**Supporting Information for "Reductions in emissions from deforestation from Indonesia's moratorium on new oil palm, timber, and logging concessions"**

*Estimation strategy*

We placed upper and lower bounds around the treatment effect of a concession designation using two econometric models, following [1-2]. We placed an upper bound on the treatment effect using a fixed effects model within a matched area, i.e. a 3-km geographic buffer around all cells in which concessions had been designated by 2010. This approach assumes that any omitted variables that affect the outcome are time-invariant. We placed a lower bound on the treatment effect using a pooled regression that included a lagged dependent variable as a regressor. This approach controls for past cell-level outcomes directly. We estimated the influence of concessions on deforestation in Stata 13.1 using a Poisson quasi-maximum likelihood estimator (QMLE) [3-5], which is theoretically consistent with forest cover loss within a 3 km x 3 km grid cell being the count of many independent, discrete binary observations of forest cover loss or maintenance at the level of 30 m x 30 m remote sensing data. A Poisson QMLE model tolerates zero values, and generates a distribution of predicted values that fits the distribution of observed data, which is concentrated nearest to zero deforestation and diminishes toward greater levels of deforestation.

Thus our econometric models are:

(1) $y_{it} = \exp(L_{it}{}' \beta_1 + \beta_2 A_{it} + \gamma_t + \lambda_i + \epsilon_{it})$

(2) $y_{it} = \exp(\beta_0 + \beta_1 y_{it-1} + L_{it}{}' \beta_2 + \beta_3 A_{it} + X_i{}' \beta_4 + \gamma_t + \epsilon_{it})$

$y_{it} = (F_{it}^o - F_{it}')/F_{it}^o$ is fractional deforestation at grid cell *i* in year *t*, where $F_{it}^o$ is forest cover at grid cell *i* at the start of year *t*, and $F_{it}'$ is forest cover at grid cell *i* at the end of year *t*. $L_{it}$ is a matrix of fractional land-use

designations at grid cell *i* at the start of year *t*, including oil palm, timber, and logging concessions, national parks, and other protected areas. $A_{it}$ is the time-variant value of potential gross revenue from agriculture per hectare at grid cell *i* in year *t*. $X_i$ is a matrix of time-invariant observable grid cell characteristics, including slope, elevation, natural logarithm of the distance to the nearest road, and natural logarithm of the distance to the nearest provincial capital. The term $\beta_0$ captures unobserved constant determinants of deforestation, $\lambda_t$ captures unobserved time-invariant cell-specific geographic factors influencing deforestation, $\gamma_t$ captures unobserved year-specific factors influencing deforestation such as interest rates or national political conditions. We excluded cells containing concessions for which license dates were unknown from the regression analyses, but not from later scenario analyses.

We assumed that treatment effects remained constant and were not affected by structural changes over the decade. Splitting the sample by half-decade in pooled-sample regressions did not show major differences in coefficients across half-decades, with one exception. The coefficient for logging concessions was negative and significant between 2000-2004 and positive and significant between 2005-2009 (Table S5).

*Indicative calculation of the effectiveness of the current moratorium*

The longer a moratorium policy remains in place, the greater the difference between the area of concessions on the landscape with and without the policy. Therefore the emission reductions achieved by the policy compound over time, with larger per-year effects of a moratorium accruing in later years (Figure S4). It can be shown that under simple arithmetic assumptions, the ratio of percent emission reductions from a shorter moratorium policy to the percent emission reductions from a longer moratorium policy is proportional to the relative length of time that the shorter and longer moratorium policies have been in place.

The derivation of this property is as follows (variables refer to lengths and areas in Figure S4):

X=cT/2

$$Y=(a+b)T/2$$

$$X/Y=c/(a+b)$$

$$x=c(t/T)t/2$$

$$y=(a+b)t/2$$

$$x/y=c(t/T)/(a+b)=(X/Y)(t/T)$$

A ten-year moratorium reduces emissions by 2.5-6.4%. Inversely, emissions would be 2.5-6.8% higher without a ten-year moratorium than with a ten-year moratorium. Consequently, by applying the property derived above, a four-year moratorium (e.g. 2011-2015) reduces emissions by about 1.0-2.5%, while emissions from deforestation would be roughly 1.0-2.7% higher without a four-year moratorium than with a four-year moratorium. This indicative estimate does not account for strategic considerations by landowners such as pre-emptive clearing during the grace period.

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Table S1. Effect of land-use designation and potential agricultural revenue on deforestation. Year=2000 omitted in panel regressions.

| Description | Decadal cross section; land-use designation in 2000, Poisson | | Annual panel; pooled; Poisson | | Annual panel; pooled; lagged dependent variable as regressor; Poisson | | Annual panel; fixed effects; Poisson | |
|---|---|---|---|---|---|---|---|---|
| Unit of observation | grid cell | | grid cell-year | | grid cell-year | | grid cell-year | |
| Dependent variable | deforestation rate (%) | | deforestation rate (%) | | deforestation rate (%) | | deforestation rate (%) | |
| n | 195,249 | | 1,903,797 | | 1,903,797 | | 1,698,996 | |
| Independent variable | Coefficient | z value | Coefficient | z value | Coefficient | z value | Coefficient | z value |
| Oil palm concession | 0.8943 | 76.11 | 1.2625 | 58.35 | 0.8177 | 29.67 | 0.3015 | 2.09 |
| Timber concession | 0.7253 | 41.47 | 1.1434 | 102.28 | 0.8286 | 60.23 | 0.4368 | 7.24 |
| Logging concession | 0.0203 | 0.70 | 0.0940 | 4.56 | 0.1049 | 5.62 | 0.0183 | 0.15 |
| National park | -1.1024 | -20.43 | -1.2448 | -32.37 | -1.1656 | -30.59 | -1.1031 | -3.83 |
| Other protected area | -0.8670 | -23.46 | -2.0219 | -66.07 | -1.9041 | -63.39 | -0.5755 | -0.57 |
| Slope | -0.0614 | -45.91 | -0.0677 | -73.36 | -0.0582 | -63.33 | | |
| Elevation (m) | -0.0012 | -39.55 | -0.0015 | -67.07 | -0.0015 | -65.54 | | |
| Log distance to road (km) | -0.0739 | -33.33 | -0.0567 | -35.66 | -0.0698 | -41.94 | | |
| Log distance to capital (km) | -0.2272 | -49.80 | -0.2266 | -72.78 | -0.1984 | -58.78 | | |
| Potential agricultural revenue ($/ha/yr; 2005 USD) | 0.000156 | 12.44 | 0.000154 | 23.38 | 0.000117 | 17.47 | 0.000101 | 3.50 |
| Year=2000 | | | (omitted) | | (omitted) | | (omitted) | |
| Year=2001 | | | 0.1179 | 8.44 | 4.5346 | 0.0337 | 0.1119 | 2.56 |
| Year=2002 | | | -0.4232 | -25.10 | 4.0179 | 0.035155 | -0.3970 | -7.85 |
| Year=2003 | | | 0.4758 | 32.64 | 4.9406 | 3.41E-02 | 0.5077 | 12.04 |
| Year=2004 | | | 0.4068 | 26.78 | 4.7705 | 0.0338 | 0.4473 | 10.41 |
| Year=2005 | | | 0.6539 | 45.77 | 5.0167 | 3.36E-02 | 0.6895 | 17.17 |
| Year=2006 | | | 0.5027 | 29.57 | 4.8634 | 0.034398 | 0.5934 | 10.49 |
| Year=2007 | | | 0.4054 | 19.80 | 4.7834 | 0.036312 | 0.5437 | 7.17 |
| Year=2008 | | | 0.6618 | 28.67 | 5.0623 | 0.03855 | 0.8357 | 9.01 |
| Year=2009 | | | 0.3497 | 16.04 | 4.6625 | 0.036591 | 0.5173 | 6.12 |
| Intercept | -1.1949 | -32.47 | -3.6383 | -191.41 | -8.1727 | -218.22 | | |

94 Table S2. Results of geographically matched fixed effects models

| | Fixed effects, 6 km buffer | | Fixed effects, 3 km buffer | | Fixed effects, own cell only | | Fixed effects, 3 km buffer with spatial lag | |
|---|---|---|---|---|---|---|---|---|
| Oil palm concession | 0.1786 | 1.23 | 0.1579 | 1.08 | 0.1169 | 0.80 | 0.1056 | 0.69 |
| Timber concession | 0.3599 | 5.65 | 0.3656 | 5.63 | 0.3814 | 5.65 | 0.2172 | 3.10 |
| Logging concession | 0.0134 | 0.11 | 0.0302 | 0.23 | 0.0540 | 0.40 | -0.0053 | -0.04 |
| National park | -0.7119 | -2.26 | -0.6553 | -2.02 | -0.5872 | -1.70 | -0.2730 | -0.76 |
| Other protected area | 0.0273 | 0.03 | 0.1075 | 0.10 | (no result) | | 0.0968 | 0.09 |

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96 Table S3. Effect of land use designation on deforestation, disaggregated by forest cover quartile

| Description | | Pooled; lagged dependent variable as regressor; Poisson | | Fixed effects; Poisson | |
|---|---|---|---|---|---|
| Unit of observation | | grid cell | | grid cell | |
| Dependent variable | | deforestation rate (%) | | deforestation rate (%) | |
| n | | 1,903,797 | | 1,698,996 | |
| Driver | Forest cover quartile | Coefficient | z value | Coefficient | z value |
| Oil palm concession (%) | Highest | 2.9794 | 5.43 | -0.3146 | -0.23 |
| | High | 0.9220 | 6.88 | -0.2821 | -0.77 |
| | Low | 0.6956 | 14.84 | 0.5277 | 2.76 |
| | Lowest | 0.6103 | 20.92 | 0.2678 | 1.84 |
| Timber concession (%) | Highest | 2.0072 | 8.72 | 1.3707 | 2.92 |
| | High | 1.1332 | 19.78 | 0.8023 | 5.55 |
| | Low | 0.7347 | 36.29 | 0.6900 | 8.17 |
| | Lowest | 0.7026 | 42.1 | 0.2795 | 4.39 |
| Logging concession (%) | Highest | 0.7613 | 9.54 | 1.0590 | 2.12 |
| | High | 0.1781 | 3.78 | 0.0547 | 0.30 |
| | Low | -0.0017 | -0.07 | -0.4221 | -3.01 |
| | Lowest | 0.4568 | 15.96 | -0.1189 | -0.89 |
| National park (%) | Highest | -0.8805 | -3.87 | 1.4810 | 1.41 |
| | High | -0.4580 | -4.82 | 0.3720 | 0.82 |
| | Low | -0.8022 | -13.91 | -0.7172 | -1.84 |
| | Lowest | -1.2157 | -18.43 | -2.0812 | -6.00 |
| Other protected area (%) | Highest | -0.4369 | -5.53 | 1.9237 | 1.01 |
| | High | -0.3987 | -10.59 | 1.2338 | 0.82 |
| | Low | -1.5613 | -33.18 | -0.0988 | -0.08 |
| | Lowest | -3.0301 | -35.71 | -0.9633 | -0.80 |
| Slope (degree) | Highest | -0.0548 | -6.71 | | |
| | High | -0.0775 | -31.95 | | |
| | Low | -0.0530 | -43.55 | | |
| | Lowest | -0.0277 | -19.65 | | |
| Elevation (m) | Highest | -0.0018 | -8.77 | | |
| | High | -0.0006 | -13.99 | | |
| | Low | -0.0008 | -31.45 | | |
| | Lowest | -0.0013 | -43.77 | | |
| Log distance from road (km) | Highest | -0.3260 | -13.06 | | |
| | High | -0.1924 | -26.61 | | |
| | Low | -0.0550 | -20.33 | | |
| | Lowest | 0.0627 | 27.46 | | |
| Log distance from capital (km) | Highest | -0.5224 | -12.4300 | | |
| | High | -0.5446 | -41.1300 | | |
| | Low | -0.2690 | -48.3400 | | |
| | Lowest | 0.0042 | 0.9000 | | |
| Maximum agricultural revenue ($/ha/yr) | Highest | -0.000088 | -1.66 | 0.0006861 | 4.73 |
| | High | -0.000047 | -3.15 | 0.0004644 | 9.60 |
| | Low | 0.000116 | 14.94 | 0.0003246 | 10.00 |

| | | | | | |
|---|---|---|---|---|---|
| | Lowest | 0.000241 | 34.71 | 0.0000487 | 1.67 |
| Forest cover quartile (0/1) | Highest | 1.8667 | 5.76 | -2.4690 | -8.33 |
| | High | 3.1336 | 38.74 | -1.3982 | -14.9 |
| | Low | 1.8339 | 49.83 | -0.7887 | -14.95 |
| | Lowest | (omitted) | | (omitted) | |
| Year = 2000 | | (omitted) | | (omitted) | |
| Year = 2001 | | 4.1579 | 108.92 | 0.0918 | 2.09 |
| Year = 2002 | | 3.5968 | 91.46 | -0.5249 | -10.32 |
| Year = 2003 | | 4.5039 | 116.96 | 0.3504 | 8.20 |
| Year = 2004 | | 4.3252 | 113.05 | 0.2535 | 5.78 |
| Year = 2005 | | 4.5686 | 120.61 | 0.4782 | 11.49 |
| Year = 2006 | | 4.3351 | 111.58 | 0.3189 | 5.49 |
| Year = 2007 | | 4.1843 | 102.60 | 0.2464 | 3.18 |
| Year = 2008 | | 4.3924 | 102.34 | 0.5460 | 5.80 |
| Year = 2009 | | 4.0085 | 97.35 | 0.2641 | 3.07 |
| Intercept | | -9.0887 | -209.03 | | |

98 Table S4. Effect of land use designation on deforestation, disaggregated by region

| Description | | Pooled; lagged dependent variable as regressor; Poisson | | Fixed effects; Poisson | |
|---|---|---|---|---|---|
| Unit of observation | | grid cell | | grid cell | |
| Dependent variable | | deforestation rate (%) | | deforestation rate (%) | |
| n | | 1,903,797 | | 1,698,996 | |
| Driver | Region | Coefficient | z value | Coefficient | z value |
| Oil palm concession (%) | Java-Bali | | | | |
| | Sumatra | 0.4347 | 11.78 | 1.6996 | 0.37 |
| | Kalimantan | 1.1965 | 45.13 | 0.1947 | 1.34 |
| | Sulawesi | | | | |
| | Eastern islands | | | | |
| Timber concession (%) | Java-Bali | | | | |
| | Sumatra | 0.9960 | 71.97 | 0.5311 | 7.75 |
| | Kalimantan | 0.1995 | 9.67 | -0.1480 | -1.05 |
| | Sulawesi | 0.5023 | 8.86 | 0.0116 | 0.01 |
| | Eastern islands | -1.0193 | -12.08 | 0.7303 | 0.30 |
| Logging concession (%) | Java-Bali | | | | |
| | Sumatra | -0.0214 | -0.36 | 0.0268 | 0.07 |
| | Kalimantan | 0.1054 | 4.14 | 0.0441 | 0.31 |
| | Sulawesi | 0.6501 | 16.59 | -0.6171 | -1.29 |
| | Eastern islands | 0.8550 | 16.89 | -0.1752 | -0.30 |
| National park (%) | Java-Bali | | | 0.0463 | 0.01 |
| | | -1.0346 | -16.75 | | |
| | Sumatra | | | | |
| | Kalimantan | -1.2840 | -22.70 | -1.1605 | -3.82 |
| | Sulawesi | 0.1675 | 3.05 | -0.4563 | -0.10 |
| | Eastern islands | -0.8024 | -22.29 | -0.9793 | -1.03 |
| Other protected area (%) | Java-Bali | -0.0024 | 0.00 | -11.2574 | -0.12 |
| | Sumatra | | | | |
| | Kalimantan | -0.6206 | -7.50 | -0.6751 | -0.66 |
| | Sulawesi | -1.3826 | -14.54 | | |
| | Eastern islands | -0.4404 | -13.60 | -27.7138 | -0.03 |
| Slope (degree) | Java-Bali | -0.0086 | -2.58 | | |
| | Sumatra | -0.0744 | -51.64 | | |
| | Kalimantan | -0.0208 | -6.67 | | |
| | Sulawesi | -0.0392 | -25.01 | | |
| | Eastern islands | -0.0126 | -8.11 | | |
| Elevation (m) | Java-Bali | -0.0005 | -11.63 | | |
| | Sumatra | -0.0011 | -39.83 | | |
| | Kalimantan | -0.0066 | -50.08 | | |
| | Sulawesi | -0.0013 | -38.52 | | |
| | Eastern islands | -0.0002 | -11.35 | | |
| Log distance from road (km) | Java-Bali | 0.2323 | 13.94 | | |
| | Sumatra | 0.0112 | 4.36 | | |
| | Kalimantan | 0.0352 | 9.70 | | |

| | | | | | |
|---|---|---|---|---|---|
| | Sulawesi | 0.0840 | 18.00 | | |
| | Eastern islands | -0.1385 | -20.92 | | |
| Log distance from capital (km) | Java-Bali | 0.2267 | 5.96 | | |
| | Sumatra | 0.0156 | 2.60 | | |
| | Kalimantan | 0.1438 | 20.14 | | |
| | Sulawesi | 0.1541 | 16.24 | | |
| | Eastern islands | -0.1871 | -13.63 | | |
| Maximum agricultural revenue ($/ha/yr) | Java-Bali | -0.000323 | -20.11 | -0.000261 | -3.94 |
| | Sumatra | 0.000034 | 4.86 | 0.000086 | 2.95 |
| | Kalimantan | 0.000063 | 8.35 | 0.000125 | 3.75 |
| | Sulawesi | -0.000161 | -19.06 | -0.000135 | -3.07 |
| | Eastern islands | -0.000235 | -19.78 | -0.000163 | -3.15 |
| Region (0/1) | Java-Bali | -1.9964 | -10.25 | | |
| | Sumatra | 0.5810 | 7.41 | | |
| | Kalimantan | -0.3644 | -4.54 | | |
| | Sulawesi | -0.4744 | -5.38 | | |
| | Eastern islands | (omitted) | | (omitted) | |
| Year = 2000 | | (omitted) | | (omitted) | |
| Year = 2001 | | 0.0961 | 6.96 | 0.1072 | 2.45 |
| Year = 2002 | | -0.3608 | -21.79 | -0.3800 | -7.49 |
| Year = 2003 | | 0.5494 | 38.56 | 0.5265 | 12.41 |
| Year = 2004 | | 0.4801 | 32.15 | 0.4684 | 10.83 |
| Year = 2005 | | 0.7100 | 51.03 | 0.7076 | 17.53 |
| Year = 2006 | | 0.6975 | 42.54 | 0.6427 | 11.11 |
| Year = 2007 | | 0.7059 | 35.82 | 0.6109 | 7.83 |
| Year = 2008 | | 1.0478 | 47.28 | 0.9158 | 9.57 |
| Year = 2009 | | 0.7002 | 33.01 | 0.5951 | 6.82 |
| Intercept | | -4.8843 | -67.35 | | |

101 Table S5. Models with spatial lag included as a method of addressing potential spatial correlation; effects by half-decade.

| Description | Annual panel; pooled; lagged dependent variable as regressor; spatial lag as regressor; Poisson | | Annual panel; fixed effects; spatial lag as regressor; Poisson | | Annual panel; pooled; Poisson, 2000-2004 | | Annual panel; pooled; Poisson, 2005-2009 | |
|---|---|---|---|---|---|---|---|---|
| Unit of observation | grid cell-year | | grid cell-year | | grid cell-year | | grid cell-year | |
| Dependent variable | deforestation rate (%) | | deforestation rate (%) | | deforestation rate (%) | | deforestation rate (%) | |
| n | 1,863,317 | | 1,661,196 | | 951,906 | | 951,891 | |
| Independent variable | Coefficient | z value | Coefficient | z value | Coefficient | z value | Coefficient | z value |
| Oil palm concession | 0.5220 | 11.02 | 0.1923 | 1.25 | 1.3879 | 36.76 | 1.2059 | 45.35 |
| Timber concession | 0.6392 | 35.77 | 0.2553 | 3.90 | 0.9543 | 46.45 | 1.1918 | 89.62 |
| Logging concession | 0.1345 | 6.93 | -0.0191 | -0.15 | -0.1431 | -5.54 | 0.1943 | 7.40 |
| National park | -1.0831 | -29.44 | -0.8005 | -2.69 | -1.1752 | -26.11 | -1.2796 | -24.02 |
| Other protected area | -1.8010 | -59.78 | -0.4368 | -0.43 | -1.7625 | -36.95 | -2.2024 | -56.33 |
| Slope | -0.0522 | -54.47 | | | -0.0504 | -42.10 | -0.0787 | -58.76 |
| Elevation (m) | -0.0014 | -62.07 | | | -0.0014 | -48.90 | -0.0016 | -48.33 |
| Log distance to road (km) | -0.0787 | -41.81 | | | -0.0580 | -24.39 | -0.0573 | -27.38 |
| Log distance to capital (km) | -0.1887 | -44.15 | | | -0.2065 | -43.93 | -0.2355 | -57.95 |
| Potential agricultural revenue ($/ha/yr; 2005 USD) | 0.000078 | 10.90 | 0.000060 | 2.01 | 0.000318 | 28.27 | 0.000130 | 31.59 |
| Year=2000 | (omitted) | | (omitted) | | (omitted) | | (omitted) | |
| Year=2001 | 2.6064 | 47.22 | 0.0974 | 2.19 | | | | |
| Year=2002 | 2.1445 | 38.41 | -0.3495 | -6.79 | | | | |
| Year=2003 | 2.9647 | 53.82 | 0.4247 | 9.84 | | | | |
| Year=2004 | 2.7988 | 49.26 | 0.3499 | 7.95 | | | | |
| Year=2005 | 3.0243 | 55.89 | 0.5416 | 13.13 | | | | |
| Year=2006 | 2.9035 | 51.85 | 0.4948 | 8.49 | | | | |
| Year=2007 | 2.8782 | 51.18 | 0.4827 | 6.18 | | | | |
| Year=2008 | 3.1173 | 54.01 | 0.7141 | 7.45 | | | | |
| Year=2009 | 2.7956 | 50.91 | 0.4537 | 5.20 | | | | |
| Lagged dependent variable | 2.5419 | 47.10 | | | | | | |
| Spatial lag | 4.1662 | 134.83 | 3.7399 | 62.83 | | | | |
| Intercept | -6.2610 | -103.67 | | | -3.9009 | -141.36 | -2.9578 | -132.87 |

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104 Table S6. Geographic characteristics by land-use designations. Mean (standard deviation)

| | All 3 km x 3 km cells | Cells with oil palm concession by 2010 | Cells with timber concession by 2010 | Cells with logging concession by 2010 | Cells with national park by 2010 | Cells with other protected area by 2010 | Cells with no concession or protected area by 2010 |
|---|---|---|---|---|---|---|---|
| n | 195,466 | 22,631 | 17,012 | 21,352 | 14,932 | 10,392 | 117,257 |
| Forest cover as % of cell, 2000 | 85.2 | 87.5 | 89.3 | 97.0 | 93.9 | 89.8 | 81.0 |
| | (24.8) | (17.3) | (16.7) | (7.9) | (`5.5) | (19.6) | (28.4) |
| Forest cover as % of cell, 2010 | 78.7 | 68.0 | 70.3 | 91.2 | 91.8 | 87.7 | 77.0 |
| | (27.4) | (25.9) | (26.6) | (14.8) | (17.2) | (20.7) | (29.2) |
| Deforestation as % of cell, 2000-2010 | 6.5 | 19.5 | 19.1 | 5.8 | 2.1 | 2.1 | 4.0 |
| | (13.8) | (22.1) | (22.7) | (11.6) | (7.1) | (5.8) | (9.3) |
| Palm oil cover as % of cell, 2010 | 3.1 | 13.1 | 3.7 | 0.7 | 0.1 | 0.5 | 2.3 |
| | (14.0) | (27.3) | (14.2) | (6.3) | (2.6) | (5.4) | (11.8) |
| Slope (%) | 7.5 | 2.9 | 3.7 | 6.9 | 12.3 | 11.7 | 7.8 |
| | (7.2) | (2.7) | (3.8) | (5.4) | (8.3) | (8.8) | (7.3) |
| Elevation (m) | 359 | 60 | 116 | 210 | 801 | 631 | 382 |
| | (550) | (78) | (218) | (239) | (842) | (691) | (546) |
| Distance to nearest highway (km) | 63 | 34 | 31 | 81 | 84 | 102 | 63 |
| | (88) | (40) | (35) | (85) | (110) | (104) | (91) |
| Distance to nearest provincial capital (km) | 230 | 170 | 169 | 279 | 255 | 326 | 227 |
| | (171) | (102) | (124) | (162) | (167) | (233) | (172) |
| Potential agricultural revenue ($/ha/yr) | 2506 | 2532 | 2554 | 2532 | 2530 | 2501 | 2490 |
| | (361) | (291) | (340) | (309) | (317) | (323) | (389) |
| Average above and below ground biomass (tC/ha) | 150 | 128 | 140 | 189 | 169 | 162 | 145 |
| | (69) | (64) | (65) | (53) | (258) | (60) | (70) |
| Peat land extent as % of cell | 20 | 36 | 65 | 13 | 29 | 4.7 | 13 |
| | (91) | (111) | (168) | (81) | (120) | (24.6) | (68) |

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107 Table S7. Sensitivity of econometric results to alternative forest cover thresholds (pooled; lagged dependent variable as regressor)

| Forest cover threshold | 50% | | 75% | | 90% | | Primary only [6] | |
|---|---|---|---|---|---|---|---|---|
| Description | Annual panel; pooled; lagged dependent variable as regressor; Poisson | | Annual panel; pooled; lagged dependent variable as regressor; Poisson | | Annual panel; pooled; lagged dependent variable as regressor; Poisson | | Annual panel; pooled; lagged dependent variable as regressor; Poisson | |
| Unit of observation | grid cell-year | | grid cell-year | | grid cell-year | | grid cell-year | |
| Dependent variable | deforestation rate (%) | | deforestation rate (%) | | deforestation rate (%) | | deforestation rate (%) | |
| n | 1,903,818 | | 1,903,820 | | 1,903,820 | | 1,102,784 | |
| Independent variable | Coefficient | z value | Coefficient | z value | Coefficient | z value | Coefficient | z value |
| Oil palm concession | 0.8206 | 29.84 | 0.8213 | 29.89 | 0.8213 | 29.89 | 0.8671 | 24.49 |
| Timber concession | 0.8306 | 60.39 | 0.8312 | 60.43 | 0.8312 | 60.43 | 1.0458 | 54.47 |
| Logging concession | 0.1047 | 5.62 | 0.1049 | 5.62 | 0.1049 | 5.62 | 0.0454 | 1.14 |
| National park | -1.1660 | -30.60 | -1.1659 | -30.6 | -1.1659 | -30.60 | -1.5679 | -20.81 |
| Other protected area | -1.9052 | -63.41 | -1.9052 | -63.41 | -1.9052 | -63.41 | -2.0568 | -32.44 |
| Slope | -0.0582 | -63.36 | -0.0582 | -63.36 | -0.0582 | -63.36 | -0.0607 | -46.96 |
| Elevation (m) | -0.0015 | -65.54 | -0.0015 | -65.54 | -0.0015 | -65.54 | -0.0018 | -60.07 |
| Log distance to road (km) | -0.0695 | -41.62 | -0.0695 | -41.62 | -0.0695 | -41.62 | -0.0789 | -33.56 |
| Log distance to capital (km) | -0.1980 | -58.58 | -0.1981 | -58.61 | -0.1981 | -58.61 | -0.1327 | -31.38 |
| Potential agricultural revenue ($/ha/yr; 2005 USD) | 0.000117 | 17.47 | 0.000117 | 17.47 | 0.000117 | 17.47 | 0.000127 | 13.19 |
| Year=2000 | (omitted) | | (omitted) | | (omitted) | | (omitted) | |
| Year=2001 | 4.5234 | 133.41 | 4.5209 | 133.27 | 4.5209 | 133.27 | 4.3832 | 62.42 |
| Year=2002 | 4.0079 | 113.66 | 4.0054 | 113.53 | 4.005403 | 113.53 | 3.7113 | 51.95 |
| Year=2003 | 4.9305 | 144.02 | 4.9280 | 143.87 | 4.9280 | 143.87 | 4.8226 | 68.04 |
| Year=2004 | 4.7609 | 140.42 | 4.7586 | 140.29 | 4.7586 | 140.29 | 4.5050 | 64.73 |
| Year=2005 | 5.0064 | 148.65 | 5.0041 | 148.51 | 5.0041 | 148.51 | 4.9407 | 70.72 |
| Year=2006 | 4.8531 | 140.50 | 4.8508 | 140.37 | 4.8508 | 140.37 | 4.6671 | 67.16 |
| Year=2007 | 4.7731 | 130.96 | 4.7709 | 130.85 | 4.7709 | 130.85 | 4.6122 | 64.09 |
| Year=2008 | 5.0531 | 130.90 | 5.0504 | 130.74 | 5.0504 | 130.74 | 4.9043 | 65.06 |
| Year=2009 | 4.6536 | 126.95 | 4.6515 | 126.84 | 4.6515 | 126.84 | 4.4705 | 62.54 |
| Intercept | -8.1648 | -217.89 | -8.1620 | -217.66 | -8.1620 | -217.66 | -8.6101 | -115.88 |

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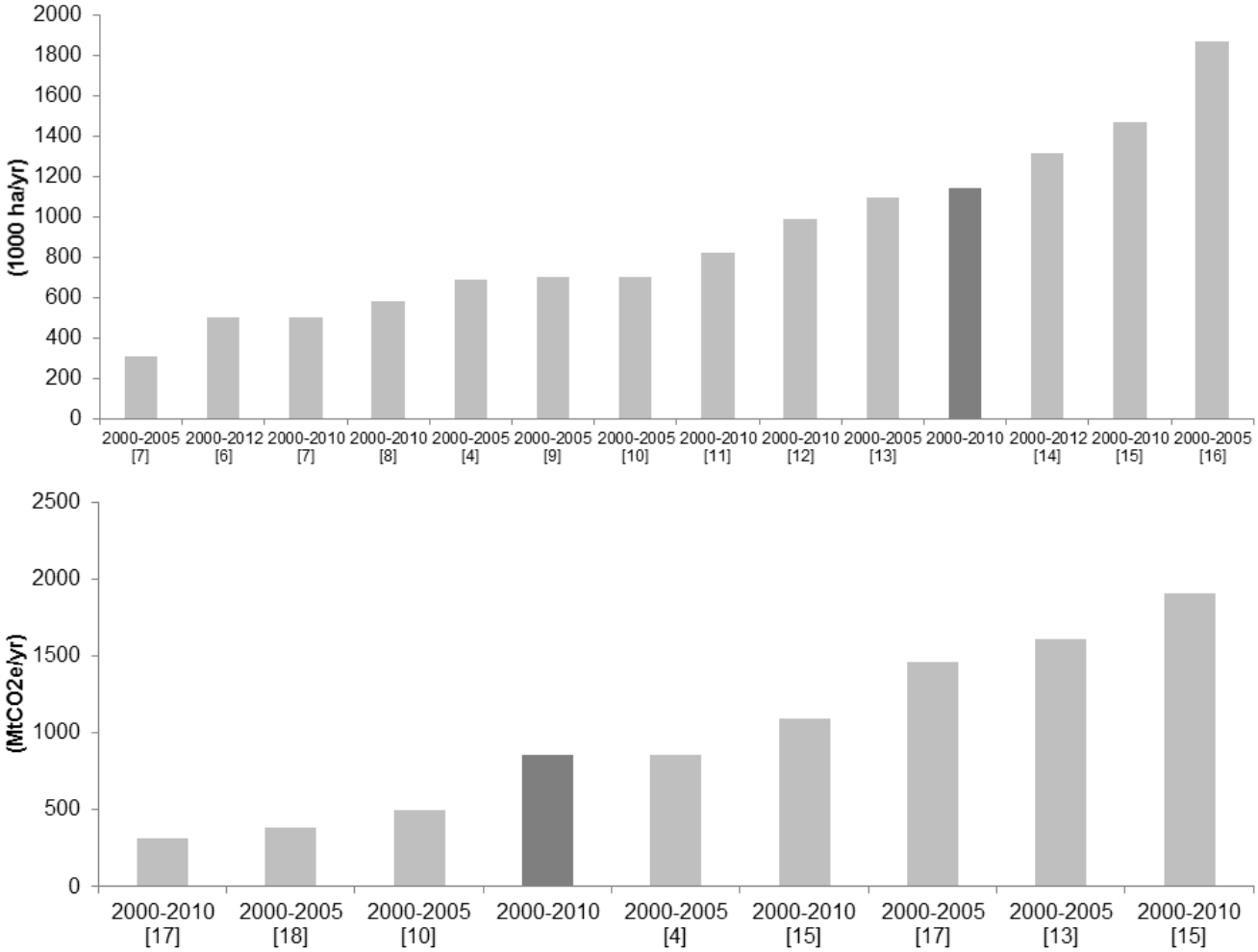
Table S8. Sensitivity of econometric results to alternative forest cover thresholds (fixed effects)

| Forest cover threshold | 50% | | 75% | | 90% | | Primary only [6] | |
|---|---|---|---|---|---|---|---|---|
| Description | Annual panel; fixed effects; Poisson | | Annual panel; fixed effects; Poisson | | Annual panel; fixed effects; Poisson | | Annual panel; fixed effects; Poisson | |
| Unit of observation | grid cell-year | | grid cell-year | | grid cell-year | | grid cell-year | |
| Dependent variable | deforestation rate (%) | | deforestation rate (%) | | deforestation rate (%) | | deforestation rate (%) | |
| n | 1,699,018 | | 1,699,020 | | 1,699,020 | | 847,797 | |
| Independent variable | Coefficient | z value | Coefficient | z value | Coefficient | z value | Coefficient | z value |
| Oil palm concession | 0.3023 | 2.10 | 0.3023 | 2.1 | 0.3023 | 2.10 | 0.0436 | 0.17 |
| Timber concession | 0.4375 | 7.25 | 0.4376 | 7.25 | 0.4376 | 7.25 | 0.8220 | 6.77 |
| Logging concession | 0.0189 | 0.15 | 0.0190 | 0.15 | 0.0190 | 0.15 | 0.3325 | 0.76 |
| National park | -1.1024 | -3.83 | -1.1023 | -3.83 | -1.1023 | -3.83 | 2.6084 | 0.99 |
| Other protected area | -0.5746 | -0.57 | -0.5745 | -0.57 | -0.5745 | -0.57 | -0.5916 | -0.57 |
| Potential agricultural revenue ($/ha/yr; 2005 USD) | 0.000101 | 3.48 | 0.000101 | 3.48 | 0.000101 | 3.48 | 0.000064 | 1.46 |
| Year=2000 | (omitted) | | (omitted) | | (omitted) | | (omitted) | |
| Year=2001 | 0.1108 | 2.53 | 0.1108 | 2.53 | 0.1108 | 2.53 | 0.2149 | 3.51 |
| Year=2002 | -0.3978 | -7.87 | -0.3978 | -7.87 | -0.3978 | -7.87 | -0.3896 | -5.04 |
| Year=2003 | 0.5069 | 12.03 | 0.5069 | 12.03 | 0.5069 | 12.03 | 0.7199 | 11.44 |
| Year=2004 | 0.446548 | 10.39 | 0.4466 | 10.4 | 0.4466 | 10.40 | 0.4914 | 7.35 |
| Year=2005 | 0.6884 | 17.14 | 0.6884 | 17.15 | 0.6884 | 17.15 | 0.8918 | 14.56 |
| Year=2006 | 0.5926 | 10.48 | 0.5927 | 10.48 | 0.5927 | 10.48 | 0.7785 | 9.04 |
| Year=2007 | 0.5431 | 7.16 | 0.5432 | 7.16 | 0.5432 | 7.16 | 0.7881 | 6.87 |
| Year=2008 | 0.8354 | 9.01 | 0.8354 | 9.01 | 0.8354 | 9.01 | 1.0966 | 7.83 |
| Year=2009 | 0.5168 | 6.12 | 0.5168 | 6.12 | 0.5168 | 6.12 | 0.6647 | 5.18 |

Table S9. Crops with highest potential agricultural revenue in greatest percent of cell-years, 2000-2009

| Crop (n=21) | % of cell-years |
|---|---|
| Palm oil | 69.0 |
| Sugar cane | 11.6 |
| Banana | 5.6 |
| Cotton | 5.3 |
| Cocoa | 4.0 |
| Tea | 1.9 |
| Rice | 1.0 |
| Coffee | 1.0 |
| Other crop | 0.7 |

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118 Figure S1. Estimated average annual deforestation and emissions from deforestation across Indonesia, by
119 source. Shaded columns represent estimates from this paper.

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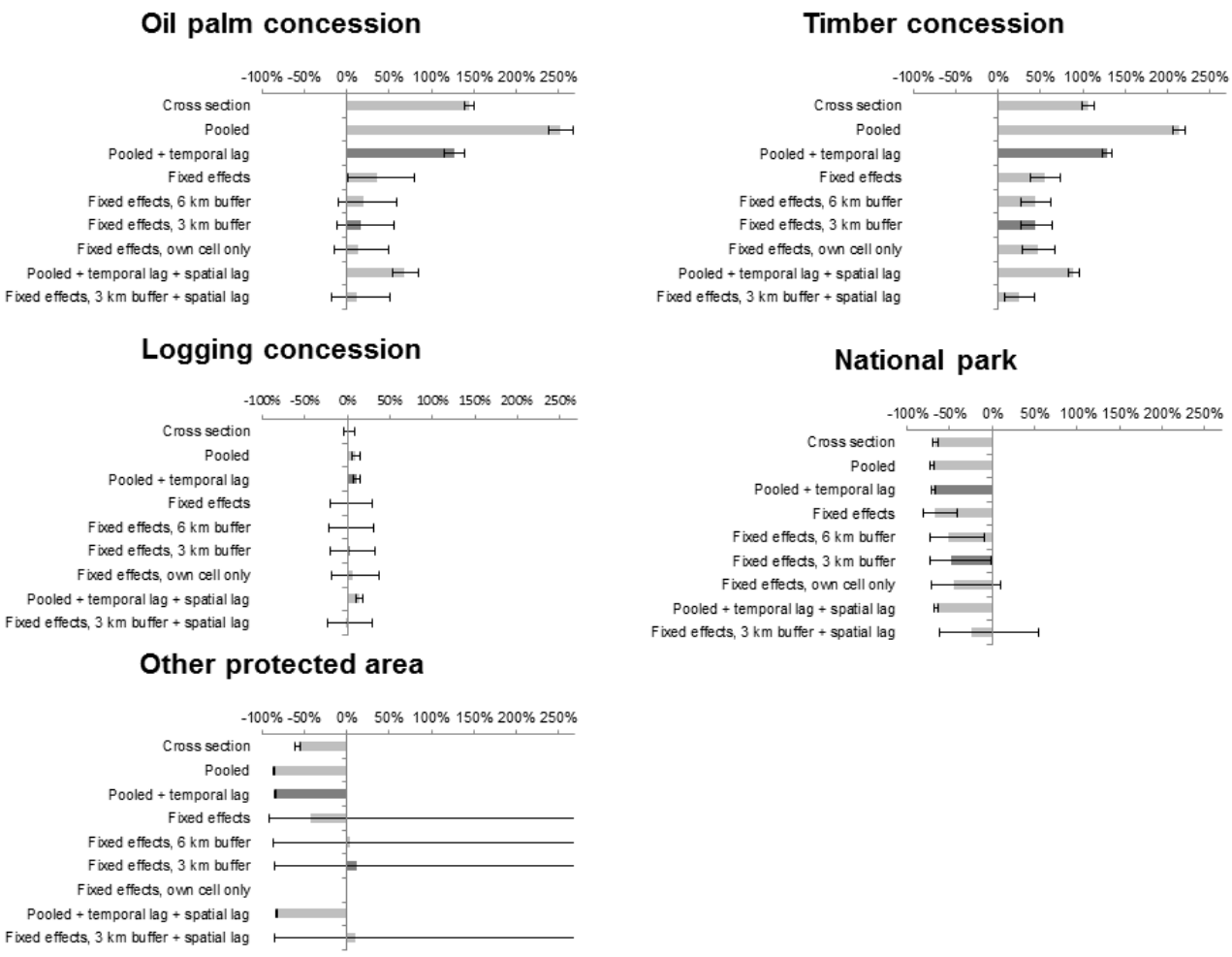



Figure S2. Change in deforestation rate due to land-use designation, by specification. Shaded bars represent upper and lower bounds of estimated treatment effects.

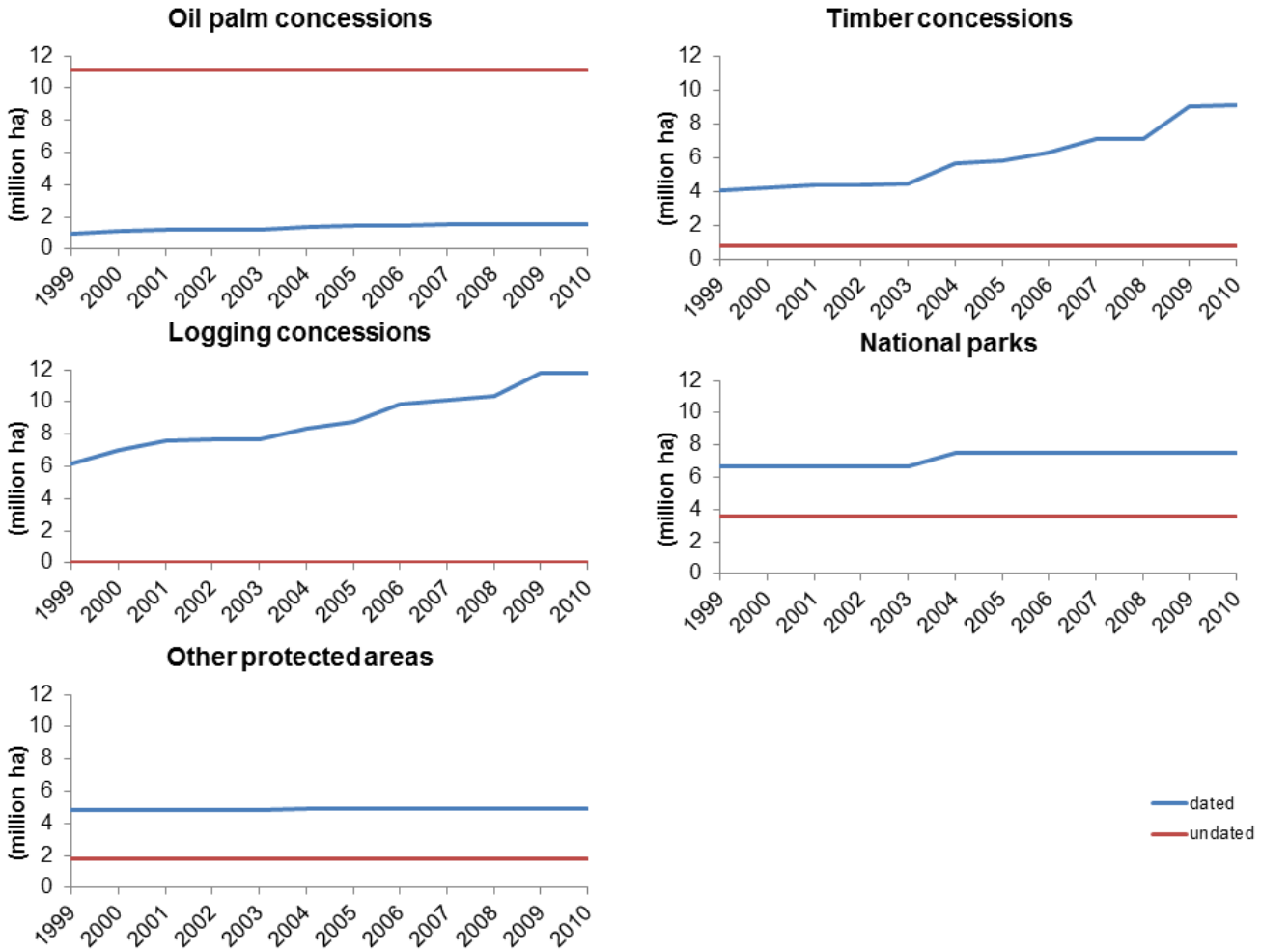
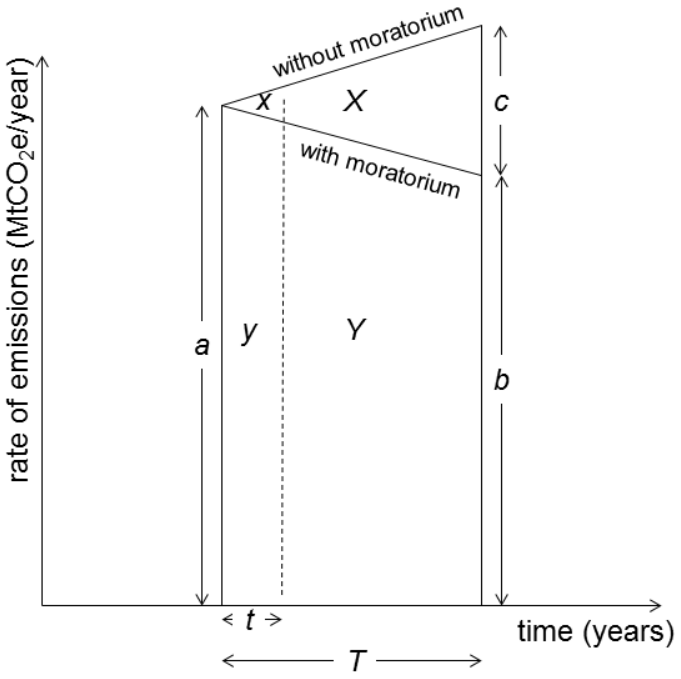



Figure S3. Growth in land-use designations across Indonesia, 1999-2010.

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132 Figure S4. Trends in emissions with and without moratorium policy.