

The Dynamic Welfare Effects of Export Restrictions

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Presenting at the EEA Conference

August 26th 2025

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 - **Include the most land intensive activity: cattle raising**

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 - Panel of beef imports of the European Union (1988-2023, 91 countries)

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 - Dynamics: Cattle ranchers as capital appreciators Rosen et al. (1994) [detail](#)

Parametrization

Parameter	Concept	Value	Source
θ	Supply Elasticity	2.116	Dominguez-lino (2021)
σ	Demand Elasticity Home	7.851	time-series IV
η	Demand Elasticity Foreign	2.825	panel IV
r	Real Interest Rate	0.01	
a_{xt}^*, a_{xt}, a_{yt}	Demand Shock	–	inversion
Z_{ait}, Z_{xit}	Productivity Shock	–	inversion

- Validation: FAO productivity, agricultural stylized facts full

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Welfare definition:

- Sectors: Value Added
- Consumers: Compensating Variation

[formulas](#)

Conclusion

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- Results
 - Underscore the need for clean redistributive tools (taxes, transfers)
 - May explain why the policy is usually short-lived

Thank You

Thank you!

Merci!

comments: jusebfer@umich.edu

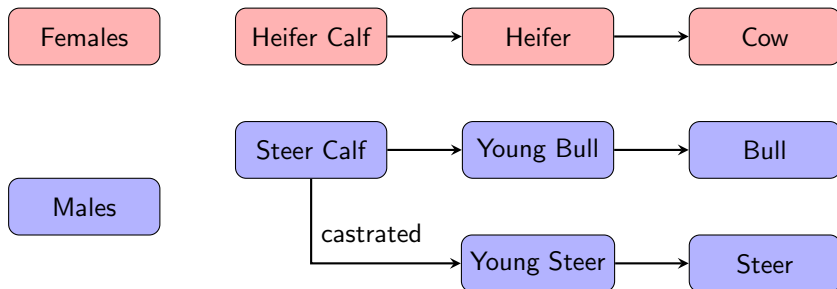
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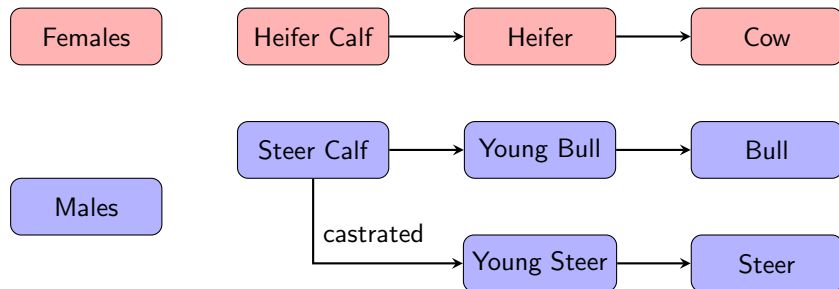
- 1 April 2006 180 ban on all beef exports
 - Few exceptions: very high value shipments to the EU (Hilton quota)
- 2 June 2006-2008 back and forth measures
- 3 2008-2015 Red Export Operation Registry “*ROE Rojo*”

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The Biology of Cattle



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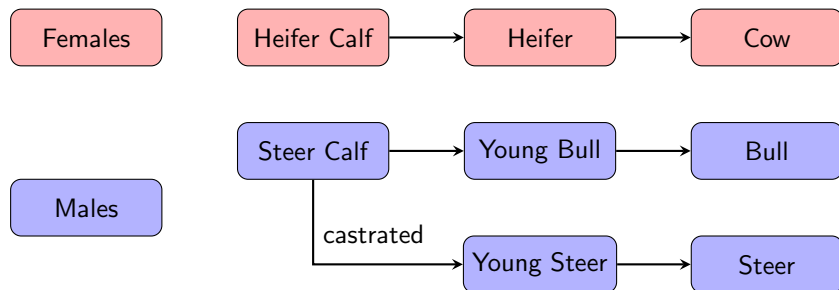


From now on:

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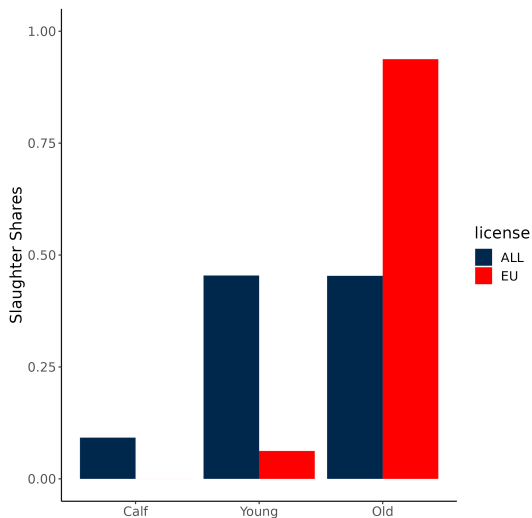
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Fact #1 EU Buys Old Variety ...

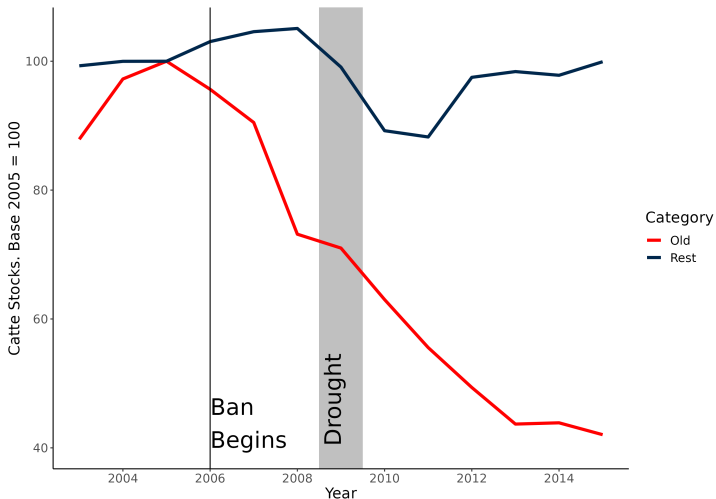
EU export licensing overwhelmingly in old variety (92%)



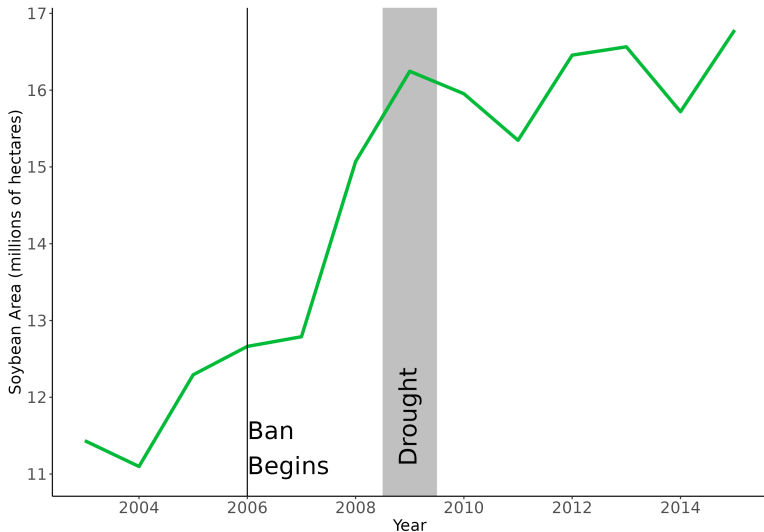
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Fact #1 ... Stocks Collapse ...

Starting 2006, a strong fall in stocks of old



Fact #2 ... Soybeans Expand



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	DV: Old Stock		
Soybean Area	0.0065*** (0.004)	-0.214*** (0.008)	-0.171*** (0.007)
Obs	2861	2861	2861
R squared	0.082	0.834	0.859
County FE	NO	YES	YES
Time FE	NO	NO	YES

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- In counties where soybeans expanded, old stock fell
- Substitutability

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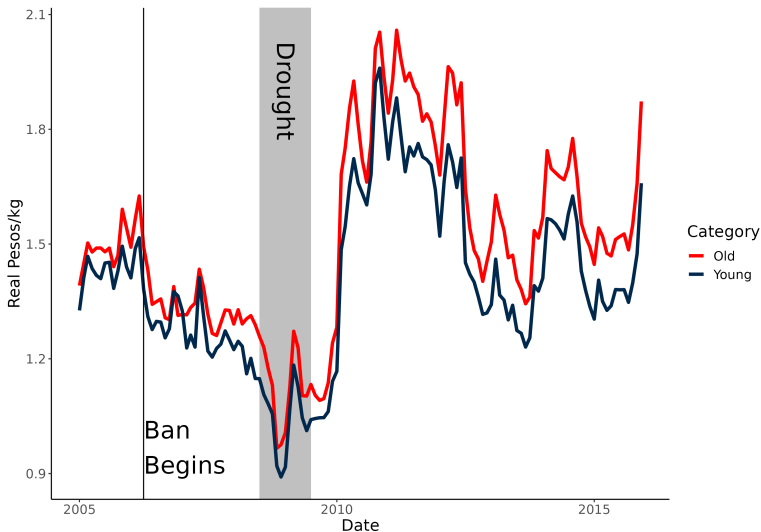
#3 Prices Uncorrelated with Market Access across Space

DV: (log)Price per Live Kg Old

distance port	0.003 (0.014)			
export share		-0.139 (0.108)		
export share EU			0.058 (0.042)	
population density				-0.011 (0.005)
Obs	2,592,243	367,950	2,638,713	2,588,903
R squared	0.897	0.361	0.882	0.887
cluster	county	county	county	county
breed FE	YES	YES	YES	YES
category FE	YES	YES	YES	YES
time FE	YES	YES	YES	YES

[back](#)

Fact #3 ... Correlated Across Time



Model: Supply

- Supply of young in county i is given by an endowment K_{yit}

back

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[back](#)

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back

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back

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 - Within each county i continuum of plots indexed by ω with productivity of option j at moment t $\zeta_{jit}(\omega)$
 - Option 1: soybeans. Grow soybeans today and get today's price (static)
 - Option 2: cattle. Buy young today and sell old tomorrow (dynamic)

back

Model: Firm FOC

- Ranchers as capital appreciators
 - (expected) revenue is the product of (expected) price appreciation and cattle per plot (productivity)

$$\underbrace{\left(\frac{P_{x'}}{1+r} - P_y \right)}_{\text{expected appreciation}} \underbrace{\zeta_{xi}(\omega)}_{\text{cattle per plot= cattle productivity}} > \underbrace{P_a \zeta_{ai}(\omega)}_{\text{agricultural revenue}} \quad (1)$$

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Microfoundation Rosen (1987): holding cost as opportunity cost of the land.

$$\left(\frac{P'}{1+r} - P\right) > H \quad (2)$$

$$\left(\frac{P_{x'}}{1+r} - P_y\right) > \frac{P_a \zeta_{ai}(\omega)}{\zeta_{xi}} \quad (3)$$

Model: County aggregation

- Assume ζ_{jit} distributed Fréchet $F(Z_{jit}, \theta)$
 - Provides upward-sloping supply curve [full formulas](#)
- Z_{jit} governs average productivity of county i in use j in moment t
- θ governs dispersion of productivity within each county \Rightarrow supply elasticity

Expectations

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- Rest: random walk

Model: Market Clearing and Equilibrium

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 - Home and Foreign maximize utility, firms maximize profits, and markets clear.

Model: Demand

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- Home: CES between categories x (old) and y (young) with fixed cattle expenditure m_t (upper Cobb-Douglas nest)

$$U_t(C_{xt}, C_{yt}) = \left((a_{xt})^{\frac{1}{\sigma}} C_{xt}^{\frac{\sigma-1}{\sigma}} + (a_{yt})^{\frac{1}{\sigma}} C_{yt}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad (4)$$

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Model: Market Clearing

Market Clearing:

- Total national capital is the sum of capital in all plots and counties
- Old must be consumed today
- Unconsumed young today become old tomorrow

$$K_{x,t+1} = \sum_i \int k_{x,i,t+1}(\omega) d\omega \quad (6)$$

$$K_{x,t} = C_x(P_{x,t}, P_{y,t}) + C_x^*(P_{x,t}) \quad (7)$$

$$K_{x,t+1}(E_t P_{x,t+1}, P_{y,t}) = K_{y,t} - C_y(P_{x,t}, P_{y,t}) \quad (8)$$

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 - markets clear

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1 Productivity

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2 Price expectations highly correlated with realized prices [graph](#)

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Inversion

- 1 Guess an arbitrary expected productivity
- 2 Given $K_{x,t+1}$ use the model to compute $E_t P_{x,t+1}$ as the saddle path price.
- 3 For each i find Z_{xit} such that

$$K_{x,i,t+1} = \frac{\left(\frac{E_t P_{x,t+1}}{1+r} - P_{y,t}\right)^{\theta-1} Z_{xit}^{\theta}}{\left([P_{at} Z_{ait}]^{\theta} + \left[\left(\frac{E_t P_{x,t+1}}{1+r} - P_{y,t}\right) Z_{xit}\right]^{\theta}\right)^{\frac{\theta-1}{\theta}}} \quad (9)$$

- 4 If average productivity equals guessed average productivity, stop. Else, guess that expected productivity is average productivity

key: **parameter**, **model object**, **variable to invert**, data

theta

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Inversion: Demand

- Home: Dividing the CES demands, the price level and expenditure cancel out. Normalizing $a_{st} = 1$

$$a_{st} = \left(\frac{C_{St}}{C_{st}} \right)^{\frac{1}{\sigma}} \left(\frac{P_{St}}{P_{st}} \right) \quad (10)$$

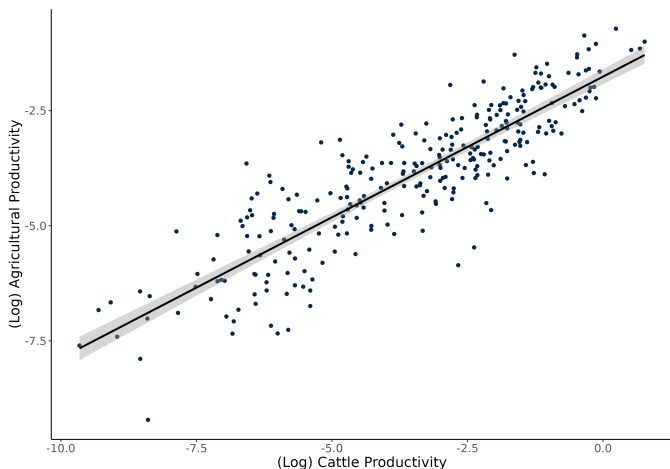
- Foreign: If t does not have export restrictions:

$$a_{St}^* = C_{St}^* (P_{St})^{\eta} \quad (11)$$

key: **parameter**, **model object**, **variable to invert**, data [back](#)

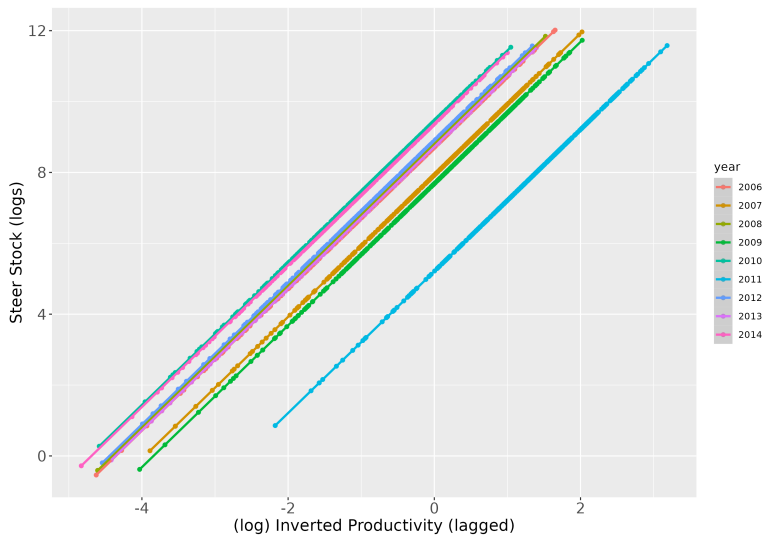
Inversion: Space

Land that is good for soybeans is also good for cattle



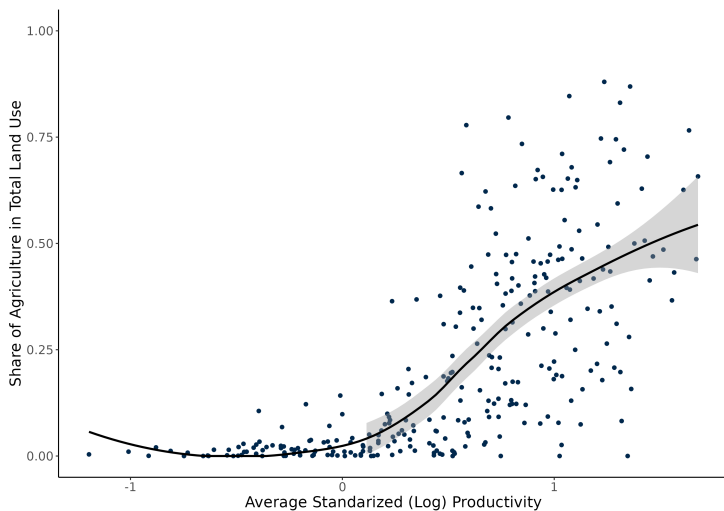
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Inversion: Supply



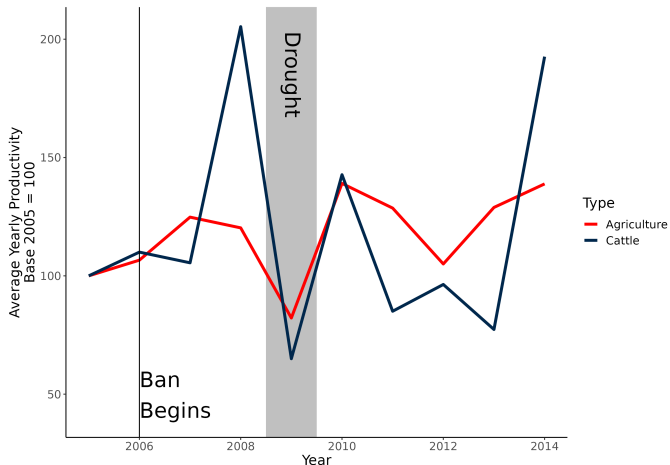
Productivity Inversion: Space

Good land goes to agriculture

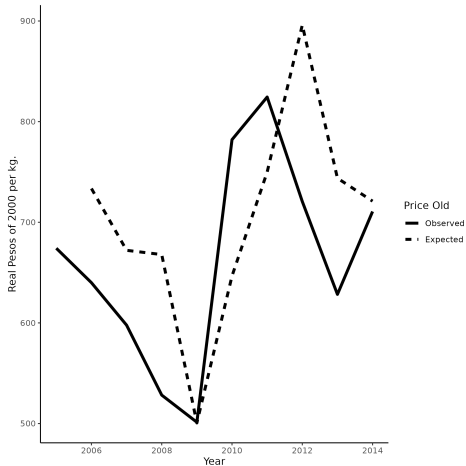


Productivity Inversion: Time

Productivity falls abruptly during the drought 2009

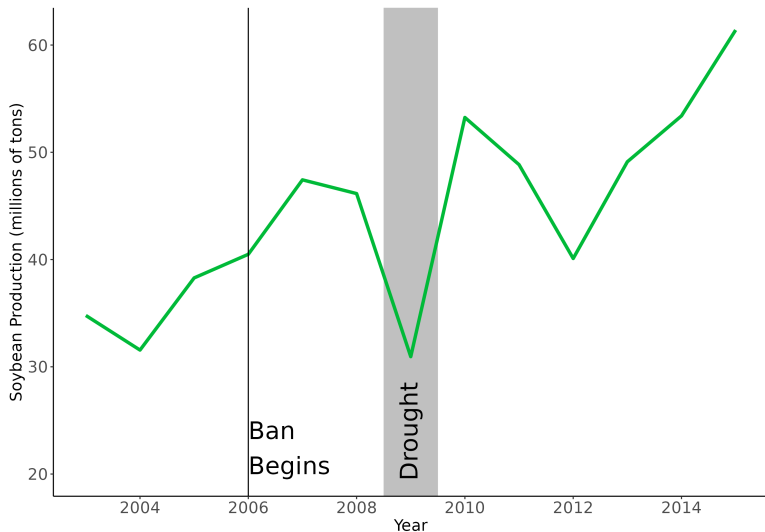


Expected Prices



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Soybean boom



Why perfect competition?

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Model: Supply

- Assuming Fréchet productivity $\zeta_{jit} \sim F(Z_{jit}, \theta)$, the county supply has a closed form solution:

$$K_{x,i,t+1} = \frac{\left(\frac{E_t P_{x,t+1}}{1+r} - P_{y,t}\right)^{\theta-1} Z_{xit}^{\theta}}{\phi_{it}^{\frac{\theta-1}{\theta}}} \quad (12)$$

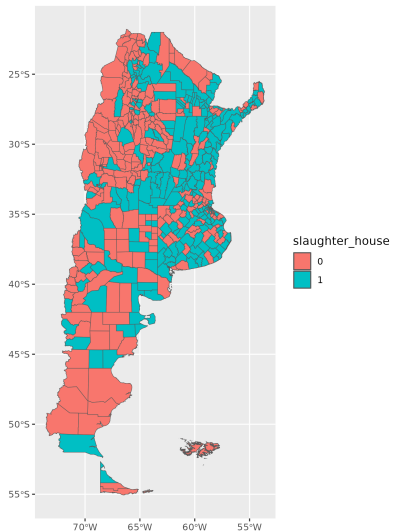
$$Q_{a,i,t+1} = \frac{(P_{at})^{\theta-1} Z_{ait}^{\theta}}{\phi_{it}^{\frac{\theta-1}{\theta}}} \quad (13)$$

where

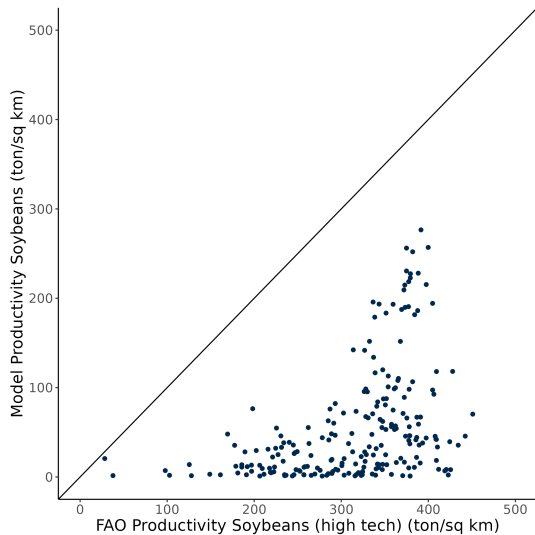
$$\phi_{it} = [P_{at} Z_{ait}]^{\theta} + \left[\left(\frac{E_t P_{x,t+1}}{1+r} - P_{y,t} \right) Z_{xit} \right]^{\theta} \quad (14)$$

back

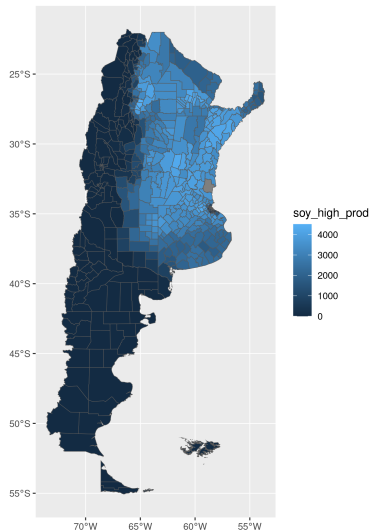
Spatial Distribution of Slaughterhouses



Productivity Model vs Data

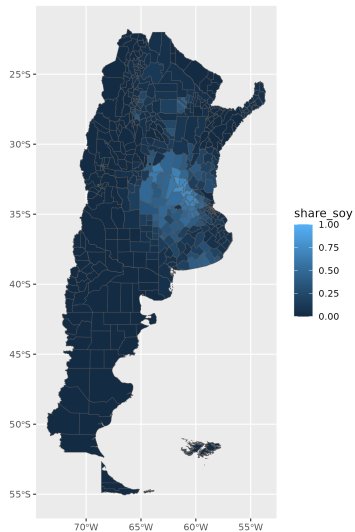


FAO Productivity Map



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Soybean Share Map (2015)



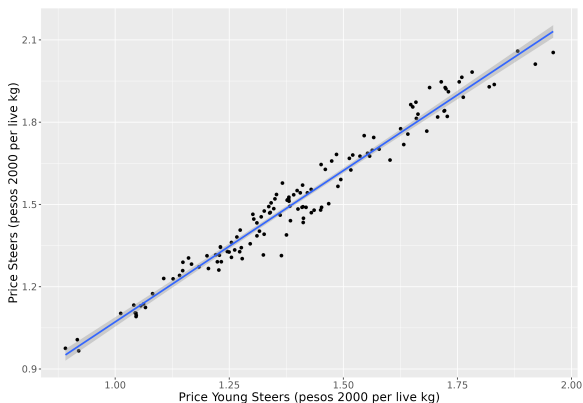
$$\ln \frac{C_{xt}}{C_{yt}} = -\sigma \ln \frac{P_{xt}}{P_{yt}} + \sigma \ln \frac{a_{xt}}{a_{yt}} \quad (15)$$

DV: log relative quantities old/young

(log) relative price	4.850*	-7.851*	-4.474	-11.147
	(2.323)	(3.189)	(12.867)	(76.790)
Instrument	OLS	log exports	RER	relative rain
Obs	19	9	10	19
F first stage	N/A	41.11	1.53	0.055

Aadland (2004)

- demand old/young as two AR(1) with contemporaneous correlation σ
- $\sigma = 0.77$



Foreign's Demand Elasticity η

Foreign has CES Preferences over beef coming from destinations c

$$\sum_c (a_{ct}^*)^{\frac{1}{\eta}} q_{ct}^{\frac{\eta-1}{\eta}} \quad (16)$$

Assuming supply iso elasticity and differencing with time and country:

$$Y_{ct} = \theta_0 + \theta_1 X_{1ct} + \theta_2 X_{2ct} + u_{ct} \quad (17)$$

Where

$$Y_{ct} \equiv (\Delta^c \ln p_{ct})^2 \quad (18)$$

$$X_{1ct} \equiv (\Delta^c \ln s_{ct})^2 \quad (19)$$

$$X_{2ct} \equiv (\Delta^c \ln s_{ct}) (\Delta^k \ln p_{ct}) \quad (20)$$

Foreign's Demand Elasticity η

θ_1, θ_2 can be used to obtain η :

$$\rho = \begin{cases} \frac{1}{2} + \sqrt{\frac{1}{4} - \frac{1}{4 + \frac{\theta_2^2}{\theta_1}}} & \text{if } \theta_2 > 0 \\ \frac{1}{2} - \sqrt{\frac{1}{4} - \frac{1}{4 + \frac{\theta_2^2}{\theta_1}}} & \text{if } \theta_2 < 0 \end{cases} \quad (21)$$

$$\eta = 1 + \frac{2\rho - 1}{1 - \rho} \frac{1}{\theta_2} > 1 \quad (22)$$

Foreign's Demand Elasticity η

Parameter	θ_0	θ_1	θ_2	η
Estimate	0.072	0.117	-0.371	2.825
S.E	(0.088)	(0.017)	(0.178)	(0.475)
95% C.I.	[-0.101, 0.245]	[0.082, 0.151]	[-0.719, -0.024]	[2.169, 3.974]
Countries		115		
Obs		1,158		

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Countries		115		
Obs		1,158		

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Value Added per sector:

- Young : $P_{yt} K_{yt}$
- Old: $(P_{xt} - P_{y,t-1}(1 + r)) K_{xt}$
- Agriculture: $P_{at} Q_{at}$

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Value function

- ζ productivity
- k firm cattle stock
- P price

$$v [k_{xi}(\omega), \zeta_{xi}(\omega), \zeta_{ai}(\omega)] =$$

value of a plot =

Value function

- ζ productivity
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$$v [k_{xi}(\omega), \zeta_{xi}(\omega), \zeta_{ai}(\omega)] = \\ P_x k_{xi}(\omega)$$

value of a plot =
value of old +

Value function

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$$v [k_{xi}(\omega), \zeta_{xi}(\omega), \zeta_{ai}(\omega)] =$$

$$P_x k_{xi}(\omega)$$

$$+ \max \left\{ P_a \zeta_{ai}(\omega) + \frac{1}{1+r} v [0, \zeta'_{xi}(\omega), \zeta'_{ai}(\omega)], \right.$$

value of a plot =

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$$\left. - P_y \zeta_{xi}(\omega) + \frac{1}{1+r} v [\zeta_{xi}(\omega), \zeta'_{xi}(\omega), \zeta'_{ai}(\omega)] \right\}$$

value of a plot =

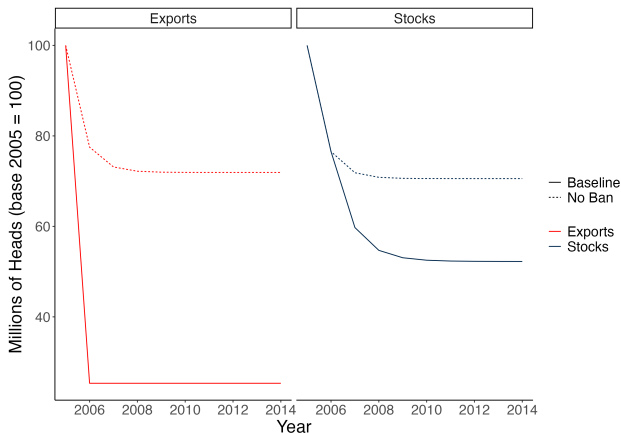
value of old +

value of agriculture or

cattle raising

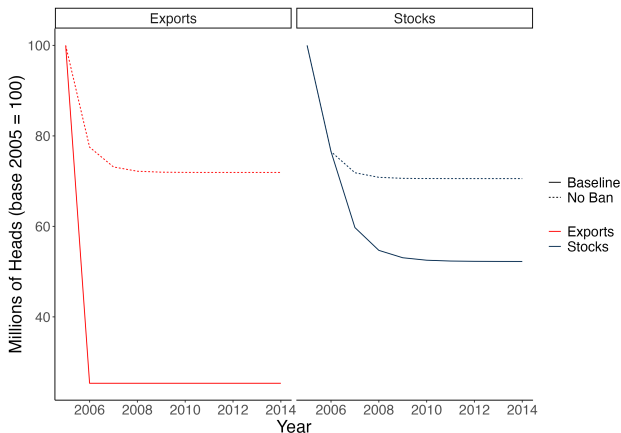
back

Counterfactual Ex Ante: Stocks and Exports



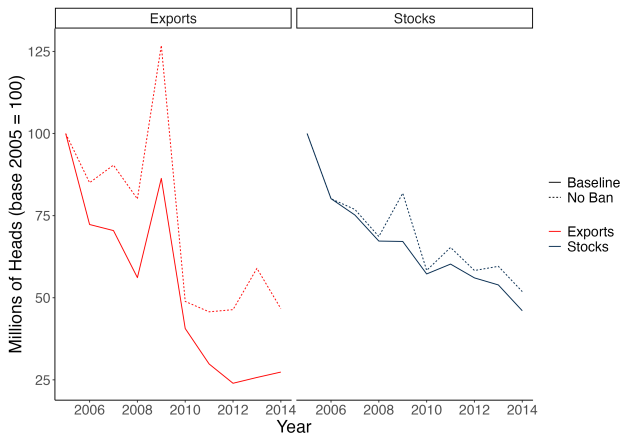
- Steady state had lower stocks and exports (soybean expansion)

Counterfactual Ex Ante: Stocks and Exports



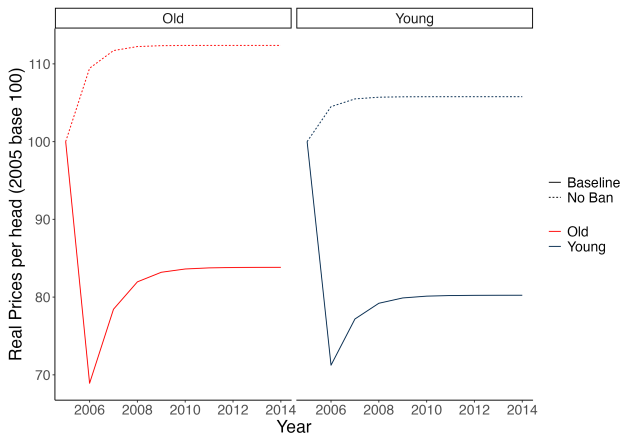
- Steady state had lower stocks and exports (soybean expansion)
- 75% reduction in exports \Rightarrow 20% reduction in stocks

Counterfactual Ex Post: Stocks and Exports



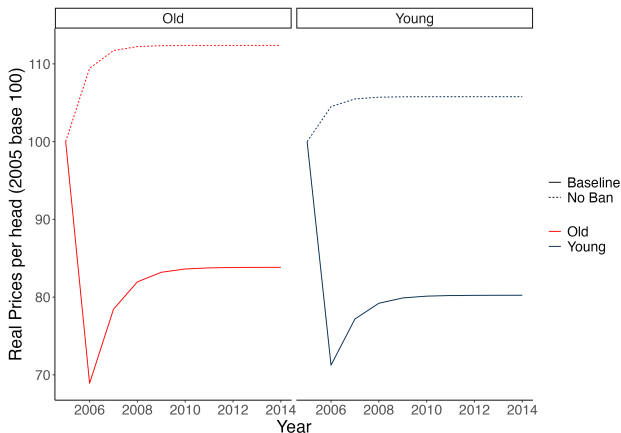
- Exports still fall under no ban
- Stocks do not change much

Counterfactual Ex Ante: Prices



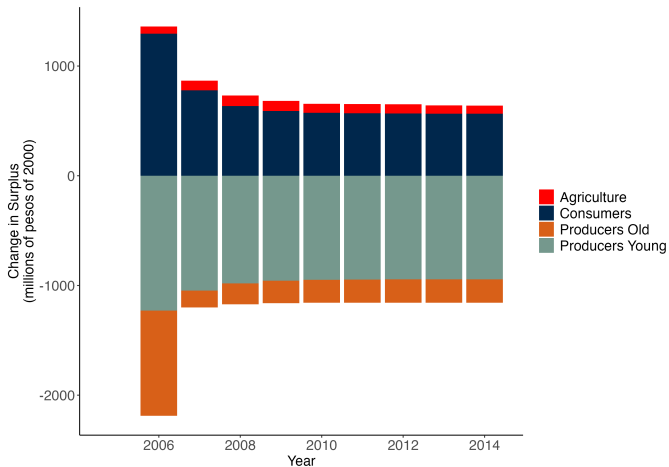
- Steady state had higher prices (soybean boom)

Counterfactual Ex Ante: Prices



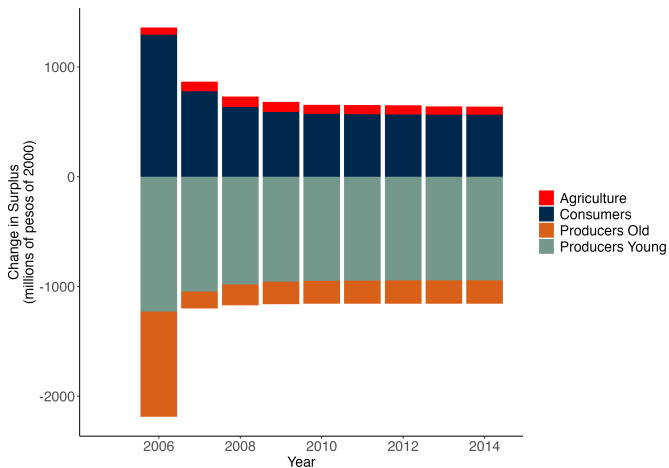
- Steady state had higher prices (soybean boom)
- Ban strongest on impact and on export variety

Counterfactual Ex Ante: Welfare



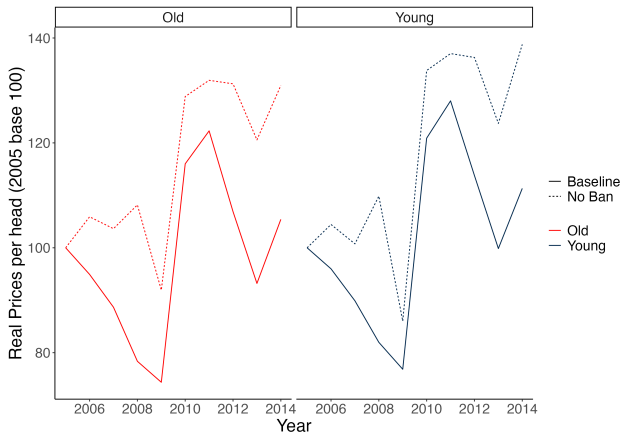
- Producers of export varieties hurt in the very short run

Counterfactual Ex Ante: Welfare



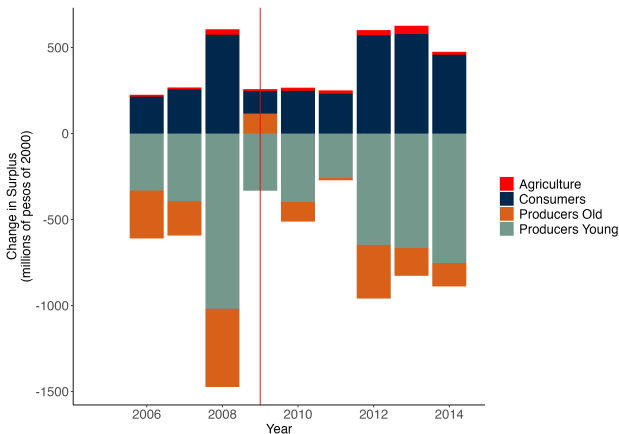
- Producers of export varieties hurt in the very short run
- Consumer gains dwindle as time passes

Counterfactual Ex Post: Prices



- Similar dynamic (drought)
- Higher levels, less difference immediately post drought

Counterfactual Ex Post: Welfare



- Drought first order 2009-11
- Larger effect as the restrictions became more strict

Table: Welfare Changes, in millions of 2000 pesos

Sector	Welfare Effect
Agriculture	198
Consumers	3267
Producers Old	-1552
Producers Young	-4802
DWL	2889

- Slower implementation of the ban and drought dampens magnitude

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Counterfactual Ex Post: Total

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Counterfactual Ex Post: Total

Table: Welfare Changes, in millions of 2000 pesos

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Producers Young	-8944
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- Most redistribution coming from producers of domestic varieties

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ex post