New Zealand Agricultural & Resource Economics Society (Inc.)
NZARES

What is the impact of reduced-impact logging (RIL) policy on the Berau Economy?

Kadim Martana[1], James Lennox[2], David Evison[1] & Bruce Manley[1]

[1]School of Forestry, University of Canterbury, NZ
[2]Fondazione Eni Enrico Mattei, Italy

Paper presented at the 2013 NZARES Conference
Lincoln University – Canterbury, New Zealand. August 28-30, 2013

What is the impact of reduced-impact logging (RIL) policy on the Berau Economy?

Kadim Martana[1]
James Lennox[2]
David Evison[1]
Bruce Manley[1]

[1] School of Forestry, University of Canterbury, NZ
[2] Fondazione Eni Enrico Mattei, Italy

Paper presented at the 2013 NZARES Conference
Lincoln University – Christchurch, August 28-30, 2013

What is the impact of reduced-impact logging (RIL) policy on the Berau Economy?

By:

Kadim Martana[1]
James Lennox[2]
David Evison[1]
Bruce Manley[1]

Abstract

A dynamic recursive CGE model of the Berau District (East Kalimantan Province, Indonesia) was constructed, to analysis the impact of REDD policies. The model was used to simulate a policy to implement reduced-impact logging (RIL) by inducing a seven percent raise in logging cost. Results suggest that impact of the policy to the Berau economy is small. Agricultural-based households' welfare decreased (with forestry households the most impacted) while non-agricultural households were better off. As logging output declines, other agricultural outputs increase, since factors of production that are not used in the logging sector, are re-employed in other agricultural sectors, especially the oil palm sector.

Key words: CGE, RIL, Berau

1. Introduction

The President of Indonesia has pledged that national greenhouse gas emissions be reduced by 26% from business as usual level by 2020. Forestry sector actions are implemented under the framework of the reducing emissions from deforestation and forest degradation (REDD) programme (Lang, 2011). Several REDD demonstration activities have been launched in Indonesia with the cooperation of country partners as well as non-profit organisations. The Berau Forest Carbon Program (BFCP) is one kind, initiated by The Nature Conservancy (TNC), Berau District Government and the Indonesian Government.

The program has proposed policy measures (planned to be implemented in 2016) to reduce the Berau emissions including, but not limited to, applying reduce-impact logging and best practice-management/including re-directing oil palm plantation establishment in

degraded land (Ministry of Forestry Indonesia, et al., 2011). This paper focuses on the former policy.

2. Methodology

A recursive computable general equilibrium (CGE) model for the Berau District was constructed. The CGE specifies blocks of production activities in which logging is separated from non-timber forest product activity; and oil palm sector is disaggregated from other agricultural activities like food crops, fishery and livestock, households, government, investment and rest of world (ROW). In the base year social accounting matrix of 2007, various local commodities are marketed locally (44%) and sold outside the District/exported (56%). Composite goods, that are mixed of locally produced goods mixed and imported commodities, are used for intermediate inputs (48%), household consumption (18%), government consumption (9%), and investment (26%). Further detail economic structure of the Berau District is in Appendix 1.

Households derived 85% their income from factor payments. The remaining comes from inter-household transfers as well as transfers from government, enterprise and the rest of world. Meanwhile, the government earns 70% of its income from indirect tax, 29% from direct taxes from both households and corporate and the remaining is transfers from ROW.

Investment is financed from households (27%), enterprise 30%, government 25%, and the ROW (18%). Imports of goods and services account for 25% of total expenditure of the ROW. The rest is paid to the ROW through transfers from domestic households, government, and enterprise, as well as factor payments to ROW.

Production and commodities

For all activities, producers maximise profits subject to their technology and the prices of inputs and outputs. The production technology is a two level nesting structure. At the bottom level, primary inputs are aggregated to produce value added output using a CES (constant elasticity of substitution) function. At the top level, the composite value added is

combined with intermediate input within a fixed coefficient (Leontief) function to create output. The profit maximisation brings about the demand for intermediate commodities, labour, capital and land demand.

Domestic output is allocated either for domestic markets or exports. This is determined by the assumption that domestic producers maximise profits subject to of imperfect transformability between these two alternatives. A constant elasticity of transformation function between the domestic supply and export defines the production possibility frontier of the economy.

On the demand side, composite commodity is made up of domestic demand and final imports and it is used for intermediate inputs, consumptions (by households and government) and investment. Armington assumption is used to distinguish between domestically produced commodities and imported goods. For every commodity, the model assumes imperfect substitutability (CES function) between imports and the corresponding domestic goods. The parameters for CET and CES elasticity are used to calibrate the function used in the CGE model are determined exogenously.

3. Data

The dataset for the CGE is an estimate of the Berau District's social accounting matrix. The SAM is a 64 X 64 matrix which specifies 23 sectors and their corresponding commodities, 7 type of households and 7 factors of production categories including capital and land factors. Other institutions are government, enterprise, saving-investment and rest of world (ROW).

In the model, elasticity of substitution between primary inputs (CES), elasticity of imported-locally produced goods substitution (the Armington elasticity) (CES), and transformation elasticity (CET) were derived from Robinson et al. (1997); Other exogenous parameters for the model dynamisation such as interest rate, depreciation rate and assumed labour growth rate were obtained from the World Bank, Schundlen (no year) and Berau and East Kalimantan statistics offices.

To understand the economic impact of selective logging, a survey of expert opinion was carried out to determine how much reduced-impact logging the increased logging costs, and how much the logging company should be compensated for maintaining RIL. Information from experts was aggregated using a simplified CONFIDE approach (Slevin, et al., 1998). Assuming that all logging companies engaged in the RIL program, the following RIL policy scenarios were specified:

a. implementing the RIL only - without providing any incentives/compensation (RIL0 Scenario), and

b. implementing the RIL with 2% output-subsidy rate on the timber sector (RIL2 Scenario).

In baseline simulation, the CGE model was calibrated to follow the actual economic path of the Berau District from 2007 to 2010; and from 2011 onward, the District's economy is expected to grow at 6%. This assumption is higher than the predicted growth of Indonesia for 2010 to 2019 which is at 4.9% (Abler, 2010). Note that historically, the GRP growth of Berau District has been higher than that of East Kalimantan Province; but only slightly higher than that of Indonesia.

4. Results and Discussion

The impact of RIL policy on the Berau District gross domestic product (GRP), which is fairly small, is presented as Figure 1. For RIL0 Scenario, in 2016 when the policy applied, the GRP is 0.27% below baseline, and then continue declining up to 1.80% below baseline. Figure 1 also suggests that the decline is reduced in the case of RIL2 Scenario. In addition to this, the impact of the RIL policy to the District's economy is presented in Table 1.

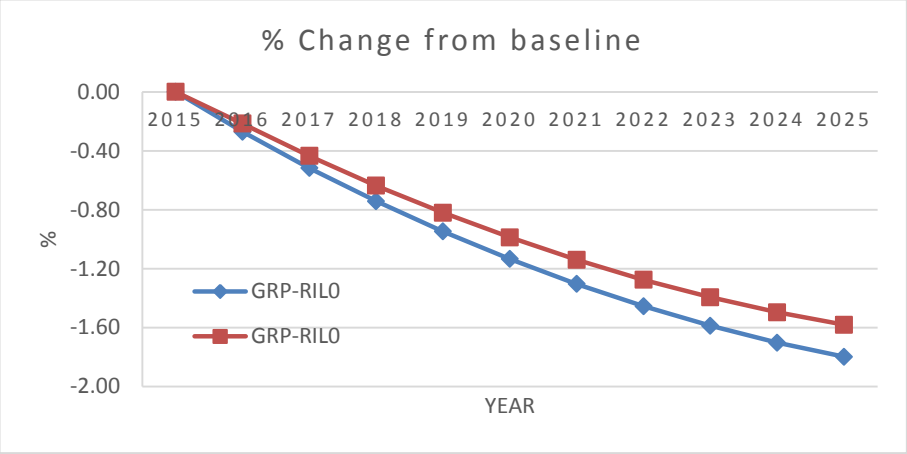


Figure 1. Impact of RIL policy on the Berau District real GRP at 2007 prices

It is expected that under the RIL0 policy, the Berau District would lost a total of IDR 1,148.36 billion (-16.78% of the 2015 condition), while the lost would be IDR 1,002.06 billion (-14.64% of the 2015 condition) under the RIL2 scenario. There is slightly over 2% GRP gain in the RIL2 scenario compared to the RIL0 scenario. The pattern also applies on other macro variables such as aggregate household consumption, aggregate investment, exports, imports as well as CPI. Note that, in the table government consumption is assumed to be fixed, and consequently there is no changes of the government consumption between scenarios.

Impact of the RIL scenario on the District's timber output is significantly negative. The value of timber output is 8% below baseline in 2016, going to 42% below baseline in 2025. Under the RIL0 scenario, cumulative value change of the timber sector's output from 2016 to 2025 is IDR 2,308.30 billion; which is -400% of the 2015 output value of the timber sector. Under the RIL2 scenario, total changes is IDR 2,111.61 billion, or about -373% of the 2015 output value of the timber sector. There is nearly 34 percentage points of improvement in the RIL2 scenario from the RIL0 scenario (see TIMB sector of Table 2).

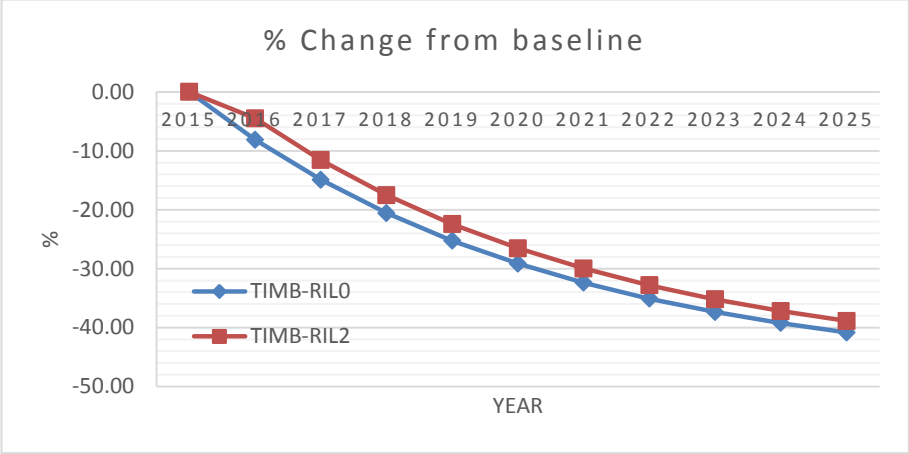


Figure 1. Impact of the RIL policy on Timber Output

Significant impacts also occur in oil palm (Figure 3) and other estate crops' output value (see sectors of OILP and OESC in Appendix 3). Both sectors experience increase in their output; which is substantial in the oil palm sector, and somewhat medium in the other estate crops. Table in Appendix 3 also shows that forestry-based (FOIN) and pulp and paper (PAPR) industries are also negatively impacted by the policy. Under the RIL0 scenario, total output changes in the FOIN and PAPR are IDR -11.30 billion and IDR -2,415.60 billion, respectively. These equals to 40% and 176% of the respective FOIN and PAPR output values in 2015 (see column 7 in Appendix 3).

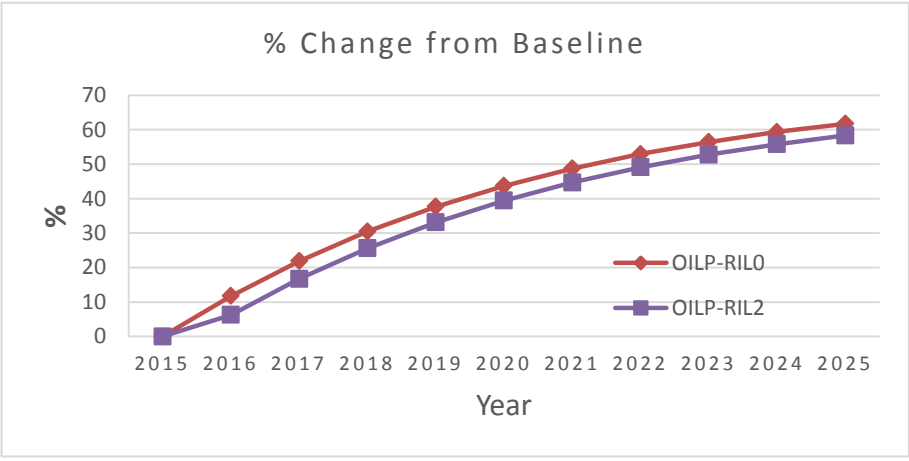
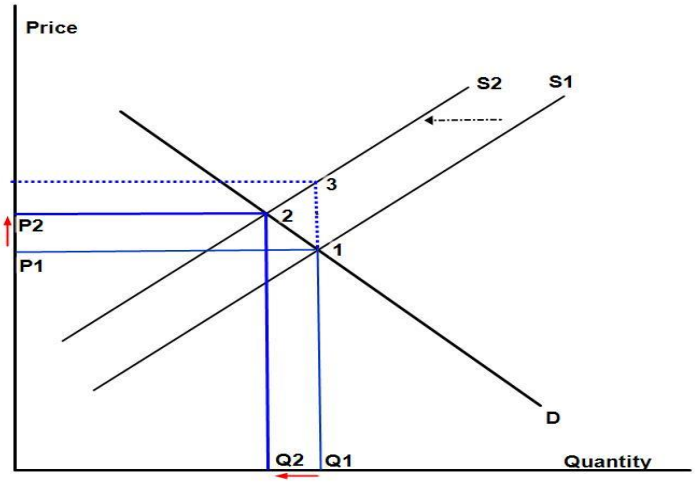


Figure 3. Impact of the RIL policy on Oil Palm Plantation Output

The impact of RIL policy on the timber output can be explained using a partial equilibrium model diagram (Figure 2). In the Figure, S1 and D represents supply and demand curve, respectively. In initial equilibrium condition of point 1, output level is Q1 with the price of P1. Suppose, due to the RIL Policy, productions costs increase. To produce the same level of Q1, more inputs are required, as indicated by point 3, where the same quantity of output can be produced at a higher cost. Subject to consumer preference, higher price of output stimulate a fall in consumer demand, as shown by a movement from point 1 to point 2. At this new equilibrium condition, less quantity of output (Q2) is produced with a higher price of output (P2) than the original price of P1.



Source: modified from Burfisher (2010)

Figure 1. Impact of RIL Policies on Timber Quantity and its Output Price

As the logging output decreases, some factors of production that previously used within the logging activity are now unemployed and are able to move to other sectors. Subject to their degree of mobility, the factors of production e.g. agricultural-based labours (of paid labour - LAP and non-paid – LANP) can move from Timber sector to other activities (only agricultural activities) and their availability would stimulates the production increase. The relatively abundant labour availability of these factors, however, pushes the relative price of the labour down.

Households' consumption may indicate the households' 'economic welfare' (Coleman, 2008). Therefore, impact of the RIL policy on the households welfare is represented by the impact on the households consumption, as in Appendix 5. The table of Appendix 5 reveals that the RIL policy significantly hurt forestry and agricultural worker households since these households' largest income derived from agricultural paid labour and wages in agriculture fall the most if the RIL policy is implemented. On the other hand, non-agricultural households (both worker and non-worker types) are slightly positively affected.

Under RIL0 policy, the total decline in consumption in households of forestry worker, agricultural (non-forestry) worker, and forestry self-employee's is estimated to be 37.24 billion, 18.57 billion rupiah, and 25.80 billion rupiah, respectively. These values equals to around 100% of their real consumption in 2015. There is a small improvement (around 10%) in their consumption, in the RIL2 scenario (see column 9 row 1-3 of the table in Appendix 5).

5. Conclusion and recommendations

Based on the results, conclusion and policy recommendation are as follows:

- In general, impact of the RIL policy to Berau economy is negative although it is relatively small; and providing compensation slightly improves the District economy.
- Under the RIL0 scenario, worker agriculture-based household group is significantly negatively affected, as this group incomes are derived from agriculture paid labour which its relative price falls the most. Non agriculture household category experiences an improvement.
- The RIL0 policy also causes a significant negative impact on the timber output which further leads to declining output of forest-based and pulp & paper industries. The RIL-related policy, however, simulates production increase in some other agricultural activities (notably in oil palm plantation).
- In the RIL2 simulation, the magnitude of economic impact is reduced than what would otherwise occur in the RIL0 Scenario. In the RIL2 Scenario, the Berau GRP, agricultural-based households' consumption, and TIMB output improve by 2%, 4% to 11%, and 35%, respectively.

- The positive effect of compensation (in the form of output-based subsidy) to the timber output is fair. However, its improvement on the most negatively affected households seems to be small.
- In the RIL2 scenario, compensation was set as an output-based subsidy (in the timber sector). Other options may need to be investigated such as setting the compensation as land subsidy (in the sector).
- The RIL policy seems to give signal of unexpected emissions leakage, that is an increase of emissions in a sector/country as an impact of emissions reduction in a particular country/sector, indicated by increases in output of some agricultural-based activities such as oil palm plantation, other estate crops, and food crops. Therefore it is deemed necessary to seek a more appropriate policy so reducing emissions efforts (in a particular sector) would not be compensated by 'increase' emissions from raising activities in other sector.

Selected references:

Abler, David. (2010). Demand Growth in Developing Countries. OECD Food, Agriculture and Fisheries Papers No. 29. http://www.oecd-ilibrary.org/docserver/download/5km91p2xcsd4.pdf?expires=1367881048&id=id&accname=guest&checksum=1BDB8C9DD295422612FA268053A489A1

Lang, Chris. (2011). President Yudhoyono promises to dedicate the next three years to protecting Indonesia's forests. http://climate-connections.org/2011/09/28/president-yudhoyono-promises-to-dedicate-the-next-three-years-to-protecting-indonesia%E2%80%99s-forests/

Ministry of Forestry Indonesia, Berau District Government, East Kalimantan Province Government, & The Nature Conservancy. (2011). Berau Forest Carbon Program 2011-2015 Berau Forest for the World Retrieved from http://tfcakalimantan.org/wp-content/uploads/2012/12/BFCP-English_Compile-Done.pdf

Schündeln, Matthias. (no year). Appreciating Depreciation:A Note on Physical Capital Depreciation in a Developing Country. http://www.economics.harvard.edu/files/faculty/54_AppreciatingDepreciation.pdf

Slevin, DennisP, Boone, LarryW, Russo, EileenM, & Allen, RichardS. (1998). CONFIDE: A Collective Decision-Making Procedure Using Confidence Estimates of Individual Judgements. Group Decision and Negotiation, 7(2), 179-194. doi: 10.1023/A:1008650524782

Appendix 1. Economic Structure of the Berau District

Commodities	Sectoral Composition (%)					Ratios (%)	
	Value added	Output	Domestic Supply	Exports	Imports	Exports/ Output	Imports/ Commposite Supply
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FCRO	3.47	2.62	2.71	1.81	1.50	38.66	11.08
OILP	1.61	1.76	0.62	2.56	-	81.66	-
OESC	0.71	0.61	0.50	0.86	1.31	79.53	52.87
LIVS	0.37	0.38	0.68	0.00	0.78	0.02	22.64
TIMB	9.11	6.75	6.37	5.87	1.65	48.74	5.18
OFOP	1.11	0.82	1.18	-	0.04	-	0.65
FISH	4.66	3.66	2.12	4.46	0.44	68.27	4.11
COAL	37.17	30.56	13.18	48.10	0.03	88.22	0.04
QUAR	0.18	0.16	0.31	-	0.26	-	16.75
FBIN	0.03	0.15	2.27	0.00	10.33	0.62	91.01
TEXL	0.02	0.03	0.33	0.00	1.41	0.01	86.00
FOIN	0.15	0.33	1.03	0.00	2.87	0.02	55.71
PAPR	14.15	21.39	12.39	26.21	0.27	68.69	0.43
OILR	0.06	0.21	12.05	0.00	58.90	0.02	97.60
FERC	0.05	0.16	1.60	0.00	6.79	0.88	84.70
ELWT	0.24	0.45	0.70	0.00	0.48	0.00	13.65
CONS	1.14	4.13	5.81	-	-	-	-
TRAD	12.02	10.92	16.32	2.51	0.31	12.88	0.37
TRAN	6.73	9.88	10.88	7.62	3.04	43.22	5.58
COMM	0.81	0.71	1.25	0.00	1.09	0.26	17.47
FINA	0.13	0.14	0.61	0.00	2.03	0.03	66.22
SERV	0.46	0.38	1.80	0.00	5.59	0.03	61.97
PUBO	5.63	3.80	5.30	-	0.89	-	3.36
Total	100.00	100.00	100.00	100.00	100.00		

Appendix 2. Impact of RIL policy on macro indicators of the Berau Economy,

Macro variables	Base condition		Total Value Change under RIL scenarios (to 2015 condition) - in Million Rupiah			Percentage change under RIL scenarios (to 2015 condition)			
	2015	2025	RIL0	RIL2	RIL2-RIL0	Base	RIL0	RIL2	RIL2-RIL0
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GRP	6,842,593.51	11,927,555.70	-1,148,362.41	-1,002,056.63	146,305.78	74.31%	-16.78%	-14.64%	2.14%
Hou. Consmpt.	1,137,848.12	1,969,761.50	-176,887.41	-145,577.39	31,310.02	73.11%	-15.55%	-12.79%	2.75%
Gov. consmpt.	592,504.55	1,061,085.40	0.00	0.00	0.00	79.08%	0.00%	0.00%	0.00%
Investment	1,620,216.56	2,813,465.28	-351,335.47	-247,173.04	104,162.44	73.65%	-21.68%	-15.26%	6.43%
Export	4,756,755.03	8,281,672.20	-822,636.43	-745,845.69	76,790.74	74.10%	-17.29%	-15.68%	1.61%
Import	1,264,730.75	2,198,428.69	-202,496.89	-136,539.47	65,957.42	73.83%	-16.01%	-10.80%	5.22%
Net export	3,492,024.29	6,083,243.51	-620,139.53	-609,306.21	10,833.32	74.20%	-17.76%	-17.45%	0.31%
CPI						-0.11%	-20.48%	-17.81%	2.67%

Notes:

- Values in columns 1 – 5 are real terms at 2007 prices.
- Column 6 is percentage change of column 2 to column 1.
- Columns 7 and 8 are ratio of column 3 and 4 respectively, to column 2.
- The Gov. consumption is assumed to grow at exogenous rate of 6%.

Appendix 3. Impact of the RIL policy on sectoral output value

Sectors	Base condition		Total Value Change under RIL scenarios (to 2015 condition) in Million Rupiah			Percentage change under RIL scenarios (to 2015 condition)			
	2015	2025	RIL0	RIL2	RIL2-RIL0	Base	RIL0	RIL2	RIL2-RIL0
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
FCRO	221,365.54	383,308.18	109,931.66	104,432.95	-5,498.71	73.16%	49.66%	47.18%	-2.48%
OILP	170,885.57	312,271.46	884,278.73	800,848.15	-83,430.58	82.74%	517.47%	468.65%	-48.82%
OESC	54,299.49	96,314.03	125,283.59	114,266.44	-11,017.15	77.38%	230.73%	210.44%	-20.29%
LIVS	31,986.74	55,620.07	-1,388.16	-527.95	860.21	73.88%	-4.34%	-1.65%	2.69%
TIMB	564,632.12	980,090.01	-2,308,301.81	-2,111,613.37	196,688.45	73.58%	-408.82%	-373.98%	34.83%
OFOP	69,127.57	120,069.51	-17,409.41	-12,339.61	5,069.80	73.69%	-25.18%	-17.85%	7.33%
FISH	312,463.90	542,306.93	554,530.94	509,650.23	-44,880.71	73.56%	177.47%	163.11%	-14.36%
COAL	2,595,486.59	4,507,568.21	2,628,163.29	2,191,318.81	-436,844.47	73.67%	101.26%	84.43%	-16.83%
QUAR	13,608.35	23,663.78	-2,758.93	-1,985.84	773.09	73.89%	-20.27%	-14.59%	5.68%
FBIN	12,321.04	21,390.87	2,913.65	2,814.51	-99.14	73.61%	23.65%	22.84%	-0.80%
TEXL	2,816.72	4,886.04	-18.98	-7.59	11.39	73.47%	-0.67%	-0.27%	0.40%
FOIN	27,598.34	47,934.33	-11,292.08	-8,655.08	2,637.00	73.69%	-40.92%	-31.36%	9.55%
PAPR	1,786,233.87	3,109,190.40	-3,145,688.94	-2,415,602.66	730,086.28	74.06%	-176.11%	-135.23%	40.87%
OILR	17,537.73	30,523.50	-1,584.07	-998.99	585.08	74.04%	-9.03%	-5.70%	3.34%
FERC	14,153.26	24,760.64	6,897.87	6,604.38	-293.49	74.95%	48.74%	46.66%	-2.07%
ELWT	38,146.88	66,507.55	-10,985.28	-9,124.92	1,860.35	74.35%	-28.80%	-23.92%	4.88%
CONS	347,810.36	604,530.18	-79,617.90	-58,142.90	21,475.00	73.81%	-22.89%	-16.72%	6.17%
TRAD	920,084.50	1,600,093.11	-215,366.53	-159,755.73	55,610.80	73.91%	-23.41%	-17.36%	6.04%
TRAN	845,117.41	1,476,994.36	101,337.25	87,782.92	-13,554.32	74.77%	11.99%	10.39%	-1.60%
COMM	60,874.37	106,457.27	-6,734.84	-5,193.04	1,541.80	74.88%	-11.06%	-8.53%	2.53%
FINA	11,860.59	20,791.04	-1,215.25	-876.44	338.81	75.30%	-10.25%	-7.39%	2.86%
SERV	32,472.49	56,494.77	-12,273.07	-10,768.04	1,505.03	73.98%	-37.80%	-33.16%	4.63%
PUBO	347,232.14	624,513.52	1,742.62	-656.04	-2,398.66	79.85%	0.50%	-0.19%	-0.69%

Notes:

- Values in columns 1 – 5 are real terms at 2007 prices.
- Column 6 is percentage change of column 2 to column 1.
- Columns 7 and 8 are ratio of column 3 and 4 respectively, to column 2.

Appendix 4. Impact of the RIL policy on households' consumption

Household type	Base condition		Total Value Change under RIL scenarios (to 2015 condition) - in Million Rupiah			Percentage change under RIL scenarios (to 2015 condition)			
	2015	2025	RIL0	RIL2	RIL2-RIL0	Base	RIL0	RIL2	RIL2-RIL0
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Forestry worker - HFW	33,413.43	56,580.70	-37,235.14	-33,941.65	3,293.49	69.34%	-111.44%	-101.58%	9.86%
Forestry self-employee - HFSE	24,588.50	41,090.57	-25,799.51	-23,090.95	2,708.56	67.11%	-104.93%	-93.91%	11.02%
Agricultural worker - HAW	17,201.60	29,024.99	-18,573.09	-16,894.74	1,678.35	68.73%	-107.97%	-98.22%	9.76%
Agricultural self-employee - HASE	247,632.54	428,166.60	-111,740.14	-101,103.56	10,636.59	72.90%	-45.12%	-40.83%	4.30%
Non-agricltural worker - HNAW	345,499.80	600,300.65	32,427.19	35,122.09	2,694.90	73.75%	9.39%	10.17%	0.78%
Non-agricltural self employee - HNASE	340,937.09	590,638.73	-1,053.22	6,231.57	7,284.79	73.24%	-0.31%	1.83%	2.14%
Others - HOTH	128,573.45	223,941.84	-14,957.82	-11,930.25	3,027.57	74.17%	-11.63%	-9.28%	2.35%

Notes:

- Values in columns 1 – 5 are real terms at 2007 prices.
- Column 6 is percentage change of column 2 to column 1.
- Columns 7 and 8 are ratio of column 3 and 4 respectively, to column 2.