Supplementary Materials

Table S1: Bio-physical factors considered in the construction of synthetic controls, due to established relationship with deforestation

Variable	Description	Units	Spatial resolution	Time frame	Source	Rationale
Tree cover 2000	Tree cover in FMU	Hectares	30 m	2000	[1]http://www.earthenginepartners.appspot.com/science-2013-global-forest/download.html	Higher initial tree cover may be associated with greater timber stocks, potentially leading to greater legal and illegal logging, which can result in temporary deforestation or provide access for agents of deforestation [2,3]
Altitude	Mean elevation from sea level	Meter	1 km	Represen-tative of 1950-2000 (Average)	SRTM elevation database (http://www2.jpl.nasa.gov/srtm/)	Higher elevations typically have more varied topography, which increases difficulty of both deforestation and monitoring.
Climate Mean temperature	Annual mean temperature	Centigrade	1 km	Represent-ative of 1950-2000 (Average)	WorldClim (Global Climate Data portal) - http://www.worldclim.org/current	Higher temperature may be associated with higher probability of wildfire damage, resulting in higher chances of deforestation [4].
Mean precipitation	Mean annual precipitation	Cm	1 km	Represent-ative of 1950-2000 (Average)	WorldClim (Global Climate Data portal) - http://www.worldclim.org/current	Areas with higher precipitation are less likely to be profitable for agriculture, possibly leading to less deforestation [5].
FMU Area	Area of the FMU (Based on official shape file.)	km^2	Polygon	2004	FMU shape files (source varies by country)	The larger a FMU, the harder to monitor and to prevent illegal activity.
Monitoring cost	Shape of FMU, indexed by the perimeter of the FMU divided by perimeter of a circle of the same area	1 = perfectly compact >1 = fragmented	Polygon	2004	FMU shape files (source varies by country)	The shape of a FMU affects the cost of monitoring and supervision, thereby influencing the probability of deforestation.

Table S2. Description of covariates in case of Estuário

Variable	Description	Units	Spatial unit	Year	Source	Plausible causal mechanism
Distance from settlement	Distance from closest settlement	Km	Point	2000	Global rural-urban mapping project (GRUMP), v1 (2000) - http://sedac.ciesin.columbia.edu/data/set/grump-v1-settlement-points	Von Thunen theory and a large body of empirical evidence suggest higher probability of deforestation closer to settlements.
Distance from timber pole, or wood processing center	Distance from closest "Polo madeireiro"	Km	Point	2004	Location of polos madeireiros from [6] http://imazon.org.br/publicacoes/fatos-florestais-da-amazonia-2010/	Better access to wood processing centers is likely to encourage both legal and illegal logging, which can result in temporary deforestation, finance deforestation, or provide access for agents of deforestation [2,3].
Distance from protected area	Distance from closest protected area	Km	Polygon	2014	UNEP-WCMC, UNEP, and IUCN. "World Database on Protected Areas." Accessed in April, 2014. www.protectedplanet.net.	Spill-over of monitoring and supervision from protected areas may decrease the probability of deforestation in nearby FMUs.
Poverty count	Poverty count	Number	1 Km (approx.)	2004	Global poverty estimates. National Geophysical Data Center (NGDC) data products http://www.ngdc.noaa.gov/eog/dmsp.html	Poverty may affect relations between FMUs and local communities, and may drive deforestation, depending on the context [7].

Table S3: Descriptive statistics for FMUs in the Estuário Landscape

Table S3 (a): Descriptive statistics for non-certified FMUs in the Estuário Landscape (Donor pool)

(i) Deforestation

	N	Mean	SD	Median	Minimum	Maximum	Range
Annual percent deforestation (2001 to 2012, average)	44	0.25	1.16	0.01	0	18.09	18.09

(ii) Covariates

Covariates	N	Mean	SD	Median	Minimum	Maximum	Range

Tree cover 2000	44	6788.91	15600.71	2260.71	74.88	66671.64	66596.76
Altitude	44	39.21	16.52	34.95	9.51	78.11	68.6
Mean temperature	44	26.64	0.66	26.74	22.72	27.09	4.37
Mean precipitation	44	250.79	17.45	249.66	216.01	302.51	86.5
Area of FMU	44	73.76	170.74	24.37	0.93	716.91	715.98
Monitoring cost	44	1.45	0.4	1.32	1.11	3.11	1.99
Poverty count	44	118.38	285.88	25.21	0	1725.96	1725.96
Distance from settlement	44	77.28	31.93	77.17	8.06	134.41	126.36
Distance from timber pole	44	55.97	23.32	56.36	6.14	102.62	96.48
Distance from protected area	44	24.31	19.62	20.05	0	67.61	67.61

Table S3 (b): Description of the certified FMU: Orsa Florestal S.A.

(i) Outcome

	Orsa Florestal S.A.
Annual percent deforestation (2001 to 2012, average)	0.73

(ii) Covariates

Tree Cover	747538.78
Altitude	107.81
Mean Temperature	26.64
Mean precipitation	209.9
Distance from settlement	31.68
Distance from timber pole	29.26
Distance from protected area	0
Poverty count	3179.95
Area of the FMU	9105.08
Monitoring cost	2.79

Table S4. Vectors of weights on covariates used in construction of synthetic control for Orsa Florestal S.A.

	Vector of weights
Percent tree cover loss (2001 to 2005)	0.363
Distance from Protected area (2004)	0.17
Distance from Timber Pole (2004)	0.114
Distance from Settlement (2004)	0.106
Altitude (2001)	0.09
Mean Annual Temperature (2001)	0.078

Monitoring effort (2004)	0.046
Poverty Count (2004)	0.019
Tree Cover (2000)	0.007
Area (2004)	0.006

Table S5. Description of covariates in case of Gabon

Variable	Description	Measurement	Spatial Resolution	Year	Source	Plausible causal mechanism
Distance from city	Euclidian distance from nearest city (km)	km	Company	2008	WRI – http://www.wri.org/our-work/project/congo-basin-forests/gabon	Von Thunen theory and a large body of empirical evidence suggest higher probability of deforestation in FMUs closer to settlements.
Quota 2008	Quotas for FMUs in 2008 (halved when a joint quota was shown in the list)	m^3	Company	2008	Statistiques SEPBG (Société d'exploitation des parcs à bois du Gabon).	Higher quotas are likely to be associated with more intensive harvest, which can result in temporary tree cover loss or provide access for agents of deforestation
Exchange rate 2008	Ratio of the CFA Franc (XAF) to the currency of the home country of the company	Ratio	Company	2008	Oanda - http://www.oanda.com/currency/converter/	Higher ratio means exports become more competitive in global market.
Okoume presence	Total area in which okoume is present (Sq.Km)	Sq.Km	Company	2005	[8]	Logging in areas with okoume is more profitable.
Number of villages	Number of villages within and in 10KM buffer around FMUs	Number	FMU	2008	WRI – http://www.wri.org/our-work/project/congo-basin-forests/gabon	Number of villages within and in the neighborhood of a company is likely associated with forest loss due to the higher demand for agricultural land and possibly forest products (e.g. fuelwood)..
Population density	Population density within the FMU (2001-2012)	Inhabitants/area	FMU	2001-2012	LandScan 2000-2012, http://web.ornl.gov/sci/landscan/ Based on the LandScan 2006™ High Resolution Global Population Data Set copyrighted by UT-Battelle, LLC, operator of Oak Ridge National Laboratory	Population density in FMU is likely associated with forest loss due to demand for agricultural land and possibly forest products (e.g. fuelwood).
Road density	Density of roads in the FMU	Km per Sq.Km	FMU	2008	WRI – http://www.wri.org/our-work/project/congo-basin-forests/gabon	Greater road density is likely to cause more deforestation mainly due to improved access.

Maximum distance between any two spatial units under concession to the same company	Maximum of the Euclidean distances between each pair of spatial units	Km	FMU	2005	Shapefiles of FMUs – from "Logging." World Resources Institute. Accessed through Global Forest Watch in April, 2014. www.globalforestwatch.org.	The greater the distance between any two spatial units in a FMU, the greater the difficulty of monitoring and protecting the forest.

Table S6: Descriptive statistics for FMUs in Gabon

Table S6 (a): Descriptive statistics of non-certified FMUs in Gabon

(i) Outcome

	N	Mean	Standard Deviation	Median	Range
Percent tree cover loss (2001 to 2012, average)	21	0.04	0.06	0.02	0.26

(ii) Covariates

	n	mean	standard deviation	median	range
Tree cover 2000	21	230216	145901.7	195159.8	479469.3
Altitude	21	431.3	155.54	482.83	577.59
Mean Temperature	21	24.4	0.76	24.16	2.63
Mean precipitation	21	1830.77	205.93	1776.81	738.89
Distance from cities	21	42.57	11.25	40.99	43.31
Quota 2008	21	34296.1	33052.69	22800	117600
Exchange rate 2008	21	0.43	1.03	0.01	3.38
Area with okoume (sq.km.)	21	1896.32	1491.51	1543.25	5512.83
Number of villages	21	56.24	48.79	42	207
Population Density	21	1.49	1.15	1.07	4.69
Road Density	21	0.04	0.02	0.04	0.08
Area in sq.km.	21	2455.16	1554.62	2084.65	5112.61
Maximum distance between units of a company	21	80.26	119.32	49.18	407.05
Shape metric	21	1.67	0.25	1.55	0.74

Table S6 (b): Description of Rougier (Certified FMU)

(i) Outcome

	Mean

Percent tree cover loss (2001 to 2012, average)	0.04

(ii) Covariates

	mean
Tree cover 2000	829633.44
Altitude	489.53
Mean Temperature	24.04
Mean precipitation	1819.66
Distance from cities	30.99
Quota 2008	158400
Exchange rate 2008	0.002
Area with okoume (sq.km.)	8867.51
Number of villages	167
Population Density	0.7
Road Density	0.04
Area in sq.km.	8867.51
Maximum distance between units of a company	391.52
Shape metric	1.79

Table S7. Vector of weights on covariates used in construction of synthetic control for Rougier

	Vector of weights
Maximum distance between units of a company (2005)	0.238
Number of villages (2008)	0.181
Mean Annual Temperature (2005)	0.091
Road Density (2008)	0.086
Mean Annual Precipitation (2005)	0.082
Percent tree cover loss (2001 to 2008)	0.06
Area under Okoume presence (2005)	0.032
Shape metric (2005)	0.017
Population density (2001-2012)	0.01
Tree cover (2001-2012)	0.001
Timber harvest quota (2008)	0.001
Area (2005)	0.001
Exchange rate (2008)	0.042
Distance from cities (2008)	0.071
Mean Elevation (2001)	0.087

Table S8. Description of covariates in case of Kalimantan (Indonesia)

Covariates

Variable	Description	Measurement	Spatial resolution	Year	Source	Plausible causal mechanism
Forest management			Spatial unit			
Area Logged	Area logged per year	Hectares	FMU (Company forest land)	2007	Forest management plans - Ministry of Forestry (MoF)	Logging creates gaps in the canopy and increases access for deforestation agents
Volume Harvested	Volume harvested per year	m3/yr	FMU (Company forest land)	2007	Forest management plans - Ministry of Forestry (MoF)	Harvest of higher volume may require more roads and skid trails that increase access
Logging Intensity	Logging intensity	m3/ha	FMU (Company forest land)	2007	Calculated as ratio of volume of timber harvested and area in ha.	Higher logging intensity may create more gaps in the canopy and increase forest access
Primary Forests	Percent of primary forests	Percent	FMU (Company forest land)	2009	Forest management plans - Ministry of Forestry (MoF)	Primary forests may be subject to more regulation and better protected by governments
Limited Production Forest Area	Percent of limited production area	Percent	FMU (Company forest land)	2009	Forest management plans - Ministry of Forestry (MoF)	Limited production areas may be subject to more regulation and better protected by governments
Previously logged forest	Percent of previously logged forest	Percent	FMU (Company forest land)	2009	MoF website at http://appgis.dephut.go.id/appgis/iuphhk.aspx.	Previously logged forests are less attractive for logging but possibly more accessible to deforestation agents.
Duration of Harvest permit	Duration of harvest permit	Years	FMU (Company forest land)	2007	Forest management plans - Ministry of Forestry (MoF)	We expect fast and intensive deforestation, if a company has limited duration to harvest trees as per their harvest permits. Companies would ignore long-term management by focusing only on short-term intensive extraction of timber rather than following sustainable harvesting.
Anthropogenic						
Population density	Population density of FMUs (2001-2012)	Population count/ Km^2	Resolution of 1 Km^2	2001-2012	LandScan 2000-2012, http://web.ornl.gov/sci/landscan/ Based on the LandScan 2006™ High Resolution Global Population Data Set copyrighted by UT-Battelle, LLC, operator of Oak Ridge National Laboratory	Higher population pressure is often associated with higher rates of deforestation.

Logging Road density	Density of logging roads in the FMUs of a company, year 2000 and 2010	Km per Sq.Km	FMU (Company forest land)	2000, 2010	[9]	Higher road density facilitates rapid forest loss by providing access to remotely-situated forests and, thereby, leading to intensive extraction and transport of timber resources.
Population Density in surrounding areas/district	Population density in surrounding areas per district	Number/sq .km.	FMU (Company forest land)	2010	National Population Census, 2010 (http://sp2010.bps.go.id/index.php/publikasi/index)	Von Thunen theory and a large body of empirical evidence suggest higher probability of deforestation in FMUs closer to settlements.
Population Change in surrounding area/District	Population change in surrounding areas per district	Percent change/Year	FMU (Company forest land)	2010	National Population Census, 2010 (http://sp2010.bps.go.id/index.php/publikasi/index)	Von Thunen theory and a large body of empirical evidence suggest higher probability of deforestation in FMUs closer to settlements.

Table S9: Descriptive statistics for FMUs in Kalimantan (Indonesia)

Table S9 (a): Descriptive statistics of the non-certified FMUs (Donor pool)

(i) Outcome

	n	Mean	Standard Deviation	Median	Maximum
Percent tree cover loss (2001 to 2012, average)	108	0.34	0.41	0.21	2.45

(ii) Covariates

	N	Mean	Standard Deviation	Median	Maximum
Tree cover 2000	108	61727.11	71274.1	41563.12	461608.8
Altitude	108	261.64	150.04	230.55	783.36
Mean Temperature	108	25.35	0.79	25.43	4.53
Mean Precipitation	108	3054.99	524.76	3085.73	2543.14
Area Logged/year (ha/year)	108	1397.01	1619.44	1000	14446.32
Volume Harvested/Yr (m3/yr)	108	51924.46	63689.64	39662.5	622874.8
Primary Forests (%)	108	20.73	25.39	9.2	92
Limited Production Forest Area (percent)	108	63.35	35.49	75	100
Previously Logged (%)	108	62.92	25.04	68.4	95

Logging Intensity (m3/ha)	108	40.22	14.28	39.54	84.91
Duration of Harvest Permit	108	25.28	13.8	15	35
Population Density Within FMU	108	7.13	8.35	4	50
Logging Road Density (2001)	108	1.33	11.3	0.16	117.53
Logging Road Density (2010)	108	0.14	0.12	0.11	0.67
Population Density in surrounding areas/district (Number/sq.km.)	108	12	12.13	8	78
Population Change in surrounding area/District (%/Year)	108	2.78	1.64	2.3	5.9
Area (Sq.Km)	108	713.98	887.49	491.64	7390.55
Shape Metric	108	1.89	0.48	1.78	2.24
Population	108	2106.76	3659.36	807.12	26757

Table S9 (b): Description of the certified FMU Suka Jaya Makmur

(i) Outcome

	Mean
Percent tree cover loss (2001 to 2012, average)	0.11

(ii) Covariates

	Mean
Tree cover 2000	171443.4
Altitude	256.14
Mean Temperature	25.56
Mean Precipitation	5779.2
Area Logged/year (ha/year)	3849
Volume Harvested/Yr (m3/yr)	99152.63
Primary Forests (%)	18.5
Limited Production Forest Area (percent)	21.28
Previously Logged (%)	73.5
Logging Intensity (m3/ha)	25.76
Duration of Harvest Permit	50
Population Density Within FMU	5
Logging Road Density (2001)	0.3
Logging Road Density (2010)	0.19
Population Density in surrounding areas/district (Number/sq.km.)	15.5
Population Change in surrounding area/District (%/Year)	1.2
Area (Sq.Km)	1829.77
Shape Metric	2.22
Population	4031

Table S10: Vectors of weights on covariates used in construction of synthetic control for Suka Jaya Makmur

Covariates	Vector of weights
Percent Tree Cover Loss (2001-2010)	0.432
Mean Elevation (2001)	0.264
Mean Temperature (2001)	0.153
Area Logged/year (ha/year) (2007)	0.041
Primary Forests (%) (2009)	0.028
Logging Intensity (m3/ha) (2007)	0.016
Duration of Harvest Permit (2007)	0.016
Mean Precipitation (2001)	0.011
Shape (2010)	0.011
Previously Logged (%) (2009)	0.011
Volume Harvested/Yr (m3/yr) (2007)	0.007
Percent of Limited Production Forest Area (2009)	0.005
Area (Sq.Km.)(2010)	0.004
Population density (2001-2012)	0.002
Density of logging roads (2010)	0.001

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