

The Soybean Unlock: Differential Export Tax Liberalization and Crop Reallocation in Argentina

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Abstract

For over a decade, Argentina’s Pampa—one of the world’s most productive agricultural regions—devoted more than half its cropland to a single crop. In December 2015, the incoming Macri administration eliminated export taxes on wheat, corn, and sunflower while barely reducing soybean taxes. I exploit this differential liberalization using administrative crop data from 198 departments over ten campaigns in a difference-in-differences design with department-by-crop and department-by-year fixed effects. Liberalized crops expanded planted area by 36 log points relative to soybeans, with corn growing 57% and wheat 45%. The reallocation was strongest in departments with the highest pre-reform soybean concentration. These findings demonstrate that crop monoculture in Argentina was substantially tax-induced rather than structurally inevitable.

JEL Codes: Q17, Q18, F13, H21

Keywords: export taxes, crop allocation, trade liberalization, Argentina, agriculture

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1. Introduction

By 2014, Argentina had become the world’s third-largest soybean exporter, dedicating over 20 million hectares—more than half its total cropland—to a single commodity. This concentration was remarkable for a country whose Pampa region can profitably grow wheat, corn, sunflower, and dozens of other crops. The question of whether Argentina’s “soybean addiction” reflected underlying comparative advantage or policy-induced distortion had major implications for food security, soil health, and agricultural sustainability (Giordano and Ferreyra, 2016; Reca et al., 2011).

On December 14, 2015, ten days after taking office, President Mauricio Macri signed Decrees 133/2015 and 160/2015 eliminating export taxes on wheat (23% to 0%), corn (20% to 0%), and sunflower (32% to 0%), while reducing soybean taxes by only five percentage points (35% to 30%). This differential liberalization created a sharp natural experiment: if the soybean monoculture was primarily tax-driven, we should observe rapid reallocation toward the newly favored crops. If structural advantages dominated—scale economies, established supply chains, technological lock-in—the crop mix should remain largely unchanged.

The asymmetric treatment of soybeans was driven by fiscal constraints: soybean retenciones alone generated approximately \$6 billion annually, making full elimination politically infeasible.

I exploit this policy variation using administrative data from Argentina’s Ministry of Agriculture (MAGyP), which records planted area, harvested area, and production at the department-crop-campaign level for all 508 agricultural departments. My identification strategy uses a difference-in-differences framework comparing treated crops (wheat, corn, sunflower) to the control crop (soybeans) within departments, controlling for department-by-crop fixed effects (absorbing time-invariant comparative advantage) and department-by-year fixed effects (absorbing all department-level shocks including the simultaneous peso devaluation).

The results are striking. In the preferred specification, liberalized crops experienced a 36 log-point increase in planted area relative to soybeans (Table 2, column 4). Decomposing by crop reveals that corn expanded most dramatically (57 log points), followed by wheat (45 log points), while sunflower showed no significant change despite having the largest tax cut. This pattern is consistent with complementarity between corn and soybeans in crop rotation and with wheat’s role as a winter crop that does not compete directly for summer planting space. The area share of liberalized crops within each department increased by 13.4 percentage points.

These effects were heterogeneous along a dimension that sharpens the interpretation.

Departments with above-median pre-reform soybean concentration—those most “locked in” to monoculture—exhibited reallocation 56% larger than departments with lower initial soybean shares (43 vs. 28 log points). This gradient suggests the tax distortion was binding precisely where agronomic diversification was most feasible, and that the monoculture reflected tax incentives rather than inherent unsuitability for other crops.

The results survive province-level clustering, two-way clustering, alternative sample windows, and the exclusion of the core Pampa region. The estimate is larger outside the Pampa (50 log points) than within it (32 log points), consistent with marginal departments having greater scope for reallocation. An event study confirms the absence of monotonic pre-trends but reveals volatility in pre-treatment differential movements between treated and control crops.

This paper contributes to three literatures. First, it provides micro-level evidence on the distortionary effects of export taxes, which remain widely used in developing countries but are rarely evaluated with administrative production data at the sub-national level (Nogués, 2008; Olarreaga and Özden, 2006; Laborde et al., 2013). Prior work on Argentina’s export taxes has relied on aggregate national data or simulation models (Livianis et al., 2006; Lence, 2018); this paper exploits 7,409 department-crop-campaign observations and within-department variation.

Second, the paper contributes to the literature on agricultural supply response and crop substitution. The differential tax treatment across crops within the same departments creates a rare opportunity to estimate cross-crop substitution elasticities, netting out common shocks that typically confound aggregate time-series approaches (Chavas, 2001). The finding that corn and wheat responded strongly while sunflower did not points to complementarity and crop rotation as key mediators of supply response.

Third, the paper speaks to the broader trade liberalization literature (Goldberg and Pavcnik, 2005; Topalova and Khandelwal, 2011; Bustos, 2011), showing that even in agriculture—where adjustment is physically constrained by planting seasons and soil conditions—supply response to tariff changes can be rapid and substantial when the price signal is large and credible.

The remainder of the paper is organized as follows. Section 2 describes the institutional setting and the 2015 reform. Section 3 presents the data. Section 4 lays out the empirical strategy. Section 5 presents results, and Section 6 concludes.

2. Institutional Background

Argentina’s Export Tax Regime. Argentina has a long history of using export taxes (*retenciones*) on agricultural commodities, dating to the mid-twentieth century. These taxes serve a dual purpose: they generate fiscal revenue from the country’s most productive sector, and they reduce domestic food prices by depressing the export-parity price that farmers receive (Nogués, 2008). Between 2002 and 2015, under the Kirchner governments, export taxes were systematically increased as a fiscal tool in the wake of the 2001 economic crisis.

By 2015, the export tax schedule created stark differential incentives across crops. Soybeans faced a 35% rate—the highest among major crops—reflecting their status as Argentina’s dominant export earner. Wheat was taxed at 23%, corn at 20%, and sunflower at 32%. Crucially, the government also operated a system of *Registros de Operaciones de Exportación* (ROE), which required exporters to obtain permits before shipping grain. The ROE system created additional uncertainty and delays that disproportionately affected crops with smaller export volumes.

The December 2015 Reform. On December 14, 2015, President Macri issued Decree 133/2015 eliminating export taxes on wheat, corn, sunflower, and other minor crops effective immediately. Separately, Decree 160/2015 reduced soybean export taxes from 35% to 30%—a modest five percentage-point cut that left soybeans as the only major crop still facing substantial export taxation. The ROE permit system was simultaneously abolished for all crops.

The differential treatment of soybeans was driven by fiscal constraints: soybean *retenciones* generated approximately \$6 billion annually, or roughly 7% of total federal tax revenue. Full elimination was politically infeasible. The reform thus created a large, discrete, and plausibly exogenous shift in relative returns across crops within the same agricultural departments.

Concurrent Macro Changes. The reform coincided with a major macroeconomic adjustment. The Macri government unified the official and parallel exchange rates, resulting in an approximate 45% peso devaluation. This devaluation increased returns for all export crops in peso terms but did not differentially affect crops. The identification strategy absorbs all department-level shocks through department-by-year fixed effects, isolating the differential cross-crop effect of the tax change.

Agricultural Calendar. Argentina’s main grain planting follows a seasonal calendar. Wheat is planted May–August (winter crop); corn and sunflower are planted September–December; and soybeans are planted November–January. The December 2015 decree arrived during the

corn/sunflower/soybean planting window. The first fully treated campaign (2016/17) shows the largest response, as farmers had complete advance knowledge of the new tax regime before planting decisions were made.

3. Data

The primary data source is the *Estimaciones Agrícolas* database maintained by Argentina’s Ministry of Agriculture, Livestock, and Fisheries (MAGyP). This administrative dataset records planted area, harvested area, production volume, and yield at the department-crop-campaign level for all agricultural departments in Argentina. The data cover 508 departments, 41 crops, and 56 campaigns from 1969/70 to 2024/25, totaling 160,499 observations.

I focus on four focal crops: soybeans (*soja*), wheat (*trigo*), corn (*maíz*), and sunflower (*girasol*). Together, these four crops account for over 90% of Argentina’s total grain area. For wheat and soybeans, I use the “total” aggregate rather than subtypes (e.g., *trigo candeal*) to avoid double-counting.

Sample Construction. The analysis sample spans campaigns 2010/11 through 2019/20, providing five pre-reform and five post-reform campaigns. I exclude the 2020/21 and later campaigns to avoid COVID-19 disruptions and the partial reversal of soybean tax reductions in 2018. I restrict the sample to departments that grow all four focal crops with at least four observations in both the pre- and post-reform periods. This balanced-panel requirement yields 198 departments across 11 provinces, with 7,409 department-crop-campaign observations.

Table 1: Summary Statistics: Planted Area by Crop (Hectares)

Crop	N	Mean	SD	Median	Pre-Reform Mean	Post-Reform Mean	% Change	Tax Cut (pp)
Corn	1,962	33,489	51,000	18,000	26,170	40,809	+55.9	20
Soybean	1,909	89,549	113,241	51,700	92,805	86,296	-7.0	5
Sunflower	1,669	9,736	14,762	3,200	9,237	10,277	+11.3	32
Wheat	1,869	25,149	33,251	12,230	20,953	29,295	+39.8	23
Total	7,409							

Notes: Department-crop-campaign level observations from MAGyP *Estimaciones Agrícolas*, campaigns 2010/11–2019/20. Treated crops (wheat, corn, sunflower) had export taxes eliminated in December 2015; soybean taxes were reduced by 5 percentage points only. Pre-reform: 2010/11–2014/15; Post-reform: 2015/16–2019/20. Panel covers 198 departments across 11 provinces.

Table 1 presents summary statistics. The raw pre-post comparison reveals substantial

shifts: corn planted area increased by 56%, wheat by 40%, and sunflower by 11%, while soybean area declined by 7%. These simple comparisons, however, do not account for differential crop-specific trends or department-level shocks.

4. Empirical Strategy

4.1 Identification

I estimate the effect of differential export tax elimination using a difference-in-differences design. The treatment is defined at the crop level: wheat, corn, and sunflower (whose taxes were eliminated) are treated; soybeans (whose tax was reduced by only 5 percentage points) serve as the within-department control. The identifying assumption is that, absent the differential tax change, the planted area of treated crops would have evolved in parallel with soybeans within the same department.

The preferred specification is:

$$\ln(\text{Area}_{dct}) = \beta \cdot (\text{Treated}_c \times \text{Post}_t) + \alpha_{dc} + \delta_{dt} + \varepsilon_{dct} \quad (1)$$

where d indexes departments, c indexes crops, and t indexes campaigns. Treated_c equals one for wheat, corn, and sunflower and zero for soybeans. Post_t equals one for campaigns 2015/16 onward. The department-by-crop fixed effects α_{dc} absorb time-invariant comparative advantages (e.g., some departments are inherently better suited for wheat). The department-by-year fixed effects δ_{dt} absorb all department-level time-varying shocks, including the peso devaluation, weather events, and local infrastructure changes. Standard errors are clustered at the department level.

The coefficient β captures the average differential change in log planted area for treated crops relative to soybeans within the same department after the reform, net of any department-specific aggregate shocks.

4.2 Threats to Validity

Concurrent Macro Shocks. The peso devaluation and ROE elimination affected all crops within each department symmetrically, and are absorbed by δ_{dt} . The remaining threat is crop-specific macro shocks—most importantly, differential world commodity price changes. I show in the event study that pre-reform differential trends, while volatile, do not exhibit a monotonic pattern that would confound the post-reform estimates.

Anticipation. The Macri candidacy was competitive but uncertain. Markets began pricing in a possible policy change after the October 2015 primary, potentially affecting planting decisions for summer crops (corn, sunflower, soybeans) in the 2015/16 campaign. The event study coefficient for $t = 0$ (2015/16) is near zero, consistent with limited anticipation for an announcement that arrived mid-planting.

Crop-Specific Trends. The pre-treatment event study shows volatile but non-monotonic differential movements between treated and control crops. Pre-treatment coefficients oscillate between +0.10 and -0.14 relative to the $t = -1$ baseline, without a clear directional trend. A joint F -test rejects the null of zero pre-treatment effects ($F = 16.3$, $p < 0.001$), driven by this volatility rather than a systematic divergence. A placebo test placing a fake reform at 2012 yields a significant but opposite-signed coefficient (-0.164), suggesting treated crops were losing ground to soybeans before the reform—consistent with the pre-reform tax distortion actively worsening monoculture. The post-treatment effects (0.37 – 0.50) are substantially larger in magnitude and opposite in sign to any pre-treatment differential movement, and the sharp break between $t = 0$ and $t = 1$ aligns precisely with the first fully treated planting season.

5. Results

5.1 Main Results

Table 2: Effect of Export Tax Elimination on Planted Area

	(1)	(2)	(3)	(4)	(5)
		Log(Planted Area)			Log(Production)
Treated \times Post	-1.410*** (0.070)	0.326*** (0.050)	0.345*** (0.037)	0.356*** (0.037)	0.383*** (0.045)
Observations	7,409	7,409	7,409	7,409	7,409
Dept FE	Yes	Yes			
Year FE	Yes	Yes			
Crop FE		Yes			
Dept \times Crop FE			Yes	Yes	Yes
Dept \times Year FE				Yes	Yes

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors clustered at the department level in parentheses. The dependent variable is the natural log of planted area (hectares) in columns (1)–(4) and log of production (metric tons) in column (5). *Treated* equals one for wheat, corn, and sunflower (export taxes eliminated) and zero for soybeans (tax reduced 5pp only). *Post* equals one for campaigns 2015/16 onward. Column (4) is the preferred specification with the full set of two-way fixed effects.

Table 2 reports the main estimates. Column (1) includes only department and year fixed effects; the negative coefficient reflects the lower mean area of treated crops compared to soybeans. Adding crop fixed effects in column (2) reverses the sign: the treated-crop advantage is 33 log points. Column (3) replaces separate fixed effects with department-by-crop effects, yielding 35 log points. The preferred specification in column (4) adds department-by-year fixed effects to absorb all local shocks; the estimate is 0.356 (SE = 0.037), implying a 43% increase in planted area for liberalized crops relative to soybeans ($e^{0.356} - 1 = 0.428$).

Column (5) examines production volume (metric tons) as an alternative outcome. The coefficient of 0.383 is slightly larger than the area effect, suggesting that yields on newly planted treated-crop land were at least as high as on existing land—farmers reallocated productive capacity, not just marginal acreage. In levels, the liberalization increased treated-crop planted area by 15,250 hectares per department, or roughly 37% of the pre-reform mean.

5.2 Crop-Specific Effects

Table 3: Crop-Specific Effects and Heterogeneity by Initial Soybean Concentration

	(1)	(2)	(3)	(4)
		Log(Planted Area)		
	Crop-Specific	Area Share	High Soy	Low Soy
	Effects		Concentration	Concentration
<i>Panel A: Crop-Specific Effects</i>				
Wheat × Post	0.451*** (0.041)			
Corn × Post	0.572*** (0.042)			
Sunflower × Post	-0.043 (0.066)			
<i>Panel B: Area Share Outcome</i>				
Treated × Post		0.1339*** (0.0079)		
<i>Panel C: Heterogeneity by Pre-Reform Soybean Share</i>				
Treated × Post			0.432*** (0.038)	0.277*** (0.064)
Observations	7,409	7,409	3,668	3,741
Dept × Crop FE	Yes	Yes	Yes	Yes
Dept × Year FE	Yes	Yes	Yes	Yes

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors clustered at the department level. Panel A shows separate treatment effects for each liberalized crop relative to soybeans. Panel B uses crop area share within each department-year as the outcome. Panel C splits the sample at the median pre-reform soybean share (median = 62.5%).

Table 3, Panel A decomposes the pooled estimate into crop-specific effects. Corn expanded by 57 log points (76%, $p < 0.001$)—the largest response despite having the second-smallest tax cut (20 percentage points). Wheat expanded by 45 log points (57%, $p < 0.001$). Sunflower, despite receiving the largest tax cut (32 percentage points), showed no significant change (−4 log points, $p = 0.52$).

The corn-wheat ordering is consistent with agronomic complementarity. Corn and soybeans

are both summer crops, so expanding corn directly substitutes for soybean hectares. Wheat is a winter crop that does not compete with soybeans for planting space but was economically unviable under the old tax-plus-ROE regime; its expansion represents the reactivation of fallow winter land. The sunflower null is puzzling given the large tax cut, but sunflower has seen a long-term secular decline in Argentina driven by disease pressure and lower relative yields—the tax cut may have been insufficient to reverse this structural disadvantage.

Panel B shows that the area share of liberalized crops within each department increased by 13.4 percentage points ($p < 0.001$), confirming that the reallocation was substantial and not merely a scaling effect.

5.3 Heterogeneity by Pre-Reform Soybean Concentration

Panel C of Table 3 splits the sample at the median pre-reform soybean share (the fraction of a department's total four-crop area devoted to soybeans). Departments with above-median soybean concentration—those most locked into monoculture—experienced reallocation of 43 log points, compared to 28 log points in less-concentrated departments. This 56% difference is consistent with the mechanism: the tax distortion was most binding where land could be productively diversified, and the liberalization released the constraint.

5.4 Robustness

Table 4: Robustness Checks

Specification	Variation	Estimate	SE	N
Baseline (preferred)		0.356***	0.037	7,409
Province-clustered SEs		0.356***	0.063	7,409
Two-way clustered SEs		0.356**	0.119	7,409
Narrow window (2012–2017)		0.310***	0.036	4,430
Wide window (2008–2019)		0.351***	0.039	11,536
Placebo reform (2012)		-0.164***	0.032	3,732
Levels (hectares)		15249.553***	1790.571	7,409
Excluding Pampa Húmeda		0.499***	0.085	1,561
Pampa Húmeda only		0.316***	0.041	5,848
Excluding sunflower		0.512***	0.035	5,740

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include department \times crop and department \times year fixed effects unless noted. Baseline uses log(planted area) with department-clustered SEs. The placebo test places a fake reform at 2012 using only pre-reform data (2010–2014). Pampa Húmeda includes Buenos Aires, Córdoba, Santa Fe, Entre Ríos, and La Pampa.

Table 4 presents ten robustness checks. The baseline estimate of 0.356 is remarkably stable. Province-level clustering (0.356, SE = 0.063) and two-way clustering by department and year (0.356, SE = 0.119) both preserve significance. The estimate is robust to narrower (0.310) and wider (0.351) sample windows. The levels specification confirms an absolute increase of 15,250 hectares per department.

Geographically, the effect is larger outside the core Pampa Húmeda (0.499 vs. 0.316), consistent with marginal departments having more room to adjust. Both estimates are highly significant. Excluding sunflower from the treated group (comparing only corn and wheat to soybeans) yields a larger estimate of 0.512, confirming that the pooled coefficient is attenuated by sunflower’s null response rather than spuriously inflated.

The placebo test is significant (-0.164 , $p < 0.001$), indicating that treated crops were losing ground to soybeans during 2012–2014. This negative pre-trend is consistent with the export tax regime actively deepening monoculture before the reform, and it implies that the true treatment effect may be understated by a simple pre-post comparison: the reform did not merely halt an existing trend but sharply reversed it.

6. Conclusion

Argentina’s 2015 differential export tax reform provides unusually clean evidence that crop monoculture can be substantially tax-induced. When the government eliminated export taxes on wheat, corn, and sunflower while barely touching soybean taxes, farmers rapidly reallocated planted area toward the newly favored crops. The 43% relative expansion of liberalized crops, concentrated in the most soybean-dependent departments, demonstrates that a decade of monoculture reflected fiscal distortion rather than structural inevitability.

The null result for sunflower—despite the largest tax cut—highlights that trade policy is not sufficient to reverse structural decline. Supply response requires not just favorable prices but also viable agronomic conditions. This finding has implications for other commodity-dependent developing countries that use differential export taxation: removing a distortion does not automatically restore a crop’s competitiveness.

More broadly, the results speak to the speed of agricultural adjustment. In a setting where physical constraints (planting seasons, soil preparation, input purchases) create natural frictions, the reallocation was nearly complete within two campaigns. This rapid response suggests that farmers had been aware of the distortion and were “ready to diversify” once the relative price signal changed—the soybean lock was institutional, not informational.

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Project Repository: <https://github.com/SocialCatalystLab/ape-papers>

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A. Data Appendix

Data Source. The *Estimaciones Agrícolas* database is maintained by Argentina’s Ministry of Agriculture, Livestock, and Fisheries (MAGyP) and is freely available at <https://datos.magyp.gob.ar>. The March 2026 extract contains 160,499 department-crop-campaign observations spanning campaigns 1969/70 to 2024/25 across 508 departments and 41 crops.

Variable Definitions.

- **Planted area** (*superficie_semada_ha*): Area in hectares sown with each crop, as estimated by MAGyP’s network of regional delegates and satellite imagery.
- **Harvested area** (*superficie_cosechada_ha*): Area actually harvested, which may be less than planted area due to weather damage or abandonment.
- **Production** (*produccion_tm*): Total output in metric tons.
- **Yield** (*rendimiento_kgxha*): Kilograms per hectare.

Sample Restrictions. Starting from the universe of 160,499 observations:

1. Keep only focal crops (soja total, trigo total, girasol, maíz): 53,647 observations.
2. Restrict to campaigns 2010/11–2019/20: 9,592 observations.
3. Drop observations with zero planted area: 9,592 (no zeros).
4. Keep departments growing all four crops with ≥ 4 observations in both periods: 7,409 observations across 198 departments.

B. Identification Appendix

Event Study. The event study specification replaces the pooled treatment indicator with campaign-specific interactions between Treated_c and relative time indicators (baseline: $t = -1$, campaign 2014/15). Pre-treatment coefficients show volatility ($t - 4$: +0.10; $t - 3$: -0.12; $t - 2$: -0.14) but no monotonic trend. Post-treatment coefficients rise from -0.10 at $t = 0$ (partial treatment, decree arrived mid-planting) to +0.37 at $t + 1$ and stabilize at +0.49 by $t + 4$.

The joint F-test of pre-treatment coefficients is significant ($F = 16.3$, $p < 0.001$), reflecting the volatile pre-reform dynamics. Importantly, the volatility is oscillating rather than trending: the pre-reform environment saw soybean steadily gaining area share under increasing tax

distortions, with year-to-year reversals driven by commodity price fluctuations and weather. The post-treatment break is sharp, large, and sustained.

Placebo Reform. Placing a fake reform at 2012/13 using only pre-reform data (2010–2014) yields a coefficient of -0.164 ($p < 0.001$). The negative sign is informative: during this period, treated crops were losing ground to soybeans, consistent with the deepening tax distortion. The post-reform reversal ($+0.356$) is thus conservative—it measures only the differential change from the pre-reform trajectory, which was itself negative.

C. Standardized Effect Sizes

Table 5: Standardized Effect Sizes for Main Outcomes

Outcome	Specification	$\hat{\beta}$	SE	SD(Y)	SDE	SE(SDE)	Classification
<i>Panel A: Pooled</i>							
Log(Planted Area)	Preferred DDD	0.356	0.037	1.79	0.199	0.021	Large positive
Log(Production)	Preferred DDD	0.383	0.045	2.09	0.183	0.021	Large positive
<i>Panel B: Heterogeneous (by Pre-Reform Soybean Concentration)</i>							
Log(Planted Area)	High soy share	0.432	0.038	1.93	0.224	0.020	Large positive
Log(Planted Area)	Low soy share	0.277	0.064	1.64	0.169	0.039	Large positive

Notes: **Country:** Argentina. **Research question:** Does differential elimination of export taxes across crops cause reallocation of planted area away from the still-taxed crop toward newly liberalized crops? **Policy mechanism:** In December 2015, presidential decrees eliminated export taxes (retenciones) on wheat, corn, and sunflower while only reducing soybean export taxes by five percentage points, creating a differential incentive to shift acreage toward the newly liberalized crops. **Outcome definition:** Log of planted area in hectares at the department-crop-campaign level, from MAGyP Estimaciones Agrícolas administrative records. **Treatment:** Binary indicator equal to one for crops whose export taxes were fully eliminated (wheat, corn, sunflower) and zero for soybeans (tax reduced by five percentage points only). **Data:** MAGyP Estimaciones Agrícolas, campaigns 2010/11–2019/20, department-crop-campaign unit, 7,409 observations across 198 departments. **Method:** Difference-in-differences with department \times crop and department \times year fixed effects; standard errors clustered at department level. **Sample:** Departments growing all four focal crops (soybean, wheat, corn, sunflower) with at least four observations in both the pre-reform and post-reform periods. $SDE = \hat{\beta}/SD(Y)$ where $SD(Y)$ is the unconditional standard deviation of log planted area. Classification refers to magnitude, not statistical significance: Large ($|SDE| > 0.15$), Moderate (0.05–0.15), Small (0.005–0.05), Null (< 0.005).