Carbon Emissions, Deforestation and the Real Exchange Rate: An African Update

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Motivation

- Huge literature on the determinants of CO2 emissions
- Almost no work on the impact of exchange rate policy on climate issues, including CO2 emissions, apart from our work presented 2 years ago
- Difficult to think that this key relative price has no effect on climate change
- Exception: our 2008 *JDE* paper on tropical deforestation: Depreciation of the REER in developing countries increases deforestation

Hypotheses

- REER depreciations, which are often recommended as a manner of increasing African competitiveness, will significantly increase CO2 emissions in Africa
- The same effect obtains, to a slightly lesser extent, with deforestation

Main empirical take-aways

- The REER elasticity of CO2 emissions in Africa is equal to -0.3
- Competitive depreciations are NOT the answer from the climate perspective
- The effect is particulary strong (4 times stronger) when the REER < 60 (2010=100)
- Depreciations also increase the rate of deforestation

The CO2 emissions argument in a nutshell

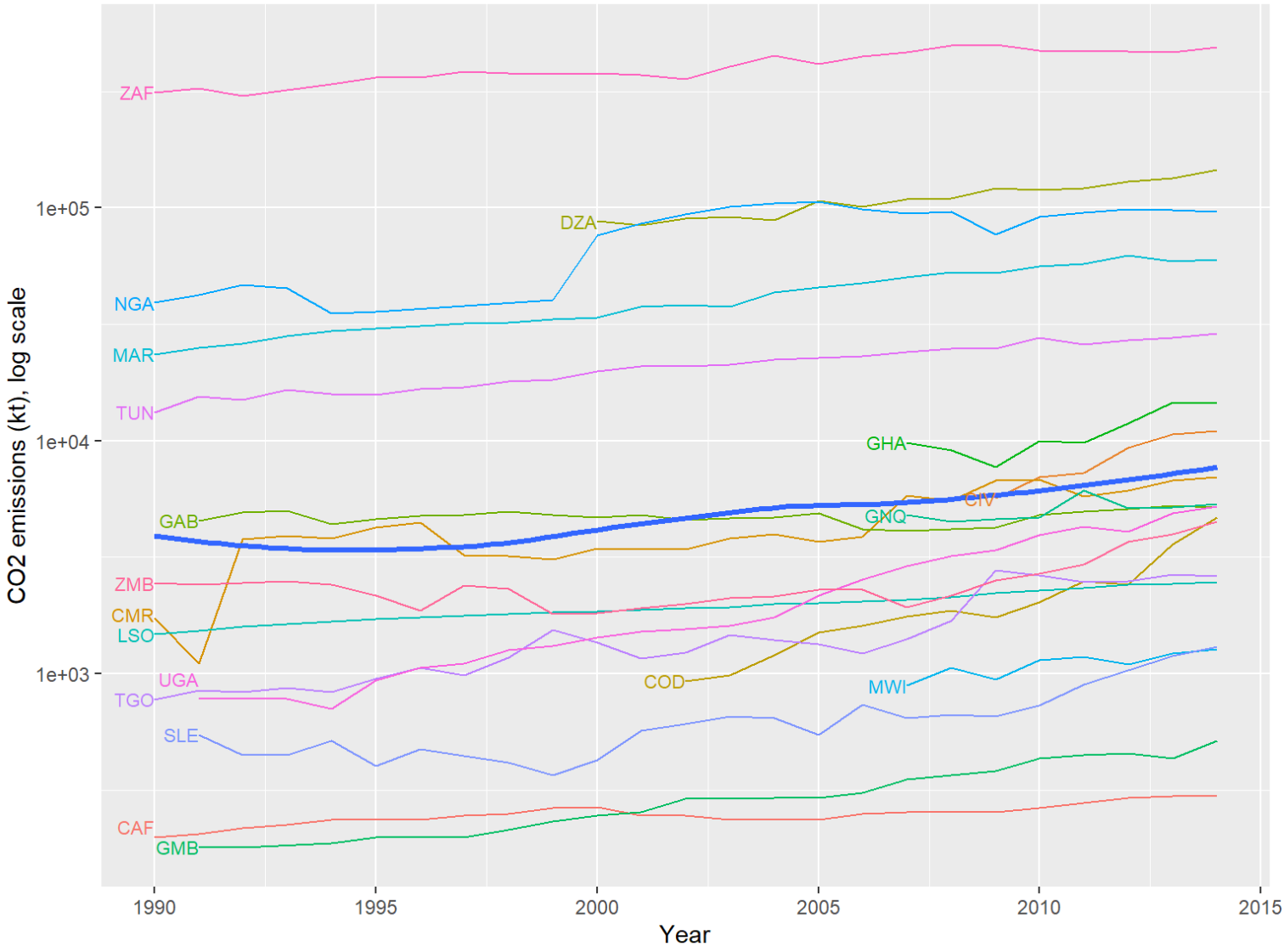
- For poor countries, CO2 emissions per unit of output are greater for tradeables than for non-tradeables
- This difference vanishes as income per capita increases
- This effect is further dampened by the Balassa-Samuelson effect (appreciation) on the equilibrium REER

The African sample

- CO2 emissions in kt
- Manufacturing value added in constant 2010 US$
- Forest cover sq. km
- GDP in constant 2010 US dollars
- REER: index where 2010 = 100
- A fall in the level of the REER corresponds to a depreciation

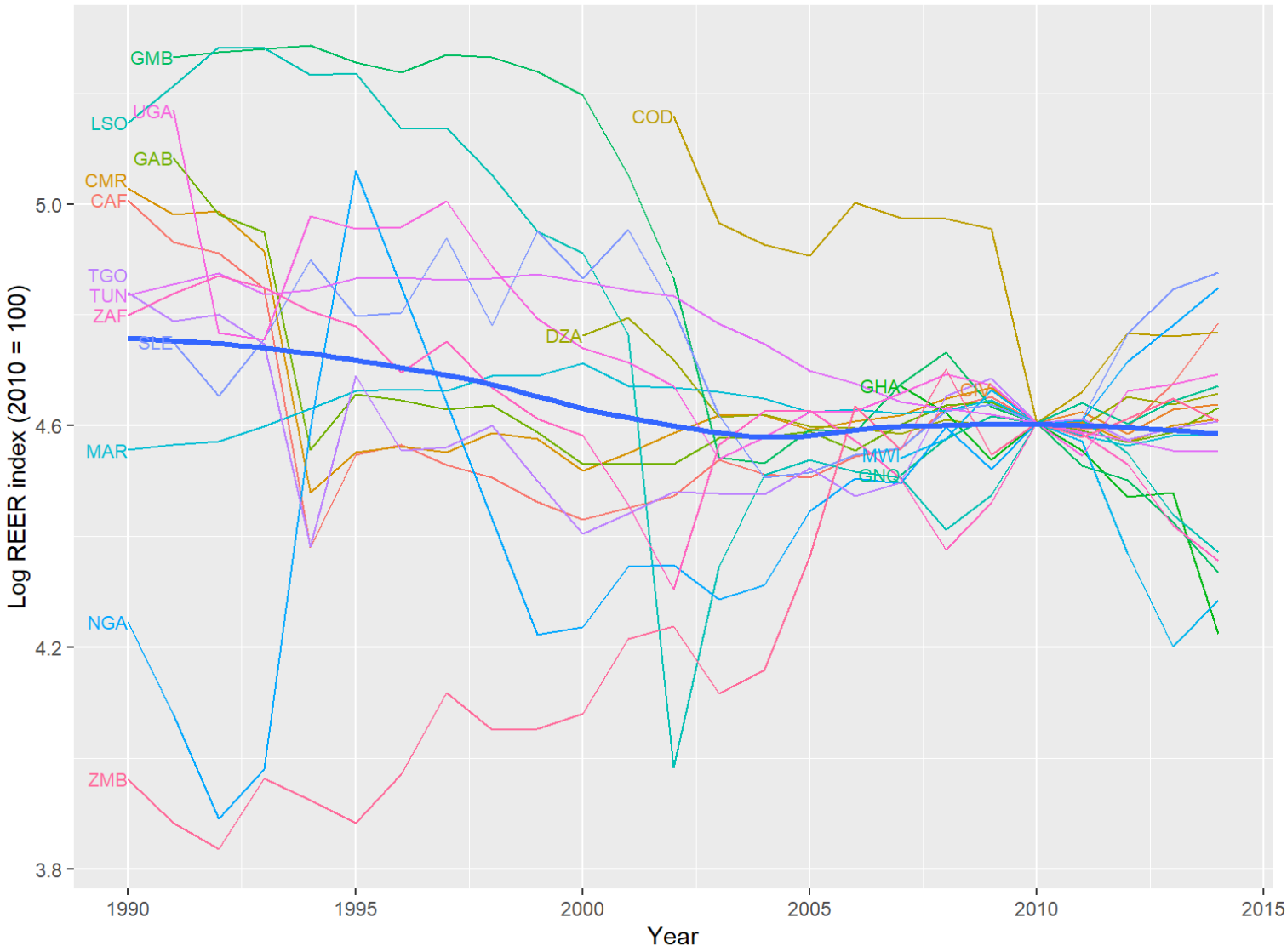
There are 19 African countries in the dataset, each observed for an average of 20 years, for a total of 375 country-years (observations)

Total carbon emissions

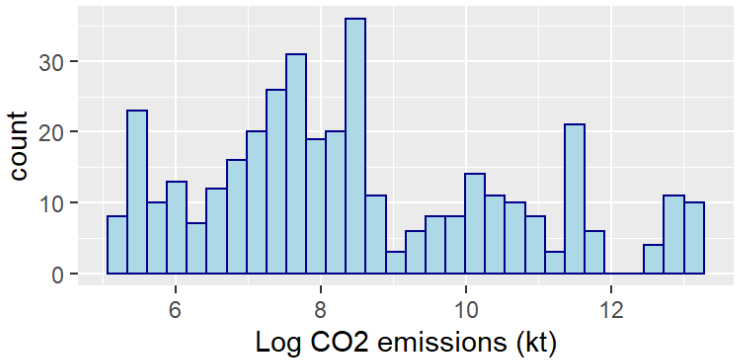


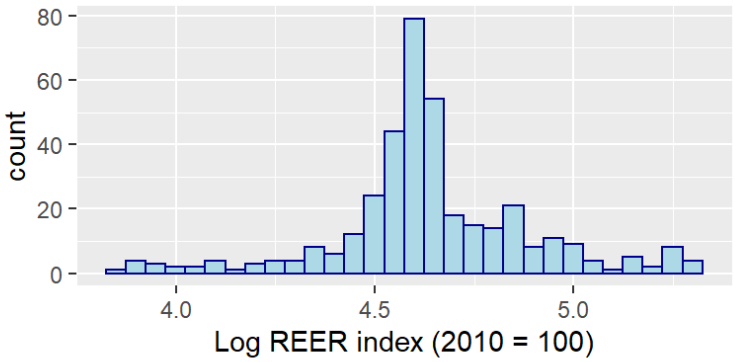
The REER

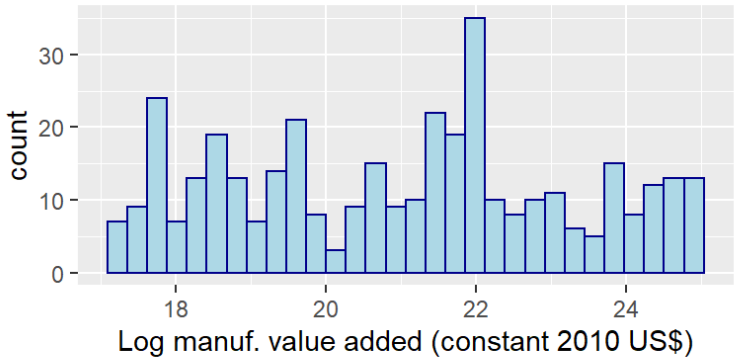
Real effective exchange rate: geometric mean of domestic to international prices

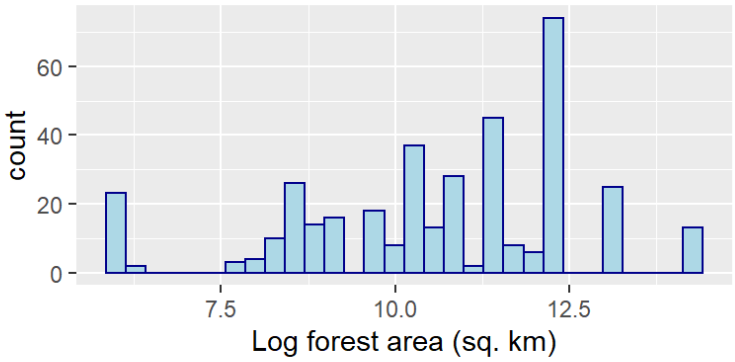


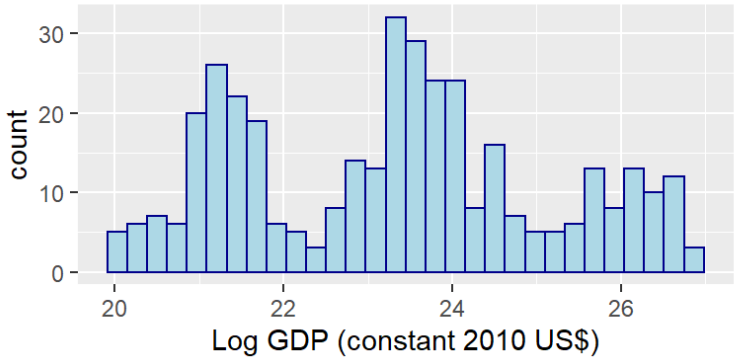
Descriptive statistics

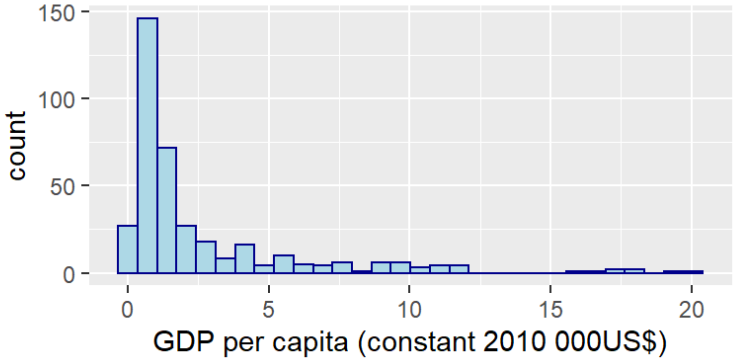






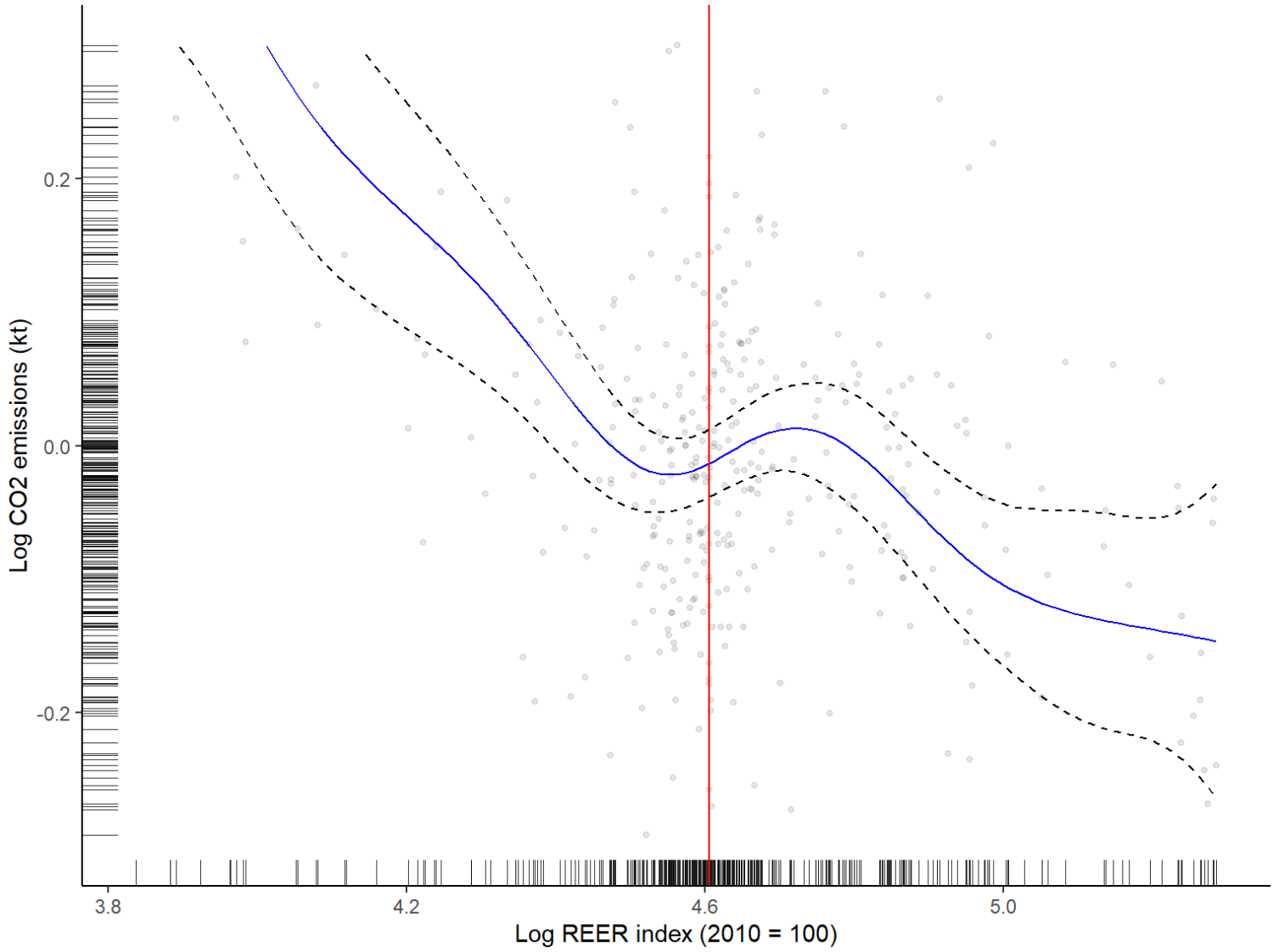






Log REER and CO2 emissions

$CO2_{it} =X_{it}\alpha+f(REER_{it})+\lambda_i+\theta_t+\epsilon_{it}$



Linear approximation

Clustering at country level

	(1)	(2)	(3)	(4)
Log REER index (2010=100)	-0.305 *	-0.323 *		-0.374 *
	(0.124)	(0.116)		(0.139)
Log REER * 1[REER>60]			-0.236	
			(0.141)	
Log REER * 1[REER<60]			-1.436 **	
			(0.415)	
GDP/cap (2010 000US$)				-0.251 *
				(0.098)
Log REER * GDP/cap				0.055 *

				(0.020)
Log GDP (2010 US$)	0.820 ***	0.832 ***	0.836 ***	0.781 ***
	(0.160)	(0.160)	(0.166)	(0.164)
Log forest area (sq. km)	-0.544 ***	-0.545 ***	-0.525 ***	-0.529 ***
	(0.121)	(0.131)	(0.107)	(0.124)
Log man. val. add. (2010 US$)		-0.118 *		
		(0.048)		
N	375	375	375	375
R2	0.995	0.995	0.995	0.995

*** p < 0.001; ** p < 0.01; * p < 0.05.

Comments

Column (1)

- A one percent increase in the REER decreases CO2 emissions by 0.305 percent
- A one percent increase in forest cover decreases CO2 emissions by 0.544 percent
- A one percent increase in GDP increases CO2 emissions by 0.82 percent

Column (2)

- Size of the manufacturing sector has a small negative impact on CO2 emissions

Spline specification

- Column (3): marginal effect of REER different above and below threshold of 60
- absolutely massive effect that is 4 times the average effect

$$ CO2_{it} =REER_{it}\times1[REER_{it}<60]\beta_1+REER_{it}\times1[REER_{it}>60]\beta_2 \\ +1([REER_{it}<60]\gamma_1+1([REER_{it}>60]\gamma_2+X_{it}\alpha+\lambda_i+\theta_t+\epsilon_{it}, $$

- Marginal effect of REER on CO2 emissions = 0 when REER > 60
- For REER < 60, marginal effect is negative and estimated very precisely

Spline specification: column (3)

	(1)	(2)	(3)	(4)
Log REER index (2010=100)	-0.305 *	-0.323 *		-0.374 *

	(0.124)	(0.116)		(0.139)
Log REER * 1[REER>60]			-0.236	
			(0.141)	
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		(0.048)		
N	375	375	375	375
R2	0.995	0.995	0.995	0.995

*** p < 0.001; ** p < 0.01; * p < 0.05.

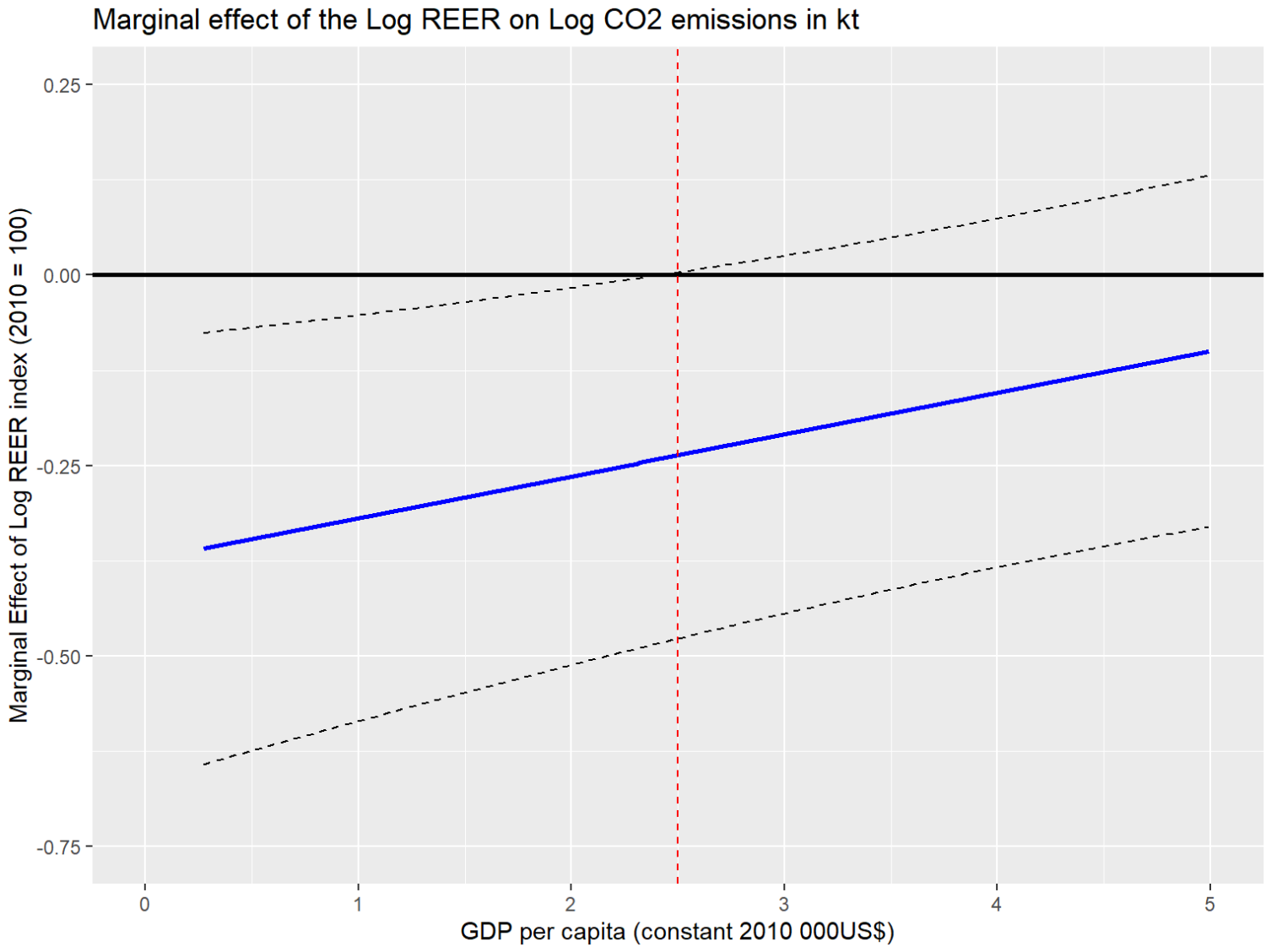
Varying marginal effect of REER: column (4)

	(1)	(2)	(3)	(4)
Log REER index (2010=100)	-0.305 *	-0.323 *		-0.374 *
	(0.124)	(0.116)		(0.139)
Log REER * 1[REER>60]			-0.236	
			(0.141)	
Log REER * 1[REER<60]			-1.436 **	
			(0.415)	
GDP/cap (2010 000US$)				-0.251 *
				(0.098)
Log REER * GDP/cap				0.055 *

				(0.020)
Log GDP (2010 US$)	0.820 ***	0.832 ***	0.836 ***	0.781 ***
	(0.160)	(0.160)	(0.166)	(0.164)
Log forest area (sq. km)	-0.544 ***	-0.545 ***	-0.525 ***	-0.529 ***
	(0.121)	(0.131)	(0.107)	(0.124)
Log man. val. add. (2010 US$)		-0.118 *		
		(0.048)		
N	375	375	375	375
R2	0.995	0.995	0.995	0.995

*** p < 0.001; ** p < 0.01; * p < 0.05.

Marginal effect REER on CO2 emissions, as function of GDP / cap

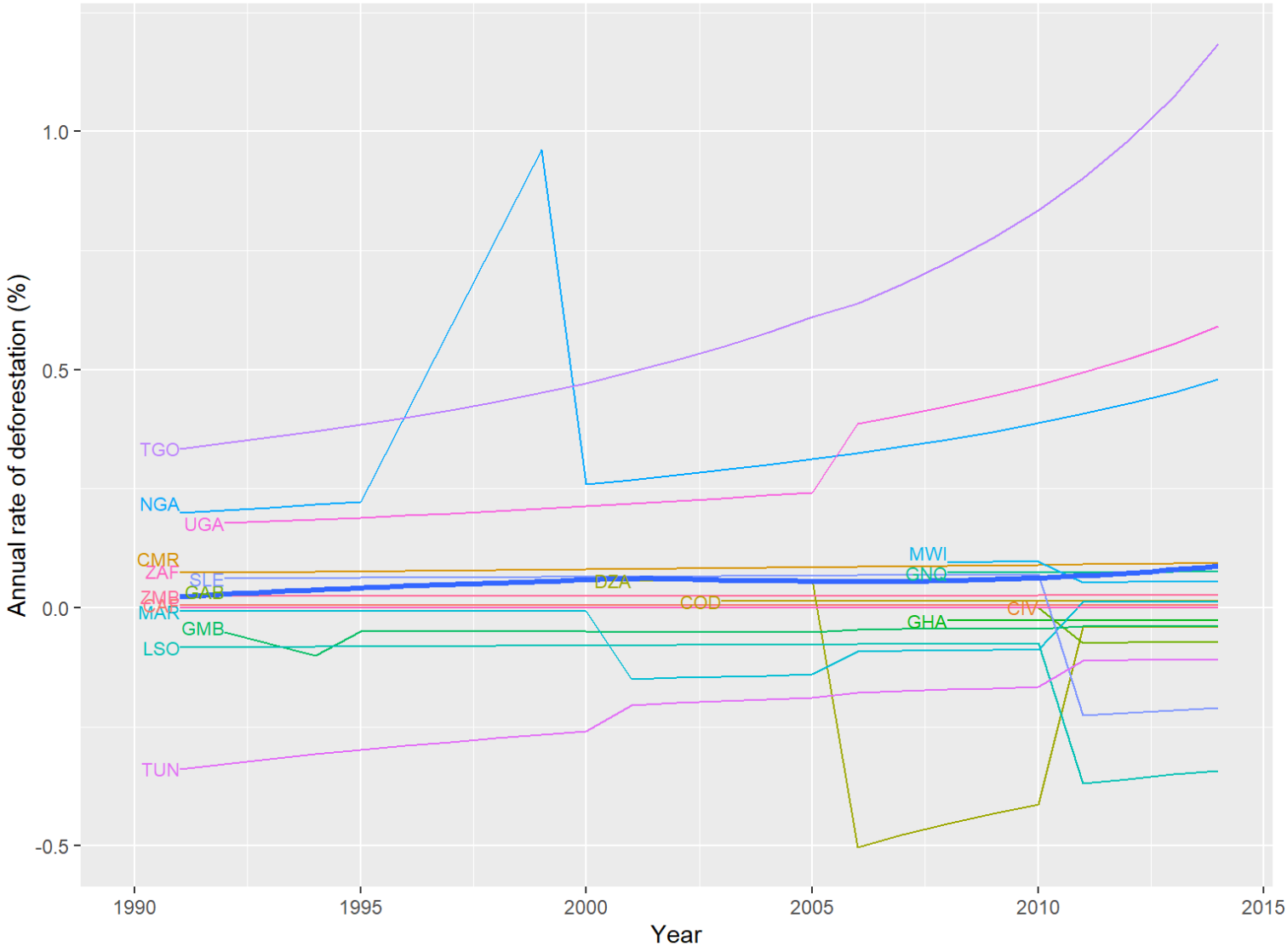


- 73.1 percent of observations with a statistically significant negative effect, 0.5 percent of observations with a statistically significant positive effect

REER depreciations lead to deforestation in Africa

- The real domestic price of timber is equal to its international price divided by the REER
- The effect of the real domestic price of timber on deforestation depends on the intertemporal discount rate
- Increases in the domestic real price of timber lead to deforestation (reforestation) when intertemporal discount rates are small (large and close to 1)
- Such high discount rates are typical of low income countries with weak institutions

Deforestation in Africa: annual rate in percent



REER depreciations lead to deforestation in Africa

- See column (2): as with CO2 emissions, the action is for REER below 60
- Effects are driven largely by NGA and ZMB

	(1)	(2)

Log REER * 1[REER>60]	-0.236	0.055
	(0.141)	(0.080)
Log REER * 1[REER<60]	-1.436 **	-0.245 *
	(0.415)	(0.106)
GDP/cap (2010 000US$)		0.000
		(0.027)
Log GDP (2010 US$)	0.836 ***	0.059
	(0.166)	(0.156)
Log forest area (sq. km)	-0.525 ***	
	(0.107)	
Log man. val. add. (2010 US$)		0.018
		(0.044)
N	375	356
R2	0.995	0.807

*** p < 0.001; ** p < 0.01; * p < 0.05.