Regression and Transgression Analysis on the Private Output Contribution to the Gross Domestic Product at Bengkulu Province, Indonesia

YOSEPH WIKATAMA KURNIAWAN
Doctorate Candidate from Faculty of Economics and Business at Postgraduate Program, University of Udayana, Denpasar, Indonesia

KEMBAR SRI BUDHI
Professor, Faculty of Economics at Postgraduate Program, University of Udayana, Denpasar, Indonesia

Abstract :
Bengkulu is a province in Indonesia that contributes national Gross Domestic Product (GDP) ranking number 27 from 34 provinces. Its agriculture and mining sectors are the main sources for the contribution. By studying the economical regression analysis for the past 34 years, and also its transgression analysis (feasibility study) for the next 30 years, it indicates an influence of private output to variables of private investment for the infrastructure development and national state expenditure. The biggest contribution for supporting private output comes from the state expenditure for infrastructure development of regression analysis and state expenditure for infrastructure development and workers. Its independent variables are private investment and state expenditure for education and health, which have less influence in transgression analysis.

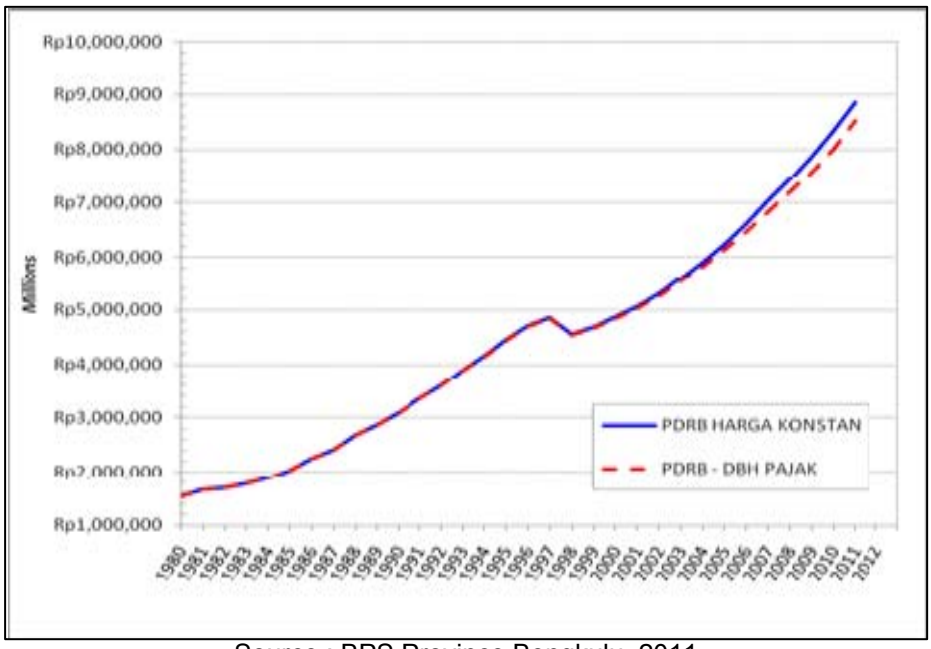
Keywords: Regression and Transgression, Private Output, Bengkulu Province, Indonesia

1. INTRODUCTION

Bengkulu province is situated on the west coast side of Sumatera island. This province has a total area of ± 22.365,6 Km² that has a population of 1,799,668 residents (See Figure 1). Based on the rank of GDP value, Bengkulu is ranked in 27th of 34 provinces which the main contributions come from agriculture and mining sector.

Figure 1 Location of Bengkulu Province, Indonesia.

Bengkulu was initially stated by Indonesian government in 1968 and is 25th province of total 34 provinces in Indonesia (ranked by the date of establishment). Its GDP growth (Private Output) from 1980 until 2011 (BPS, 2011) is shown in Figure 2 below.



Source : BPS Province Bengkulu, 2011

Figure 2. Growth of Gross Domestic Regional Product (GDRP) ith & without Tax from 1980 to 2011

Since this province was initially established, the natural resources such as coal, gas, minerals, and any local products were not optimally exploited to be as import commodities due to lack of infrastructure development, particularly main roads and ports..

Private Investments (capital=K), Labors (L), State Expenditure for Construction (PK 1), State Expenditure for Education (PK 2), Income Tax from Private or Private Output (Y), are the main components that contribute the increasing amounts of Bengkulu's GDP (Z) (Kurniawan 2012). Taken from the feasibility study of a mega project in this province on 2010, it is projected that the private output will contribute 10,25% of total GDP in 2033 (see Figure 3) which this condition shows a noticable significant progress. Private companies investments are expected to stimulate the growth of GDP from tax income (Private *Output*). This paper is created to compare the contribution of Private Output from 2010 to 2011 (using a Regression Analysis Technique) with a predicted income based on the feasibility study of a mining transportation Mega-Project (Kurniawan, 2010), which this technique is called Transgression Analysis Technique. The outputs of both components could elicit a valid informations that show the importance of optimizing the tax income coming from this project investment which technically and economically is feasible.

Based on result of this Feasibility Study, it shows that Private Output together with the State Expenditure for Construction (PK 1) are the two top contribution for Bengkulu's GDP (Z).

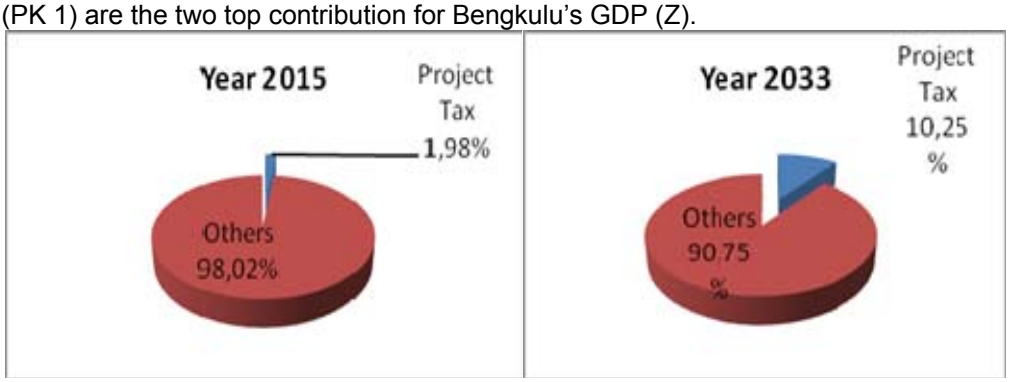


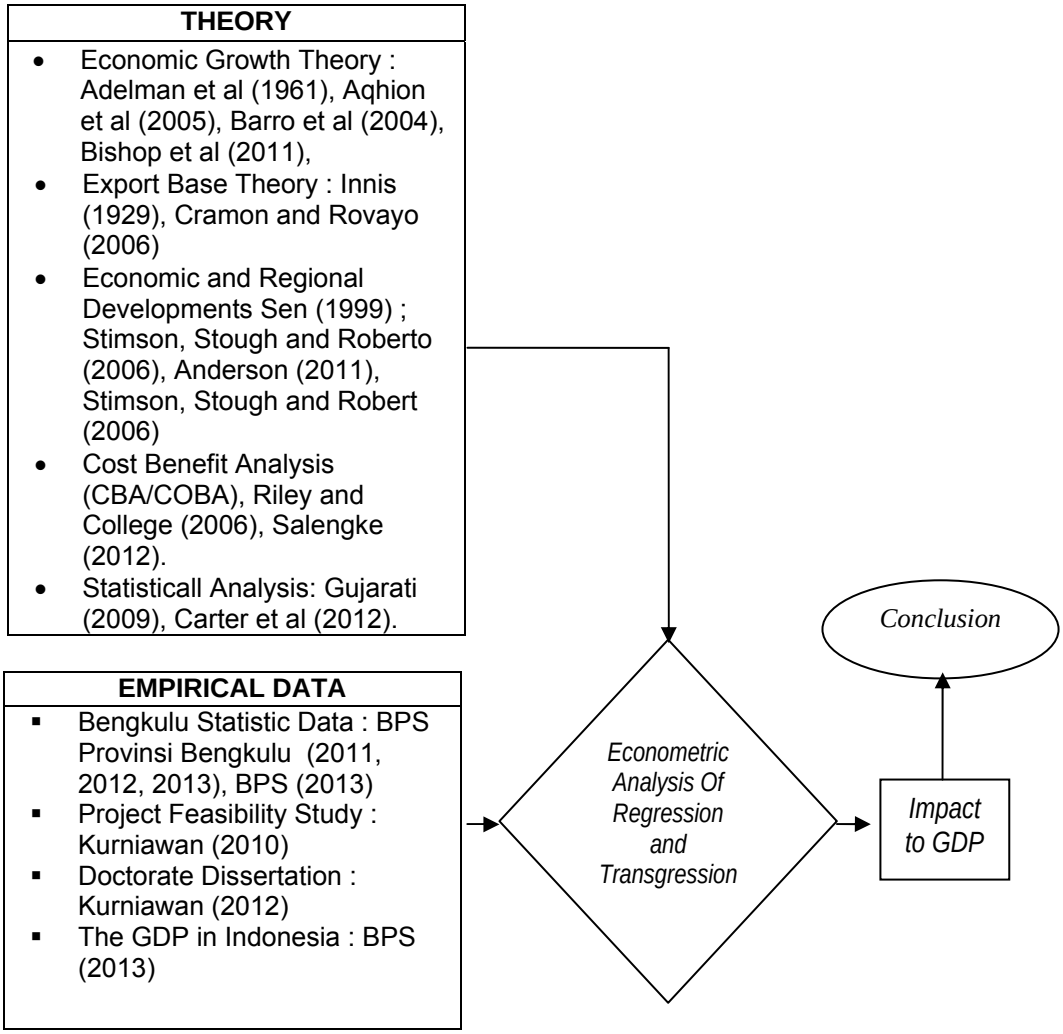
Figure 3. Predicted Contribution of Private Output in 2015 and 2033

Regression and Transgression anaysis are the methods being used in order to observe the functions of those variables to increase GDP. Regression is defined as statistical method that describe dependent variables from one or more independent variables. (Gujarati, 2009, Carter et al, 2012). Transgression is defined by writer as statistical method that describe dependent variables from one or more independent variables based on projected data analysis from the feasibility study.

Comparable assumptions that used in the analysis are Private Investmens (K), Labors (L), State Expenditure for Infrastructure (PK 1), State Expenditure for Education and Health (PK 2) as independent variables, Private Output (Z) as an Intervening and GDP (Z) as dependent variable.
This study is limited up to regression analysis of the Private Output against GDP of Bengkulu from 1980 until 2011 with is compared the Private Output from the feasibility study of transportation project from 2010 until 2040 by transgression analysis.

2. METHODOLOGY

The concept of this study is illustrated as follows.



The models of economic growth theory were introduced by Harrod – Domar Model (1940), Kaldor Model (1961 vide, D'Agata and Freni 2003), Solow Model (1956), Schumpeter Model (1934, vide Arsyad 2010), Rostow Model (1990, Romer (1990) and Bishop et al Model (2011). These models embrace the economic growth from the factors of capital, technology innovation, and investment ouput that have roles to increase GDP.

The export base theory was introduced by Harold Innis (England), beginning of year 1920, and developed by North (1955), Dusenberry (1950), Andrews (1953) and deeply stressed by Cramon and Rovayo (2006). This theory refers to the Neoclassical approach to regional growth based on resource areas in North America with the economic growth of the industry by exporting goods and services from region to region because of there sources of an Area (Cramon and Rovayo, 2006).

Economic and regional developments theory was determined well by Amarta Sen (1999), Stimson, Stough and Robert (2006); Stimson, Robson, Stough and Salazar (2009).
Cost Benefit Analysis (CBA / COBA) is a technique for assessing the monetary social costs and benefits of a capital investment project over a given time period. The investment criteria methods of project and its application might be determined by five models; 1. Net Present Value / Worth (NPV), 2. Benefit Cost Ratio, 3. Profitability Indexs, 4. Payback Periods, 5. Internal Rate of Return / IRR (Riley and College, 2006, Salengke 2012).

Regression and Transgression analysis with path analysis are applied with E_{VIEWS} programme from secondary data gained from BPS 2012 which is a time series from 1980 until 2011 by using Regression analysis (Attachment 1). Empirical Data are the time series of feasibility study result from 2010 until 2040 for the Transgression Analysis (Attachment 2). Consistency and Cointegration test are conducted before both time series data are analyzed within 30 years range by the Regression and Transgression analysis method.

Equation model and the connections of each regression and transgression variables use some formulas as described below:

$LnY_t = \alpha_0+\alpha_1 LnKt_{-1} +\alpha_2 LnL_{t-1}+ \alpha_3 LnPK1_{t-1}+\alpha_4 LnPK2_{t-1} + e_{1t}$..... (1a)

$LnZ_t = \alpha_0+\alpha_1 LnKt_{-1} +\alpha_2 LnL_{t-1}+ \alpha_3 LnPK1_{t-1}+\alpha_4 LnPK2_{t-1} + e_{2t}$..... (1b)

$LnZ_t = \alpha_0+\alpha_1 LnYt_{-1} +\alpha_2 LnKt_{-1} +\alpha_3 LnL_{t-1}+ \alpha_4 LnPK1_{t-1}+\alpha_5 LnPK2_{t-1}+ e_{2t}$.. (1c)

Which :

LnY_t	=	Private Output in year t,
LnZ_t	=	$LnGRDP_t$ = Gross Regional Domestic Product in year t,
α_0	=	Constant,
$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$	=	Estimated Parameter,
K_t	=	Private Investment in year t,
L_{t-1}	=	Labors in year t-1,
$PK1_{t-1}$	=	State Expenditure for Infrastructure Development in year t-1,
$PK2_{t-1}$	=	State Expenditure for Education and Health in year t-1,
e_t	=	Error Variables in year t

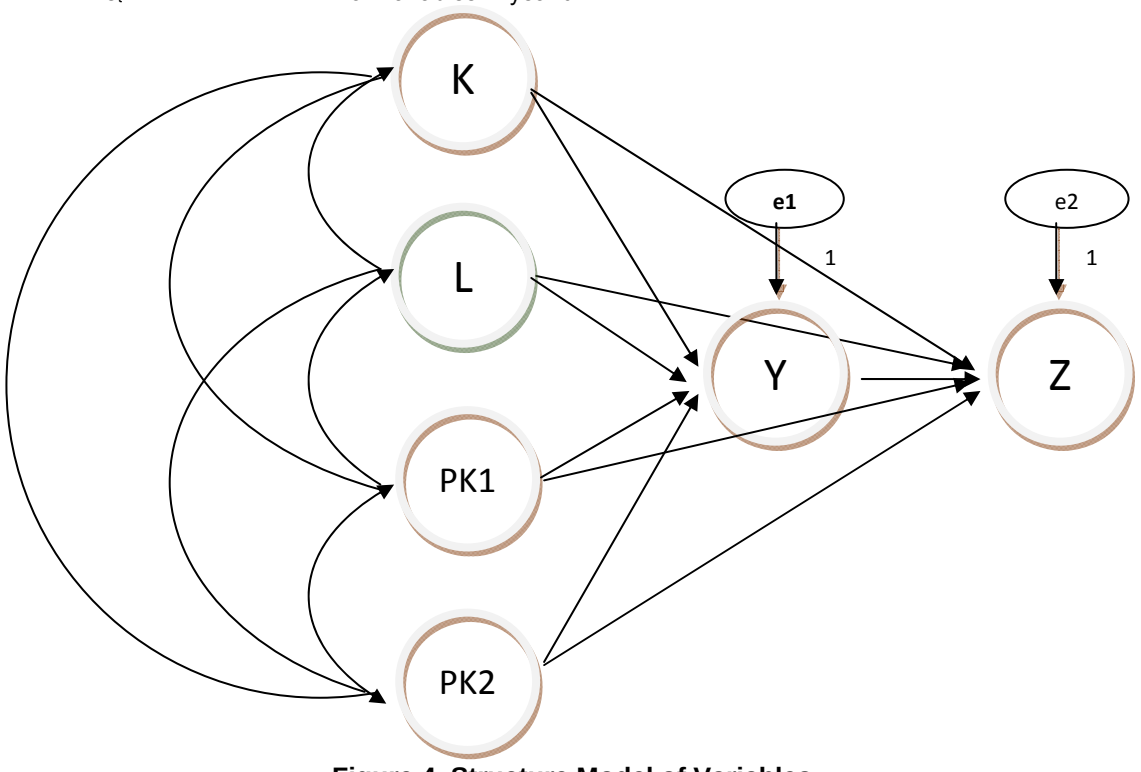


Figure 4. Structure Model of Variables

Which:

K	=	Private Investment (Capital)
L	=	Labors
PK1	=	State Expenditure for Infrastructure Development
PK2	=	State Expenditure for Education and Health
Y	=	Private Output
Z	=	Gross Regional Domestic Product
e	=	Error

3. ECONOMETRICAL REGRESSION AND TRANSGRESSION ANALYSIS RESULT

The Regressive data result of BPS for Bengkulu province from 1980 to 2011 are shown in table 1. Figure 5 shows the variables connections with path coefficient. Table 2 shows the direct and indirect influence of each variables.

Table 1-Regression Analysis: Coefficient or Direct Influence of each Variables of BPS Data Research

Variable	Coef	St Error	Coef Beta	t	Prob
LNK(-1) □ LNY	0.560	0.078	0.156	7.147	0.000
LNL(-1) □ LNY	3.276	0.396	0.338	8.265	0.000
LNPK1(-1) □ LNY	0.458	0.138	0.306	3.312	0.003
LNPK2(-1) □ LNY	0.276	0.113	0.215	2.455	0.021
LNK(-1) □LNZ	0.137	0.017	0.151	7.862	0.000
LNL(-1) □LNZ	0.587	0.098	0.239	6.015	0.000
LNPK1(-1) □LNZ	0.045	0.021	0.119	2.111	0.045
LNPK2(-1) □LNZ	0.041	0.016	0.126	2.524	0.018
LNY □LNZ	0.095	0.025	0.377	3.757	0.001

Table 2- Regression Analysis: Direct, Indirect, and Total Influences of Each Variables of BPS Data Research

Independent Variables	Influence Category	Dependent Variables	
		LNY	LNZ
LNK(-1)	Direct Influence	0.156	0.151
	Indirect Influence	-	0.059
	Total Influence	0.156	0.210
LNL(-1)	Direct Influence	0.388	0.239
	Indirect Influence	-	0.127
	Total Influence	0.388	0.366
LNPK1(-1)	Direct Influence	0.306	0.119
	Indirect Influence	-	0.115
	Total Influence	0.306	0.234
LNPK1(-1)	Direct Influence	0.215	0.126
	Indirect Influence	-	0.081
	Total Influence	0.215	0.207
LNPK1(-1)	Direct Influence	-	0.337
	Indirect Influence	-	-
	Total Influence	-	0.337

The Transgression data of Feasibility Study from 2010 until 2040 are shown in Table 3. The corellation of each variables with path coefficient are shown in Figure 6 and the direct, indirect and total influences of each variables are shown in table 4.

Table 3-Transgression Analysis: An Overview of Path Coefficient or Direct Influences of each variables of Feasibility Study Data Research

Variable	Coef	St Error	Coef Beta	t	Prob
LNK(-1) □ LNY	0.820	0.262	0.234	3.131	0.005
LNL(-1) □ LNY	4.737	1.061	0.145	4.464	0.000
LNPK1(-1) □ LNY	0.485	0.092	0.488	5.301	0.000
LNPK2(-1) □ LNY	1.123	0.451	0.132	2.491	0.022
LNK(-1) □LNZ	0.369	0.177	0.105	2.085	0.051
LNL(-1) □LNZ	6.864	0.831	0.208	8.262	0.000
LNPK1(-1) □LNZ	0.279	0.079	0.278	3.545	0.002
LNPK2(-1) □LNZ	0.785	0.286	0.091	2.745	0.013
LNY □LNZ	0.331	0.124	0.328	2.673	0.015

Table 4- Transgression Analysis: Direct, Indirect, and Total Influences of Each Variables of BPS Data Research

Independent Variables	Influence Category	Dependent Variables	
		LNY	LNZ
LNK(-1)	Direct Influence	0,234	0,105
	Indirect Influence	-	0,077
	Total Influence	0,234	0,182
LNK(-1)	Direct Influence	0,145	0,208
	Indirect Influence	-	0,048
	Total Influence	0,145	0,256
LNPK1(-1)	Direct Influence	0,488	0,278
	Indirect Influence	-	0,160
	Total Influence	0,488	0,438
LNPK2(-1)	Direct Influence	0,132	0,095
	Indirect Influence	-	0,043
	Total Influence	0,132	0,138
LNY	Direct Influence	-	0,328
	Indirect Influence	-	-
	Total Influence	-	0,328

Path coefficients in Table 3 and 4 can be exposed in an interconnecting diagrams in Figure 5 and 6.

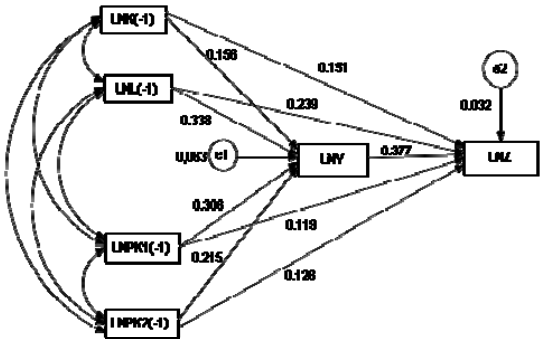


Figure 5.-Regression Analysis: A Diagram of Researched Variables Connections by using BPS Data

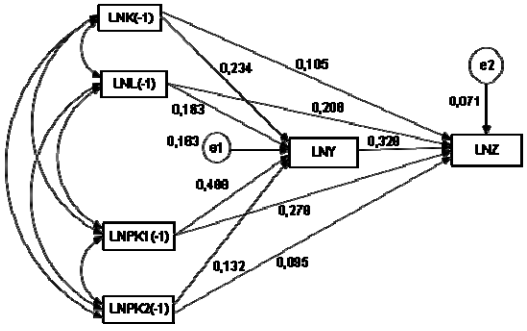


Figure 6-Transgression Analysis: A Diagram of Researched Variables Connections by using Feasibility Study Data

4. CONCLUSION

The two above models show that the two methods of analysis (Regression and Transgression) have resulted a typical result of private output contribution towards the GDP. The contribution of private output variables leads the top rank among other variables in which its path coefficient is 0,377 by regression analysis and 0,328 by transgression analysis towards GDP. The highest direct influence coefficient of other independent variables is 0,488 which comes from the state expenditure for infrastructure development by transgression analysis. Meanwhile, by regression analysis, 0,338 is the coefficient number for labors and 0,306 for the state expenditure for infrastructure development.

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REFERENCES

Adelman, Irma. 1961 : *Theories of Economic Growth and Development*, California: Stanford University Press.

Aghion, Philippe & Steven Durlauf (eds.). 2005 : *Handbook of Economic Growth*, Elsevier.

Arsyad, Lincolin. 2010 : *Pembangunan Ekonomi :* STIM YKPN, Yogyakarta.

Barro, Robert J. & Xavier Sala-i-Martin. 2004 : *Economic Growth*, Second Edition, Cambridge: The MIT Press.\

Bishop, Sangeta, and Parrott, Christine et al. 2011 : AP. *Macroeconomics/Microeconomics;Publisher :Kaplan Publishing*, New York.

BPS *(Bengkulu Statistic Center).* 2011 : Berita Resmi Statistik, No 47/08/Thun XIV, 1 Agustus.

BPS (Bengkulu Statistic Center) Bengkulu Province. 2009 : *Indikator Kesejahteraan Rakyat / Welfare Indicators*, Publisher: BPS, Jakarta, Cataloque No: 4102004.

2010 : Provinsi Bengkulu dalam Angka : BPS Provinsi Bengkulu, Katalog Bps : 1102001.17.

2011 : Berita Resmi BPS Statistik Provinsi Bengkulu tentang Keadaan Ketenagakerjaan Provinsi Bengkulu, edisi Mei, 2011

2012 : Data Olahan dari Perpustakaan BPS Provinsi Bengkulu, (tidak di publikasikan).

2013 : Data Olahan dari Perpustakaan BPS Provinsi Bengkulu, (tidak di publikasikan).

Carter Hill, R, Griffiths William and Lim. Guay C. 2012 : Principles of Economics, John Wiley and Sons, Pte Ltd, Fourth Edition

Cramon, Von dan Rovayo, A. 2006 : *Export - Base Theory Georg – August – Universitat,Gottingen*,www.uni-goettingen.de/de/...pdf/EXPORT-BASE%20THEORY.pdf.

D'Agata, Antonio dan Freni, Giuseppe. 2003 : *The structure of growth models: Acomparative survey, University of Cotania (Italy) and Parthenope University, Noples* : http://growthconf.ec.unipi.it/papers/DAgataFreni.pdf, diunduh 10 Januari 2011

Gujarati, 2009 : Dasar-dasar ekonometrika *(Essentials of Economics),* Erlangga, Jakarta, Edisi Jilid 1 dan 2, Cetakan Ulang dari 2006.

http://www.bps.go.id

http://economistsview.typepad.com/economistsview/2008/10/new-trade-theor.html.

Kurniawan, Paulus. 2010 : *Feasibility Study, Coal Port and Double Track Railway from Muara Enim to Pulau Baai Transportation Project to Increase Export Capacity in Bengkulu,* dengan Perusahaan Terbatas Pratama Widya Jakarta terdiri 8 (delapan) buku laporan lengkap (tidak dipublikasikan).

Paulus. 2011 : *Teori Pertumbuhan Ekonomi Sektoral dan Keterkaitannya*, Perpustakaan FEB, UNUD, tidak dipublikasikan.

Kurniawan, Paulus, Kembar SB, Suyana Utama, Mahaendra Yasa. 2013 : *Impact of Coal Railroad Transportation Project on GDP Promotion and Unemployment Reduction in Bengkulu Province, Indonesia*, Journal of Economic Development, Quarterly Journal, University of Economics Hochiminh City, Vietnam, No, 216.

Riley, Geoff and College, Eton. 2006 : *A2 Macroeconomics / International Economy Theories of Economic Growth.http://tutor2u.net/economics/revision-notes/a2-macro-theories-of-economic growth.html*.

Romer, Paul N. 1990 : Endogenous Technological Change, *The Journal of Political Economy*, Vol. 98(5), pp. S71-S102.

Rostow, Walt Whitman. 1990 : *Theories of Economic Growth from David Hume to the present: With a Perspective on the Next Century,* New York: Oxford University Press.

Salengke. 2012 : *Engineering Economy, Techniques for Project and Business Feasibility Analysis*, Identitas Unhas, Makassar.

Sen, Amartya. 1999 : *Development as Freedom*, New York: Oxford University Press.

Solow, Robert M. 1956 : A Contribution to the Theory of Economic Growth, *The Quarterly Journal of Economics*, Vol. 70(1), pp.65-94.

Stimson, R. J, R. R. Stough, B. H. Roberts. 2006 : *Regional Economic Development: Analysis and Planning Strategy*, Revised Edition., Berlin, Springer.

Stimson, Robert.J dan Stough, Roger.R dan Salazar, Maria. 2009 : *Leadership and institutions in regional endogenous development. Corresponding Author : Roger R. Stough, (rstough@gmu.edu) ,* publisher : George Mason University, VA, USA.

Swan, Trevor W. 1956 : Economic Growth and Capital Accumulation*, Economic Record*, Vol. 32, pp. 334-361.

Attachment 1

No	Year	GDRP	Investment (PMTB)	Labors (People)	PK1 (Construction)	PK2 (Education and Health)	DBH General Mining	Private Output
1	1980	1532627,16	128717,14	421152	12724,36	8201,08	6,00	50,03
2	1981	1654120,92	143051,14	428912	16513,14	10643,01	8,03	66,93
3	1982	1691279,84	161638,68	437113	17887,19	11528,61	10,71	89,28
4	1983	1762194,65	174283,71	450683	21959,02	14152,98	12,77	106,38
5	1984	1880794,94	176189,89	459550	21999,95	14179,36	16,99	141,61
6	1985	2025569,18	205429,91	472675	27097,23	17464,65	37,16	309,71
7	1986	2242561,64	261173,81	494589	27573,47	17771,59	34,18	284,81
8	1987	2412253,15	291105,48	511420	28734,20	18519,70	40,98	341,52
9	1988	2675147,99	392196,45	525221	33461,29	21566,40	40,72	339,35
10	1989	2873580,85	428452,53	534576	40632,51	26188,38	49,32	411,03
11	1990	3088776,13	527211,27	540165	49395,44	31836,24	60,39	503,23
12	1991	3347461,78	575916,98	546719	56407,84	36355,86	65,91	549,25
13	1992	3591324,08	655865,72	573272	65274,74	42070,73	83,27	693,93
14	1993	3887507,26	781988,74	612814	73529,66	47391,17	111,63	930,27
15	1994	4153534,69	824488,09	614372	80169,74	51670,83	154,25	1285,45
16	1995	4461571,06	904424,83	617930	87636,47	58090,29	192,08	1600,69
17	1996	4716892,41	850871,34	696536	107039,25	70719,00	246,61	2055,10
18	1997	4861662,53	638153,03	703308	132220,75	86352,15	274,05	2283,74
19	1998	4556614,91	418640,24	718319	129460,08	88900,71	314,15	2617,93
20	1999	4687631,23	387875,06	733329	154531,97	109817,82	399,43	3328,57
21	2000	4871897,22	402743,82	639618	198163,96	140366,65	1835,79	15298,26
22	2001	5068427,19	412624,00	686474	172818,11	181180,27	1408,53	11737,77
23	2002	5310017,09	429553,00	749490	194469,25	207063,73	1730,25	14418,78
24	2003	5589130,11	446714,00	673239	297964,47	277805,58	2606,10	21717,53
25	2004	5896253,00	475606,00	720036	218773,20	267041,57	2926,49	24387,38
26	2005	6239361,00	530809,00	756142	379795,61	385504,52	2772,58	23104,81
27	2006	6610628,57	563481,00	759772	810409,53	670902,83	2486,18	20718,14
28	2007	7037404,03	757346,28	823370	1492878,64	1142585,84	2656,42	22136,86
29	2008	7441873,08	827097,88	802963	1799001,55	1551655,64	2919,94	24332,84
30	2009	7859919,71	869534,71	821706	1333993,00	1806072,92	3182,24	26518,63
31	2010	8336018,75	920708,08	830741	1002714,25	1623582,43	3784,71	31539,27
32	2011	8869250,28	1013142,82	848187	1100396,86	2227800,95	4608,92	38407,63

Attachment 2 Feasibility Study

No.	Year of Project	K	L	PK1	PK2	Y	Z
		CASH FLOW (000 USD)	LABOUR (ribu orang)	BPbP (000 USD)	BPdP (000 USD)	NET INCOME (000 USD)	PDRB atau TAX (000 USD)
1	2011	6036,588	168,000	0,000	1680,000	– 6036,588	0,000
2	2012	11362,386	484,563	0,000	4894,086	–11362,386	0,000
3	2013	8722,030	727,564	0,000	7421,880	–8722,030	0,000
4	2014	5468,297	840,000	0,000	8654,528	–5468,297	0,000
5	2015	264121,042	840,000	467,772	8741,074	77962,060	23388,618
6	2016	272670,419	840,000	541,053	8828,484	90175,456	27052,637
7	2017	279337,003	840,000	598,195	8916,769	99699,147	29909,744
8	2018	284257,680	840,000	640,372	9005,937	106728,686	32018,606
9	2019	287553,078	840,000	668,618	9095,996	111436,397	33430,919
10	2020	289329,065	840,000	683,841	9186,956	113973,522	34192,056
11	2021	291427,199	840,000	701,825	9278,826	116970,856	35091,257
12	2022	292336,018	840,000	709,615	9371,614	118269,169	35480,751
13	2023	292135,273	840,000	707,894	9465,330	117982,390	35394,717
14	2024	386095,172	840,000	1513,265	9559,984	252210,817	75663,245
15	2025	383877,275	840,000	1494,254	9655,583	249042,393	74712,718
16	2026	380735,289	840,000	1467,323	9752,139	244553,841	73366,152
17	2027	376715,786	882,000	1432,870	10342,144	238811,695	71643,508
18	2028	371858,852	882,000	1391,239	10445,565	231873,217	69561,965
19	2029	366198,653	882,000	1342,723	10550,021	223787,218	67136,165
20	2030	431288,836	882,000	3696,761	10655,521	616126,908	184838,072
21	2031	420932,389	882,000	3607,992	10762,076	601331,984	180399,595
22	2032	410161,685	882,000	3515,672	10869,697	585945,264	175783,579
23	2033	537560,152	882,000	4607,658	10978,394	767943,074	230382,922
24	2034	525910,558	882,000	4507,805	11088,178	751300,797	225390,239
25	2035	513794,980	882,000	4403,957	11199,060	733992,829	220197,849
26	2036	501194,780	882,000	4295,955	11311,050	715992,542	214797,763
27	2037	488090,571	882,000	4183,633	11424,161	697272,244	209181,673
28	2038	474462,194	882,000	4066,819	11538,402	677803,134	203340,940
29	2039	460288,681	882,000	3945,332	11653,786	657555,259	197266,578
30	2040	467550,727	882,000	4007,578	11770,324	667929,610	200378,883

Source: Kurniawan, 2010