of this project into practice in 2015, GDP growth should increase again.

From the above mentioned it is obvious that the hypothesis was verified – regarding all the measured parameters, the values of the two methods differed. It can be concluded that for predicting the development of PNG, a combination of trend analysis and an appropriate prediction is the right alternative. The conclusions of trend analysis can be considered to be theoretical values, which PNG should reach according to its historical development, while the prediction according to moving average includes the temporary status and changes, which may be very useful for the exact prediction.

Appendix A. Linear Trend Analysis of GDP (in mil. USD, constant prices)

year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$	year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$	year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$
1994	5 503	-9	81	-49 527	1994	5 503	-9	81	-49 527	1994	5 503	-9	81	-49 527
1995	4 636	-8	64	-37 088	1995	4 636	-8	64	-37 088	1995	4 636	-8	64	-37 088
1996	5 155	-7	49	-36 085	1996	5 155	-7	49	-36 085	1996	5 155	-7	49	-36 085
1997	4 937	-6	36	-29 622	1997	4 937	-6	36	-29 622	1997	4 937	-6	36	-29 622
1998	3 789	-5	25	-18 945	1998	3 789	-5	25	-18 945	1998	3 789	-5	25	-18 945
1999	3 477	-4	16	-13 908	1999	3 477	-4	16	-13 908	1999	3 477	-4	16	-13 908
2000	3 521	-3	9	-10 563	2000	3 521	-3	9	-10 563	2000	3 521	-3	9	-10 563
2001	3 081	-2	4	-6 162	2001	3 081	-2	4	-6 162	2001	3 081	-2	4	-6 162
2002	2 999	-1	1	-2 999	2002	2 999	-1	1	-2 999	2002	2 999	-1	1	-2 999
2003	3 536	0	0	0	2003	3 536	0	0	0	2003	3 536	0	0	0
2004	3 927	1	1	3 927	2004	3 927	1	1	3 927	2004	3 927	1	1	3 927
2005	4 902	2	4	9 804	2005	4 902	2	4	9 804	2005	4 902	2	4	9 804
2006	5 599	3	9	16 797	2006	5 599	3	9	16 797	2006	5 599	3	9	16 797
2007	6 329	4	16	25 316	2007	6 329	4	16	25 316	2007	6 329	4	16	25 316
2008	8 010	5	25	40 050	2008	8 010	5	25	40 050	2008	8 010	5	25	40 050
2009	7 915	6	36	47 490	2009	7 915	6	36	47 490	2009	7 915	6	36	47 490
2010	9 480	7	49	66 360	2010	9 480	7	49	66 360	2010	9 480	7	49	66 360
2011	12 394	8	64	99 152	2011	12 394	8	64	99 152	2011	12 394	8	64	99 152
2012	15 654	9	81	140 886	2012	15 654	9	81	140 886	2012	15 654	9	81	140 886
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
total	114 844	0	570	244 883	total	114 844	0	570	244 883	total	145 001	0	1012	365 478
n	19				n	19				n	23			
β_0	6 044				β_0	6 044				β_0	6 304			
β_1	430				β_1	430				β_1	361			
t	10				t	10				t	12			
Tt ₂₀₁₃	10 341				Tt ₂₀₁₃	10 341				Tt ₂₀₁₅	10 638			

Appendix B. Linear Trend Analysis of GDP growth (in %)

year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$	year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$	year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$
1992	13,85	-11	121	-152,4	1992	13,85	-11	121	-152,4	1992	13,85	-11	121	-152,4
1993	18,2	-10	100	-182	1993	18,2	-10	100	-182	1993	18,2	-10	100	-182
1994	5,94	-9	81	-53,46	1994	5,94	-9	81	-53,46	1994	5,94	-9	81	-53,46
1995	-3,31	-8	64	26,48	1995	-3,31	-8	64	26,48	1995	-3,31	-8	64	26,48
1996	7,73	-7	49	-54,11	1996	7,73	-7	49	-54,11	1996	7,73	-7	49	-54,11
1997	-3,9	-6	36	23,4	1997	-3,9	-6	36	23,4	1997	-3,9	-6	36	23,4
1998	-3,77	-5	25	18,85	1998	-3,77	-5	25	18,85	1998	-3,77	-5	25	18,85
1999	1,86	-4	16	-7,44	1999	1,86	-4	16	-7,44	1999	1,86	-4	16	-7,44
2000	-2,49	-3	9	7,47	2000	-2,49	-3	9	7,47	2000	-2,49	-3	9	7,47
2001	-0,12	-2	4	0,24	2001	-0,12	-2	4	0,24	2001	-0,12	-2	4	0,24
2002	-0,16	-1	1	0,16	2002	-0,16	-1	1	0,16	2002	-0,16	-1	1	0,16
2003	2,16	0	0	0	2003	2,16	0	0	0	2003	2,16	0	0	0
2004	2,72	1	1	2,72	2004	2,72	1	1	2,72	2004	2,72	1	1	2,72
2005	3,6	2	4	7,2	2005	3,6	2	4	7,2	2005	3,6	2	4	7,2
2006	2,58	3	9	7,74	2006	2,58	3	9	7,74	2006	2,58	3	9	7,74
2007	7,2	4	16	28,8	2007	7,2	4	16	28,8	2007	7,2	4	16	28,8
2008	6,7	5	25	33,5	2008	6,7	5	25	33,5	2008	6,7	5	25	33,5
2009	5,5	6	36	33	2009	5,5	6	36	33	2009	5,5	6	36	33
2010	8	7	49	56	2010	8	7	49	56	2010	8	7	49	56
2011	9	8	64	72	2011	9	8	64	72	2011	9	8	64	72
2012	8	9	81	72	2012	8	9	81	72	2012	8	9	81	72
2013	7,83	10	100	78,3	2013	7,83	10	100	78,3	2013	7,83	10	100	78,3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
total	57,24	0	570	274,55	total	83,27	0	770	170,85	total	103,5	0	1012	89,01
n	19				n	21				n	23			
β_0	3,01				β_0	3,97				β_0	4,50			
β_1	0,48				β_1	0,22				β_1	0,09			
t	10				t	11				t	12			
Tt ₂₀₁₃	7,83				Tt ₂₀₁₄	6,41				Tt ₂₀₁₅	5,56			

Appendix C. Linear Trend Analysis of Inflation rate (CPI, in %)

year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$	year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$	year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$
1994	2,85	-9	81	-25,65	1993	4,97	-10	100	-49,7	1992	4,31	-11	121	-47,41
1995	17,28	-8	64	-138,2	1994	2,85	-9	81	-25,65	1993	4,97	-10	100	-49,7
1996	11,62	-7	49	-81,34	1995	17,28	-8	64	-138,2	1994	2,85	-9	81	-25,65
1997	3,96	-6	36	-23,76	1996	11,62	-7	49	-81,34	1995	17,28	-8	64	-138,2
1998	13,57	-5	25	-67,85	1997	3,96	-6	36	-23,76	1996	11,62	-7	49	-81,34
1999	14,93	-4	16	-59,72	1998	13,57	-5	25	-67,85	1997	3,96	-6	36	-23,76
2000	15,6	-3	9	-46,8	1999	14,93	-4	16	-59,72	1998	13,57	-5	25	-67,85
2001	9,3	-2	4	-18,6	2000	15,6	-3	9	-46,8	1999	14,93	-4	16	-59,72
2002	11,8	-1	1	-11,8	2001	9,3	-2	4	-18,6	2000	15,6	-3	9	-46,8
2003	14,71	0	0	0	2002	11,8	-1	1	-11,8	2001	9,3	-2	4	-18,6
2004	2,1	1	1	2,1	2003	14,71	0	0	0	2002	11,8	-1	1	-11,8
2005	1,84	2	4	3,68	2004	2,1	1	1	2,1	2003	14,71	0	0	0
2006	2,37	3	9	7,11	2005	1,84	2	4	3,68	2004	2,1	1	1	2,1
2007	0,91	4	16	3,64	2006	2,37	3	9	7,11	2005	1,84	2	4	3,68
2008	10,76	5	25	53,8	2007	0,91	4	16	3,64	2006	2,37	3	9	7,11
2009	6,92	6	36	41,52	2008	10,76	5	25	53,8	2007	0,91	4	16	3,64
2010	6,02	7	49	42,14	2009	6,92	6	36	41,52	2008	10,76	5	25	53,8
2011	8,44	8	64	67,52	2010	6,02	7	49	42,14	2009	6,92	6	36	41,52
2012	2,24	9	81	20,16	2011	8,44	8	64	67,52	2010	6,02	7	49	42,14
-	-	-	-	-	2012	2,24	9	81	20,16	2011	8,44	8	64	67,52
total	157,2	0	570	-232,1	2013	4,2	10	100	42	2012	2,24	9	81	20,16
					total	166,4	0	770	-239,8	2013	4,2	10	100	42
										total	175,2	0	1012	-237,7
n	19				n	21				n	23			
β_0	8,27				β_0	7,92				β_0	7,62			
β_1	-0,41				β_1	-0,31				β_1	-0,23			
t	10				t	11				t	12			
Tt ₂₀₁₃	4,20				Tt ₂₀₁₄	4,50				Tt ₂₀₁₅	4,80			

Appendix D. Linear Trend Analysis of Budgetary Balance as % GDP

year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$	year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$	year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$
1998	-1,80	-7	49	12,60	1997	0,20	-8	64	-1,60	1996	0,50	-9	81	-4,50
1999	-2,60	-6	36	15,60	1998	-1,80	-7	49	12,60	1997	0,20	-8	64	-1,60
2000	-2,00	-5	25	10,00	1999	-2,60	-6	36	15,60	1998	-1,80	-7	49	12,60
2001	-3,40	-4	16	13,60	2000	-2,00	-5	25	10,00	1999	-2,60	-6	36	15,60
2002	-3,80	-3	9	11,40	2001	-3,40	-4	16	13,60	2000	-2,00	-5	25	10,00
2003	-0,90	-2	4	1,80	2002	-3,80	-3	9	11,40	2001	-3,40	-4	16	13,60
2004	1,70	-1	1	-1,70	2003	-0,90	-2	4	1,80	2002	-3,80	-3	9	11,40
2005	0,10	0	0	0,00	2004	1,70	-1	1	-1,70	2003	-0,90	-2	4	1,80
2006	3,20	1	1	3,20	2005	0,10	0	0	0,00	2004	1,70	-1	1	-1,70
2007	2,40	2	4	4,80	2006	3,20	1	1	3,20	2005	0,10	0	0	0,00
2008	-2,20	3	9	-6,60	2007	2,40	2	4	4,80	2006	3,20	1	1	3,20
2009	-0,20	4	16	-0,80	2008	-2,20	3	9	-6,60	2007	2,40	2	4	4,80
2010	0,70	5	25	3,50	2009	-0,20	4	16	-0,80	2008	-2,20	3	9	-6,60
2011	-0,20	6	36	-1,20	2010	0,70	5	25	3,50	2009	-0,20	4	16	-0,80
2012	-1,00	7	49	-7,00	2011	-0,20	6	36	-1,20	2010	0,70	5	25	3,50
2013	1,02	8	64	8,20	2012	-1,00	7	49	-7,00	2011	-0,20	6	36	-1,20
-	-	-	-	-	2013	1,02	8	64	8,20	2012	-1,00	7	49	-7,00
total	-10,00	0	280	59,20	-	-	-	-	-	2013	1,02	8	64	8,20
					total	-8,78	0	408	65,80	2014	0,94	9	81	8,42
										-	-	-	-	-
n	15				n	17				total	-7,34	0	570	69,72
β_0	-0,67				β_0	-0,52				n	19			
β_1	0,21				β_1	0,16				β_0	-0,39			
t	8				t	9				β_1	0,12			
Tt ₂₀₁₃	1,02				Tt ₂₀₁₄	0,94				t	10			
										Tt ₂₀₁₅	0,84			

Appendix E. Linear Trend Analysis of Merchandise Trade Balance (in mil. USD)

year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$	year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$	year	$\sum y_t$	$\sum t'$	$\sum t'^2$	$\sum y_t * t'$
1997	663	-8	64	-5 301	1997	663	-8	64	-5 301	1996	1 015	-9	81	-9 137
1998	717	-7	49	-5 020	1998	717	-7	49	-5 020	1997	663	-8	64	-5 301
1999	885	-6	36	-5 310	1999	885	-6	36	-5 308	1998	717	-7	49	-5 020
2000	1 097	-5	25	-5 487	2000	1 097	-5	25	-5 487	1999	885	-6	36	-5 308
2001	875	-4	16	-3 500	2001	875	-4	16	-3 500	2000	1 097	-5	25	-5 487
2002	562	-3	9	-1 687	2002	562	-3	9	-1 687	2001	875	-4	16	-3 500
2003	1 013	-2	4	-2 027	2003	1 013	-2	4	-2 027	2002	562	-3	9	-1 687
2004	1 159	-1	1	-1 159	2004	1 159	-1	1	-1 159	2003	1 013	-2	4	-2 027
2005	1 792	0	0	0	2005	1 792	0	0	0	2004	1 159	-1	1	-1 159
2006	2 214	1	1	2 214	2006	2 214	1	1	2 214	2005	1 792	0	0	0
2007	2 119	2	4	4 237	2007	2 119	2	4	4 237	2006	2 214	1	1	2 214
2008	2 665	3	9	7 995	2008	2 665	3	9	7 995	2007	2 119	2	4	4 237
2009	1 522	4	16	6 086	2009	1 522	4	16	6 086	2008	2 665	3	9	7 995
2010	2 216	5	25	11 080	2010	2 216	5	25	11 080	2009	1 522	4	16	6 086
2011	2 675	6	36	16 052	2011	2 675	6	36	16 052	2010	2 216	5	25	11 080
2012	1 723	7	49	12 058	2012	1 723	7	49	12 058	2011	2 675	6	36	16 052
2013	2 564	8	64	20 513	2013	2 564	8	64	20 513	2012	1 723	7	49	12 058
2014	2 676	9	81	24 083	2014	2 676	9	81	24 083	2013	2 564	8	64	20 513
-	-	-	-	-	-	-	-	-	-	2014	2 676	9	81	24 083
total	23 234	0	280	35 534	total	26 460	0	408	50 748	total	30 151	0	570	65 694
n	15				n	17				n	19			
β_0	1 549				β_0	1 556				β_0	1 587			
β_1	127				β_1	124				β_1	115			
t	8				t	9				t	10			
Tt ₂₀₁₃	2 564				Tt ₂₀₁₄	2 676				Tt ₂₀₁₅	2 739			

References

- Asian Development Bank. (2013). Key Indicators for Asia and the Pacific. Mandaluyong City, Philippines.
- Bank of Papua New Guinea. (2012). Quarterly Economic Bulletin June 2012. Port Moresby, Papua New Guinea.
- Chudárková, S., & Verner, T. (2013). Production Function and Human Capital: The Case of Visegrad Countries, Proceedings of 31st International Conference Mathematical Methods in Economics 2013, pp. 321–325. College of Polytechnics Jihlava, Czech Republic.
- International Monetary Fund. (2013). World Economic Outlook April 2013 – Growth Resuming, Dangers Remain. Washington, DC, USA.
- Kozák, J., Hindls R., & J. Arlt. (1994). Úvod do analýzy ekonomických řasových řad. [Introduction to the Analysis of economic time Series] Prague: University of Economics in Prague, Czech Republic.
- Majerová, I. (2012). Global Financial Crisis and its Impact on the Least Developed Countries. In Stavarek, D. & Vodova, P. (Eds.) Proceedings 13th International Conference of Finance and Banking, pp. 216–228. Karviná: Silesian University, Czech Republic.
- Majerová, I. (2011). Ekonomické a politické aspekty vývoje zemí LDC a jejich perspektivy v rámci světové ekonomiky. [Economic and political Aspects of the LDC Countries and their Perspectives in the global Economy]. Karviná: Silesian University, Czech Republic.
- Nevima, J. & Kiszová, Z. (2013). Multiplicative and Additive Approach in Analytic Hierarchy Process – Case Study of Competitiveness Evaluation of Czech and Slovak Regions. *International Journal of Mathematical Models and Methods in Applied Sciences*, 5(7), 490–499.
- Tradingeconomics. (2013). [online]. Available at: <http://www.tradingeconomics.com/papua-new-guinea/forecast>.
- UNCTAD (2010). Handbook of Statistics. United Nations Conference on Trade and Development. United Nations, Geneva.
- UNCTAD (2012). Handbook of Statistics. United Nations Conference on Trade and Development. United Nations, Geneva.
- UNCTAD. (2013) Unctadstat. Total export and import values. [online]. Available at: <http://unctadstat.unctad.org/TableViewer/tableView.aspx>.
- United Nations ESCAP. (2012). Statistical Yearbook for Asia and the Pacific 2012 – Country Profiles. Economic and Social Commission for Asia and the Pacific. Geneva: United Nations Publication, Switzerland.
- World Bank Group. (2013). Papua New Guinea Economic Briefing 2013-1. Washington DC, USA.
- World Bank. (2013a). International Debt Statistic 2013, Washington DC, USA.
- World Bank. (2013b). GDP growth. [online]. Available at: <http://data.worldbank.org/country/papua-new-guinea>.
- World Bank. (2013c). GDP. [online]. Available at: <http://data.worldbank.org/country/papua-new-guinea>.
- World Bank. (2013d). Global Economic Prospect. June 2013. East Asia and the Pacific Region. Annex. Washington DC, USA.
- World Bank. (2013e). Global economic prospects. Exports and Imports. [online]. Available at: <http://databank.worldbank.org/data/views/reports/tableview.aspx>.
- World Bank. (2013f). Inflation. [online]. Available at: <http://data.worldbank.org/country/papua-new-guinea>.