Does Trade Discipline Buyer Conduct?
Evidence from Uruguayan Meatpacking Firms *

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Abstract

Trade in an input can discipline domestic buyer power through the input's cost, even without direct competition. I ask whether this discipline works through prices alone or also through firms' conduct. In Uruguayan meatpacking, Turkey buys feeder cattle upstream of the packers. Its sharp cut in purchases between 2013 and 2015 lowered the packers' cattle costs, a natural experiment I use to structurally separate the cost effect from a change in conduct. As their margin widened, meatpackers internalized their rivals more and widened markdowns, so cattle prices fell by more than costs alone, mainly a transfer from ranchers to meatpackers. Because conduct responds to trade, restricting raw-input exports can widen processors' margins and strengthen their buyer power. **Keywords: Buyer Market Power, Firm Conduct, Meat-Packing Industry. JEL Classification**: L13, L40, C51.

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1 Introduction

Buyer power is common in input markets (Morlacco, 2019; Prager and Schmitt, 2021; Rubens, 2023).[1] Trade is a natural check on this, even when the foreign buyer buys at a different point in the chain and never competes for the input directly. Beyond the price, firms' conduct can also respond. If foreign demand recedes and the margin widens, domestic firms might exercise more buyer power in addition to paying a lower price. I ask whether trade disciplines buyer power through conduct as well as through prices.

To tell the two apart, I study the Uruguayan meatpacking industry between 2011 and 2019, a concentrated market that exports about three-quarters of what it produces. One stage above the meatpackers, Turkey has since 2010 been the dominant foreign buyer of Uruguayan feeder cattle, the animals ranchers fatten into the livecattle meatpackers buy.[2] Between 2013 and 2015 Turkey sharply cut these purchases for reasons internal to its own policy, and the fall in cattle prices prompted an antitrust investigation. The industry also consolidated over this period, letting me weigh the transitory trade shock against a permanent change in structure.

I ask three questions. First, does buyer conduct respond to trade, or does the cheaper input explain the whole fall in cattle prices? Second, what does this do to total surplus, and who gains and who loses? Third, how does keeping raw-input exports open compare with merger control as a lever for protecting suppliers?

Preliminary evidence shows part of this. When Turkey buys less feeder cattle, feeder prices fall and the livecattle that packers buy gets cheaper, even after controlling for other demand and supply factors. What the data cannot show is whether firms also changed conduct, since the same episode lowers prices mechanically. To separate the two I estimate a structural model with three parts. The first is domestic demand for meat at the wholesale level, with exports sold at a price Uruguay takes as given. The second is an upward-sloping supply of livecattle over which meatpackers exercise oligopsony power. The third is conduct, a parameter λ measuring how much each firm internalizes its rivals' purchases, which I let respond to trade (Turkey) and to consolidation (mergers). For a merger, λ captures the coordinated response only. I identify conduct from an instrument built on the slaughter performance of distant rival plants -persistent productivity differences that shift rivals'

[1] In this aspect, competition agencies have responded increasing their enforcement and awareness in these markets. For example, a preliminary draft of DOJ/FTC merger guidelines now includes labor market provisions (DOJ and FTC, 2023). For a global perspective, see United Nations Conference on Trade and Development (2023).

[2] To clarify, breeders raise calves until they become feeder cattle-defined as recently weaned calves and not ready for slaughter-, which can be considered an input good. This is then purchased by ranchers, which fatten the cattle until ready for slaughter. Once ready it is called livecattle (an intermediate good). This is finally purchased by meatpacking plants to produce meat products (a final good). More detail in Section 2.

quantities without affecting a firm's own cost- so how much a firm cuts its own purchases in response reveals its conduct. Turkey's imports and the timing of consolidation then identify how conduct responds to each. I use the model for two counterfactuals. The first separates the input-cost and conduct effects of the Turkey shock. The second compares the Turkey conduct effect with the effect of consolidation.

Buyer conduct does respond to trade. The coefficient on Turkey's imports is negative and significant. When Turkey buys less, meatpackers internalize their rivals' purchases more and pay further below cattle's competitive value. Consolidation enters in two ways. First, it changes ownership directly, so a firm fully internalizes the plants it acquires. This unilateral effect is mechanical. Second, it can raise conduct toward the remaining rivals, which the coefficient on λ captures. This is the coordinated effect. The estimate is not distinguishable from zero. Including both merger channels means the trade effect is estimated holding market structure fixed. During the low-import episode, meatpackers paid about 11.91% below cattle's competitive value, against 4.92% under non-cooperative pricing. Internalization runs on a 0-to-1 scale, where 1 is full internalization of rivals. Its baseline level is 0.121, and a one-standard-deviation fall in Turkey's monthly imports, about 3,000 tonnes, raises it by roughly 0.025. A conduct test rejects non-cooperative (Nash) oligopsony in favor of the internalization model.

In welfare terms, this response is mainly a transfer from ranchers to meatpackers. The decomposition splits the fall in cattle prices into a cost effect -cheaper cattle at unchanged conduct- and a conduct effect, the additional markdown firms impose. The cost effect raises total surplus, though not every agent gains. Meatpackers buy more, and total surplus would have risen by about 0.581%, a modest efficiency gain from cheaper cattle. The conduct effect works the other way and mostly redistributes. Firms restrict purchases, push cattle prices lower still, and capture about $35 million of the saving, roughly what ranchers lose, so it stays with meatpackers rather than reaching ranchers and total surplus barely moves.

The trade channel and the merger act on the same buyer-power margin, but they are not of comparable size. Turkey's competition for feeder cattle disciplines conduct. It raises livecattle prices by about 1.8% and rancher surplus by roughly $300 million. The permanent consolidation moves both the other way by about -0.3% and $-\$53$ million, roughly a fifth as much. I do not model the decision to merge, only what the observed ownership change did to the price ranchers receive. For ranchers, keeping the input-export market open is the larger lever. A common policy restricts raw-input exports to build domestic processing, usually through export taxes that fall more heavily on the unprocessed good (Piermartini, 2004; Bouët *et al.*, 2014). My results suggest such a restriction would strengthen processor buyer power, working against ranchers rather than for them.

My paper relates to two literatures. The first documents buyer power in input and labor markets (Morlacco, 2019; Yeh *et al.*, 2022; Rubens, 2023), adapting the production approach to markup estimation (Loecker and Warzynski, 2012; De Loecker *et al.*, 2016) to the buying side. Closest to me, Huang (2022) studies the US meatpacking cartel of 1903-1917 and Delabastita and Rubens (2025) recover firm conduct in the Belgian coal labor market from production-function markdowns, and Zavala (2022) recovers exporters' buyer power over farmers in Ecuadorian cash crops from their responses to international price shocks. By estimating both supply and demand, I add counterfactuals at every level of the chain and the redistributive consequences of changes in buyer conduct, and I estimate how conduct responds to a trade shock rather than its level alone. The second studies how trade disciplines market power, almost entirely on the *selling* side, where incomplete pass-through and offsetting adjustments in other markets can make the pro-competitive gains of openness elusive (De Loecker *et al.*, 2016; Arkolakis *et al.*, 2019); a smaller, recent strand carries this to the buying side, with input-tariff liberalization lowering labor markdowns (Kondo *et al.*, 2024), openness reforms that erode monopsony power raising welfare (Jha *et al.*, 2026), oligopsony embedded in open-economy trade models (Macedoni and Tyazhelnikov, 2024), and mergers and conduct studied in open economies (Clougherty and Zhang, 2005; Ohashi and Toyama, 2017; Salvo, 2010). In my setting, the discipline comes from foreign export demand for the raw input. This demand raises the cost of processors' input and checks their buyer power.

Methodologically, I build on the estimation and testing of firm conduct. Identification is well understood (Bresnahan, 1982; Berry and Haile, 2014), and the literature both estimates conduct, summarized by an internalization parameter that measures departure from non-cooperative pricing (Ciliberto and Williams, 2014; Miller and Weinberg, 2017; Michel *et al.*, 2024; Eisenberg *et al.*, 2026), and tests it against candidate models.[3] I estimate conduct on the *buying* side, provide instruments for identification, let the parameter respond to a trade shock, and test the internalization model against non-cooperative oligopsony.[4]

[3]On estimation versus testing, Nevo (1998) recommends testing given the demanding instrument requirements of estimation, and Magnolfi and Sullivan (2022) show testing is less onerous and more robust to misspecification; see also Duarte *et al.* (2024) and Backus *et al.* (2021).

[4]The conduct test is in Appendix C.1. That market conditions shape non-competitive behavior has a theoretical literature. For demand shocks, on the observability and persistence of collusion (Green and Porter, 1984; Rotemberg and Saloner, 1986); for supply shocks, on information and repeated-game incentives under cost or capacity uncertainty (Fried, 1984; Li, 1985; Shapiro, 1986; Slade, 1990; Athey and Bagwell, 2001). I take this to markets with oligopsony power under observable, exogenous supply shocks, and give the formal argument in Appendix D.

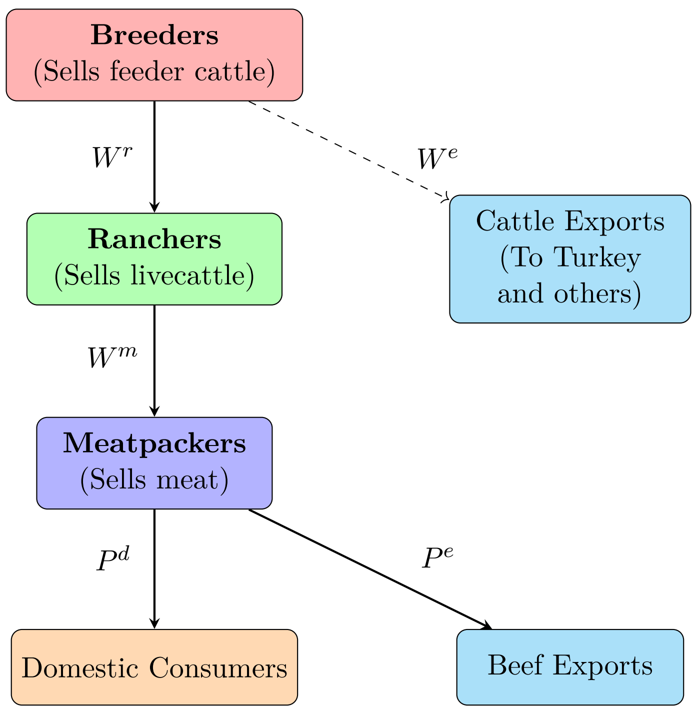
2 Overview of the Uruguayan Meatpacking Industry

This section provides an overview of the Uruguayan meatpacking industry in the last 10 years.[5] Section 2.1 describes all relevant industry agents and industry trends, including Turkey's role as the main importer of feeder cattle. Section 2.2 provides descriptive evidence of the effect of supply fluctuations (imports from Turkey) into meatpacking margins and livecattle prices.

2.1 Background

Figure 1 shows the structure of the Uruguayan meat industry.

Figure 1: Industry Structure



At the first level, breeders (primary input firms) are atomized and all over Uruguay.[6] They raise calves until weaning. A weaned male is called a steer, a weaned female a heifer.[7]

[5] For data sources and construction specific see Appendix A.1.

[6] In the year 2020, the number of breeder establishments was 25,953, that possessed around 57% of all farm and agriculture used land. These numbers have remained stable since 2008. Although atomized, breeders are organized in 2 main associations, Asociacion Rural del Uruguay and Federacion Rural del Uruguay.

[7] Calves are weaned about six months after birth (Plan Agropecuario, 2017). A heifer that has delivered offspring is called a cow. Breeder costs are mainly breeding, forage, veterinary services, labor and energy (Plan Agropecuario, 2011).

A breeder sells these animals in domestic or international markets, and steers or heifers sold to be fattened and later slaughtered are called feeder cattle.[8] Turkey and other Middle East countries are the main foreign buyers of feeder cattle.

Starting 2010 Turkey became an important importer of feeder cattle worldwide. The main reason was rising population and changing consumption that domestic production could not meet.[9] Because meat is an important component of the CPI food index, imports were also a way to control inflation. Turkey cut tariffs on feeder cattle while raising them on meat imports, with high discretion and frequent changes.[10][11] For Uruguay, Turkey became the most important buyer of feeder cattle, with shares over 70% (Gerencia de Informacion - INAC, 2021).[12]

Turkey and the domestic meatpacking plants do not compete for the same good. Turkey imports *feeder* cattle -animals to be fattened abroad- whereas meatpackers buy *livecattle*, animals ready for slaughter. Turkey therefore competes with domestic *ranchers* for feeder cattle, one stage upstream of the packers. Between 2013-2015 Turkey's imports fell sharply on internal decisions, and by the end of the sample returned to earlier levels.[13] This withdrawal does not remove a direct rival for the packers' input but shifts the livecattle supply curve downward through the feeder-price channel, since lower feeder demand lowers feeder prices, which in turn cheapens the livecattle that packers buy. These changes are exogenous to Uruguay's meat industry. They define three episodes, $2011-2012$ (PRE), $2013-2015$ (LOW), and $2016-2019$ (POST). Appendix A.2 documents the policy chronology, confirming the switch was driven by Turkish policy rather than Uruguayan supply conditions.

At the middle level, ranchers (intermediate goods firms) buy feeder cattle domestically, fatten it, and sell the resulting livecattle to meatpacking plants.[14] Feeder cattle price is the

[8]Uruguay fully liberalized livecattle exports in 1993 (Plan Agropecuario, 2017). A 2013 rule added quarantine requirements and permit uncertainty, overruled in 2020. Abroad, steers are fattened and slaughtered while heifers are used for reproduction and milk, and China is an important importer of heifers (Montes, 2020).

[9]For an overview of Turkey's beef industry, see Akin *et al.* (2020) and Eroğlu and Bozoğlu (2023).

[10]Turkey's feeder cattle imports are allowed under temporal permits by the Ministry of Food, Agriculture and Livestock. The administration of these permits has been canalized either by government bodies (the Fish and Meat Office) or through private domestic firms. See Report USDA Foreign Agriculture Service (2018)).

[11]The idea that Turkey's policies could eventually stopped or change was known. For example, in 2011: "*(...) creo que es un elemento esencial para el gran dinamismo que ha adquirido el sector ganadero, pero estamos ante una situacion particular, de repente mañana sale un decreto en Turquia y se termina (...)*"(it is an key element for the industry dynamism, but I am at a particular situation, tomorrow a decree is issued in Turkey and it is over). See Tertulia Agropecuaria (2011).

[12]Other relevant importer countries are Egypt, Syria and Tunisia with less frequent activity.

[13]Total imports to Turkey were lower worldwide during 2013-2015, and Uruguay's importance to Turkey was also low at this point.

[14]In 2020 there were about $4,650$ rancher establishments (Oficina de Estadisticas Agropecuarias - DIEA, 2020). Ranchers are short-term (feedlots and supplemented pastures, selling steers after 18-24 months) or long-term (natural pastures, 24-30 months). Most Uruguayan ranchers are long-term (Rosso, 2003).

main cost for a rancher, and can be purchased in centralized physical or virtual markets.[15]

In Uruguay, meatpacking plants process livecattle for exports mainly. In particular, total production has steadily increased over time, mostly triggered by exports (Appendix S1). This implies that the share of livecattle destined to exports increased from 70% in 2011 to above 80% by the end of sample. As a consequence of this, meat imports have also increased to cover for this difference.[16] This means that the share of domestic meat in consumption moved from 100% to slightly less than 80%. Export transactions are done by brokers or representatives that close deals with buyers internationally. These prices, although not equal, don't vary much by meatpacking plant. Once a given price and quantity are agreed, the meatpacking plant needs to find the livecattle.[17]

Meatpacking plants pay per kilogram of usable carcass meat. Bones, hides, offal and rendering, known in the industry as the fifth quarter, are excluded from the weight the plant pays for. This is a pricing convention and not a statement that these parts lack value. The plant acquires the whole animal, and Section 4.3 values the fifth quarter separately as by-product revenue. Performance is the share of livecattle weight that is finally purchased. It depends on the animal's sex, age and forage, and it also differs across plants in ways that persist. How many kilos an animal yields is known only once it has been slaughtered. The livecattle price and quantity are therefore in carcass-weight units. Appendix A describes how I build monthly plant purchases.

The number of meatpacking plants has remained fairly stable across my sample (around 35). Meatpacking plants differentiate according to the access they have to international markets. To be able to export, a meatpacking plant needs a country-destination specific permit that details the product characteristics that can be exported.[18] These type of permits are not only costly but they depend on other multiple meatpacking non-observable variables. The number of non-exporter meatpacking plants at the beginning of sample was slightly more than a third of all plants. But since then their number and importance has been decreasing. Additionally, their share in terms of livecattle purchases fluctuates around 7% and decreasing

[15]Other important costs are forage (weather-dependent for pasture-reliant ranches), interest rates, and the opportunity cost of land relative to crops like soy and rice (Plan Agropecuario, 2017). Distance to plants matters little and is usually included in the price paid.

[16]To satisfy internal demands, imports have began to be important -mainly from Paraguay and Brazil-. Although beef is the most popular meat; poultry, lamb and pork are also important. See Consumo de Carnes en Uruguay - Informe 2022, INAC `https://www.inac.uy/innovaportal/file/18275/1/cierre-del-consumo-de-carnes.pdf`

[17]Although publicly information does not exist, it is known that some meatpacking firms (MINERVA, MARFRIG) have agreements with ranchers (feedlots) and/or they own their own ranch. The main reasons for this vertical integration is to ensure quality and constant supply of livecattle. As seen in Gerencia de Informacion - INAC (2021), the percentage of slaughtered livecattle sourced from feedlots was (on average) 8% between 2013-2015 and 11.5% between 2016-2019. A potential threat to the impact of the low imports from Turkey could be that during these years, meatpackers strongly integrated with ranchers, but this is not the case.

[18]Additionally, this usually involves country-level negotiations between agriculture and health public offices.

(Appendix S1).

Meatpacking plants belong to different parent companies, with Uruguayan and international (Brazilian, Argentinian, Chinese, Japanese) capital. The industry consolidated over my sample.[19] I date three consolidation events that materially change ownership concentration -May 2014, July 2017 and August 2018. The pooled merger indicator Merger_t in the conduct equation switches on at the first, May 2014.

The firm-level HHI for livecattle purchases averages about 870 and stays well below the usual 2,500 screen for a highly concentrated market. It rises after 2017, from about 840 to 1,090. MARFRIG is the largest firm and MINERVA gains share from 2014 (Appendix S1). Turkey buys feeder cattle one stage upstream, not in this livecattle market, but its purchases are large enough that its withdrawal moves cattle prices.

Feeder cattle prices (W^r) run at around 50% of livecattle prices (W^m), so changes in W^r matter for the supply of W^m; and between 2013-2015 the export price P^e deviates upward from W^m and W^r, which I explore next (Figure S1.4, Appendix S1).

The industry has been subject to multiple antitrust investigations. In 2009, the competition authority started an investigation into potential price-fixing by meatpackers. Using a time-series analysis, it did not conclusively find oligopsony power, but found international conditions only partially passed through to ranchers and breeders.[20] In 2014, a second investigation addressed the fall in livecattle prices during 2013-2015 (detailed in Section 2.2). Here the analysis used meatpacking-level data and categorized the industry as an oligopsony with parallel behavior, but the authority again found insufficient evidence to prosecute.[21]

2.2 Descriptive Evidence

Before estimating the structural model, I provide the reduced-form evidence.

Turkey's feeder-cattle purchases are driven by Turkish policy and exogenous to Uruguayan conditions (Section 2.1), and they raise feeder cattle prices. I regress feeder cattle prices on Turkey's imports, controlling for demand and supply factors, and find a positive effect.[22] This

[19]In 2009 MARFRIG controlled Frigorifico Tacuarembo, Elbio Rodriguez and Frigorifico Colonia. Since then, in 2009, it acquired Frigorifico Caballada. MINERVA buys Frigorifico Pulsa in 2011, Frigorifico Carrasco (CATER) in 2014 and Frigorifico Canelones in 2017. Sundiro Holdings buys Frigorifico Lirtix and Rondatel in 2017, and its Rondatel absorbs Lorsinal in 2018. The three reassignments my estimation uses, dated from the plant-level ownership transitions in the data, are CATER to MINERVA (May 2014), Frigorifico Canelones to MINERVA (July 2017) and Lorsinal to Rondatel (August 2018), listed in Table S6.1.

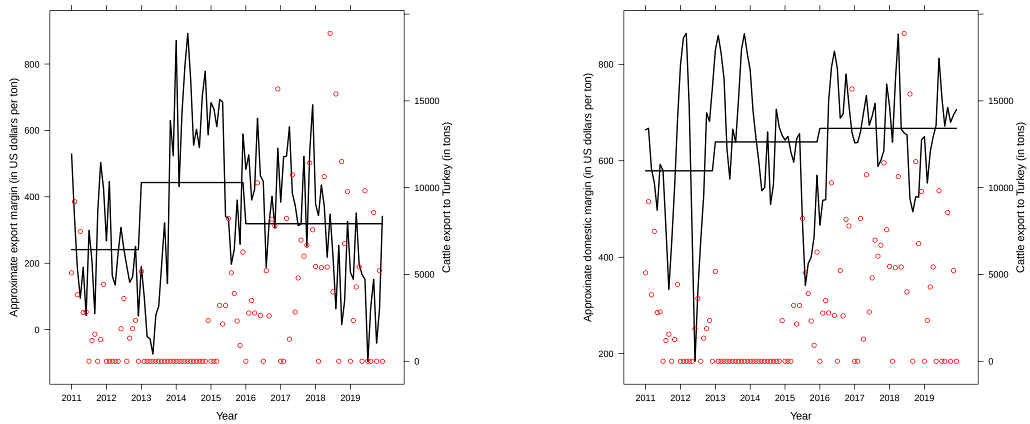
[20]See Resolución 11/010.

[21]See Resolución 56/014. The competition authority has no explicit dawn-raid powers, which limits its capacity to gather evidence.

[22]In Appendix A.3 I show the impact of Turkey imports both as a dummy and considering the number of tonnes of these, controlling for other demand and supply factors, time trends and period dummies. In Table A.3 (Column 3) I find that feeder prices are about 8.3% higher in the months with imports to Turkey. The coefficient on tonnes is not significant once the dummy is included.

is consistent with Turkey's imports raising feeder cattle demand and prices.[23] A low-import episode therefore means lower feeder prices and, for meatpackers, higher margins. Figure 2 plots approximate domestic and export margins ($P_t^d - W_t^m$ and $P_t^e - W_t^m$) against Turkey's feeder cattle imports on a secondary axis.

Figure 2: Approximate Margin Measures



(a) Exports (b) Domestic

Left panel: Approximate margin is defined as $P_t^e - W_t^m$ USD per tonne in the left vertical axis with the following means: 382.17 (2011 – 2012), 504.04 (2013 – 2015) and 382.17 (2016 – 2019). Right panel: Approximate margin as $P_t^d - W_t^m$ USD per tonne in the left vertical axis with the following means: 566.08 (2011 – 2012), 639.57 (2013 – 2015) and 667.25 (2016 – 2019). In both panels red dots represent total exports of feeder cattle to Turkey in tonnes (right vertical axis).

Margins increased during 2013 – 2015 both domestically and internationally, the years with the lowest feeder cattle exports to Turkey. Margins depend on other demand and supply factors too, but the pattern hints at a link to Turkey's purchases, possibly through buyer conduct.

Feeder prices move livecattle prices, but during the low-import episode livecattle prices fell by more than the feeder-price channel alone explains. To show this, I regress livecattle prices W_t^m on feeder prices W_t^r (supply), export meat prices P_t^e (demand), and Turkey's

[23] According to some agents, as a argued in this paper, the absence of Turkey purchases will result in lower feeder cattle prices: "*Turquía de junio a diciembre cambio de cuatro veces los aranceles de importación de carne y ganado. Entonces, que hoy los turcos paguen 2.70 no es una buena señal para el criador, porque tal vez mañana prohiban la importacion de ganado para engordar, y ese dia el precio baja a lo que tiene que bajar.*"(From June to December (2011) Turkey changed import tariffs four time for beef and feeder cattle. Then, Turkey paying 2.70 (USD per kg) it is not a good signal for the breeder, maybe tomorrow they will ban all feeder cattle imports and, that day prices will be lower to the correct levels). See Tertulia Agropecuaria (2011).

imports interacted with the three period dummies, with year fixed effects,

$$\begin{aligned} W_t^m = &\sigma_t + \beta_1 W_t^r + \beta_2 P_t^e + \beta_{3,0}\text{Turkey x PRE}_t + \beta_{3,1}\text{Turkey x LOW}_t + \\ &\beta_{3,2}\text{Turkey x POST}_t + \eta_t \end{aligned}$$

where Turkey_t is either a dummy for imports or kilograms imported. With β_1 and β_2 absorbing supply and demand, the β_3 coefficients capture any effect of Turkey beyond costs. If Turkey worked only through costs they would be zero. If they are not, that points to a conduct change.

Table 1: Preliminary Evidence: Turkey and Live-cattle Prices

	Baseline	Turkey (dummy)	Turkey (tonnes)
Feeder Cattle Price W_t^r	0.93^{***}	0.96^{***}	0.95^{***}
	(0.09)	(0.09)	(0.09)
Export Price P_t^e	0.41^{***}	0.41^{***}	0.44^{***}
	(0.07)	(0.07)	(0.07)
Turkey (dummy) × Pre		−42.73	
		(47.62)	
Turkey (dummy) × Low imports		118.44^{***}	
		(40.14)	
Turkey (dummy) × Post		-64.37^{*}	
		(35.41)	
Turkey Imports (tonnes) × Pre			−0.01
			(0.01)
Turkey Imports (tonnes) × Low imports			0.02^{*}
			(0.01)
Turkey Imports (tonnes) × Post			−0.00
			(0.00)
Observations	132	132	132
R^2	0.95	0.96	0.96

Notes: Dependent variable is the livecattle price. Standard errors in parentheses. Year fixed effects included. Pre is 2009-2012, Low imports is the 2013-2015 Turkish withdrawal, and Post is 2016-2019.

In Table 1, β_1 and β_2 are positive and significant. Column 1 is the baseline without Turkey. Columns 2 and 3 add Turkey's imports as a period-interacted dummy and as tonnes. During the low-import period, livecattle prices were higher because of Turkey. Absent its imports, W^m would have been about 118 USD per tonne lower (around 3.69%), after controlling for demand, supply and unobserved factors. The tonnes specification (Column 3) gives a coefficient of the same positive sign, significant at the 10% level, so the effect is not an artifact of the dummy coding. Turkey's imports thus move W^m through channels beyond feeder costs W^r.

Finally, and closest to conduct, firms' strategic response to their rivals strengthens exactly when Turkey's imports fall. Buyer conduct is the strength of that response, identified from how a firm cuts its own purchases when a rival's performance is higher, and a firm that internalizes its rivals cuts back by more than one that does not. I test this by interacting rival performance with Turkey's import intensity in the relevance regression. The interaction is positive and significant (0.048) over the full sample, and larger on the pre-merger window -where Turkey is the only conduct shifter- (0.267, significant at the 5% level, Appendix A.4). The rival-performance response is thus stronger exactly when competition for feeder cattle is weaker.

These results are consistent with a change in conduct, but the reduced form cannot quantify it separately from the fall in input costs. I use the structural model for this decomposition.

3 Model and Estimation Methods

This section describes my model for the Uruguayan meatpacking industry. I first give the intuition (Section 3.1), then the formal model (Section 3.2), and my estimation and identification (Section 3.3).

3.1 Overview of the Model

When the inverse supply curve shifts down -for example because Turkey buys less feeder cattle- a plant's marginal cost falls. On its own this *cost effect* would raise purchases. But conduct can also respond. Turkey's feeder demand keeps meatpackers' procurement margin thin, and when it recedes the wider margin can make coordinating on markdowns more rewarding. A repeated-game model gives one channel in which this happens and in which coordination is also easier to sustain.[24] Firms would then internalize rivals' purchases more and push livecattle prices further below their competitive level. I call this the *conduct effect*, and it works against the cost effect.

I test whether conduct in fact rises, and by how much, in Section 4.

3.2 Industry Equilibrium

A group of meatpacking plants $j \in J$ buys livecattle and processes it to sell domestically or internationally. The ability to export depends on a destination-country-specific export permit.[25] I do not model the permit decision. I split plants into two types. Non-exporters

[24]If coordinating carries a cost that does not scale with the size of the market, a wider margin shrinks that cost relative to the surplus at stake and slackens the incentive constraint. Appendix D develops this.

[25]These permits can take several years to be acquire and can involve long negotiations that involve governmental agencies in both Uruguay and the destination country.

sell only domestically, and exporters also sell abroad. In a given period t both types are present.

Export prices are set in negotiations by firm-brokers, so I take them as given in period t (Section 2.1). They vary mostly across destination and product, and little across plant.[26] I standardize all products to a carcass-weight unit so exports and domestic sales are comparable.[27] I then aggregate export prices to the year-month level. Given the low variation across plants, I treat export prices as exogenous and common across plants.

Then, in period t each meatpacking firm chooses the domestic and export quantities of the plants $j \in J$ it owns to maximize their joint profit. Writing $q_{jt}^m = q_{jt}^d + q_{jt}^e$ for plant j's livecattle purchases, the firm's problem for a plant j it owns is

$$\max_{q_{jt}^d, q_{jt}^e} \left(P\left(Q_t^d\right) + b\right) q_{jt}^d + \left(p_t^e + b\right) q_{jt}^e - TC\left(W(Q_t^d, Q_t^e), \lambda_t, q_{jt}^m, Q_{-jt}^m, X_{jt}^{nc}\right)$$

such that $Q_t^d = \sum_j q_{jt}^d$ are aggregated domestic meat quantities, $Q_t^e = \sum_j q_{jt}^e$ are aggregated export meat quantities, $Q_t^m = Q_t^d + Q_t^e$ are aggregated livecattle purchases, Q_{-jt}^m is the sum of livecattle purchases by plants owned by firms *other* than the one that owns j (plants under j's own ownership are internalized fully, entering the own-cost term below, so λ_t weights only rival firms), $P\left(Q_t^d\right)$ is the inverse demand function of domestic wholesalers (Section 4.1), p_t^e is the export meat price, b is by-product revenue per unit of carcass weight, the value of the fifth quarter of Section 2.1, $W\left(Q_t^m\right)$ is the inverse supply function that meatpackers face and X_{jt}^{nc} are non-cattle cost shifters. Total costs will depend on the price of livecattle W, but also on conduct parameter and aggregate rival purchases of livecattle. Maximization can be characterized by the following first order conditions

$$P'\left(Q_t^d\right) q_{jt}^d + P\left(Q_t^d\right) + b = MC\left(W\left(Q_t^d, Q_t^e\right), \lambda_t, q_{jt}^m, Q_{-jt}^m, X_{jt}^{nc}\right) \quad (1)$$

$$p_t^e + b = MC\left(W\left(Q_t^d, Q_t^e\right), \lambda_t, q_{jt}^m, Q_{-jt}^m, X_{jt}^{nc}\right) \quad (2)$$

that imply that the marginal return from selling meat domestically or internationally must be equal to marginal cost (MC). Since all meat is carcass-weight equivalent, the marginal return from domestic and export sales is the same, and for non-exporters only equation (1) is relevant. Meatpackers exert downstream market power only domestically, as export

[26] Table S1.1 regresses export prices with different sets of fixed effects. As seen, product characteristics and destination explain most of the variation in the data ($r^2 = 0.6549$). Including additional fixed effects -like time or meatpacking ID-, only increases r^2 marginally (to 0.6840 and 0.6876).

[27] For example, it is seen that certain cuts have higher prices than others. The carcass-weight standardization converts these cuts to the kilos of carcasses that would have been needed to obtain a specific cut. Then, it increases the weight of the product and allows for comparable USD per kilo among products. Conversion ratios were obtained from Oficina de Estadisticas Agropecuarias - DIEA (2013).

prices are taken as given. For an exporting plant the procurement first-order condition ($p_t^e + b = MC$, up to the export cost differential c^e discussed below) pins down marginal cost without reference to domestic demand or downstream conduct, so buyer conduct is identified on the procurement margin rather than on the selling side. Consistent with this, Appendix C.6 shows the export price and implied domestic marginal revenue comove, and Appendix D gives the formal argument. I specify MC as the derivative of TC with respect to livecattle quantities as follows

$$MC_{jt} = \underbrace{W(Q_t^m) + \frac{\partial W}{\partial Q^m} \sum_{k \in O(j)} q_{kt}^m}_{\text{cattle MC (own firm)}} + \underbrace{\lambda_t \frac{\partial W}{\partial Q^m} \sum_{k \notin O(j)} q_{kt}^m}_{\text{conduct (rival firms)}} + \underbrace{X_{jt}^{nc} \beta^{nc}}_{\text{non cattle MC}} + \underbrace{\eta_{jt}^c}_{\text{unobserved MC}}$$

where $O(j)$ denotes the set of plants under the same ownership as j (including j itself). Marginal cost decomposes into four elements. First, the price of livecattle and, because the firm maximizes the joint profit of its plants, the marginal increase in W over *all* its own plants' purchases (the sum over $O(j)$), which it internalizes fully. Second, a conduct parameter λ_t by which the firm internalizes the marginal increase in W arising from the purchases of *rival* firms' plants ($k \notin O(j)$). If $\lambda_t = 0$, then meatpackers do not internalize rivals' decisions and are non-cooperative (Nash) oligopsonists, still exercising their own-plant markdown, while if λ_t is closer to 1 firms' behavior will resemble industry profit maximization. Third, I allow for additional marginal cost not related directly to livecattle purchases (like specific capital or region fixed effect). Finally, there is an unobserved marginal cost term to account for other possible variation.

Two forces move λ_t over my sample. The first, and the focus of this paper, is the trade shock. When Turkey withdraws from the feeder cattle market, competition for the input weakens and firms internalize their rivals' purchases more, which raises λ_t. The second is the meatpacking consolidation, which I turn to now. Section 3.3 parametrizes λ_t as a function of both.

Ownership enters through the set $O(j)$, and a merger changes it. Before a consolidation, plants under common ownership are internalized fully (weight one, the sum over $O(j)$) and λ_t weights the purchases of rival firms' plants. A consolidation enlarges the acquirer's ownership set. The acquired plant moves from the rival term into the own-firm sum $O(j)$, so it becomes fully internalized (the *unilateral* effect, a mechanical rise in own-firm internalization), while any additional market-wide rise in λ_t after consolidation is the *coordinated* effect that κ_{merger} captures in Section 3.3. This unilateral-versus-coordinated distinction is what the counterfactuals in Section 5.3 exploit. Appendix S6 lists the three within-sample ownership reassignments -which plant changes hands, and when- so the reader can see exactly how the ownership sets $O(j)$, and hence the unilateral term, change at each date.

For further reference I define additional variables I use later. Markups are $\text{markup}_{jt} = 100 \times \frac{(P_t^d - MC_{jt})}{MC_{jt}}$. Markups relate to domestic meat prices, so they exist only for firms that participate in that market. Let $\Delta_{jt} = \frac{\partial W}{\partial Q^m}\left(\sum_{k\in O(j)} q_{kt}^m + \lambda_t \sum_{k\notin O(j)} q_{kt}^m\right)$ be the markdown wedge. Markdowns are $\text{markdown}_{jt} = 100 \times \frac{\Delta_{jt}}{W_t^m + \Delta_{jt}}$, the wedge as a share of cattle's competitive value.

3.3 Estimation and Identification

I estimate the model in three steps, demand, supply, and the pricing equation. The demand approach for homogeneous goods follows Röller and Steen (2006), Igami (2015) and Igami and Sugaya (2022). The supply and buyer-power estimation follows Rubens (2023), Huang (2022) and Delabastita and Rubens (2025).

3.3.1 Demand

Using market-level data, I run the following regression

$$Q_t^d = \sigma_t^d + \beta_1 P_t^d + \beta_2 \text{UY GDP}_t + \beta_3 P_t^{\text{pork}} + \beta_4 P_t^{\text{lamb}} + \beta_5 P_t^{\text{import}} + \eta_t^d \tag{3}$$

where σ_t^d are time fixed-effects, P_t^d is the domestic meat price, UY GDP_t is Uruguayan GDP, P_t^{pork} is the domestic price of pork, P_t^{lamb} is the domestic price of lamb, P_t^{import} is the domestic import price of meat and η_t^d is an unobserved domestic meat variable.[28] Since P_t^d can correlate with η_t^d, I instrument it via linear GMM-IV with the moment condition $\mathbb{E}[Z_t^d \eta_t^d] = 0$. The instrument set Z_t^d uses the feeder cattle price W^r, an input price uncorrelated with demand.

3.3.2 Supply

For supply, I run the following market-level regression

$$Q_t^m = \sigma_t^m + \gamma_1 W_t^m + \gamma_2 P_t^{\text{fuel}} + \gamma_3 P_t^{\text{fertilizer}} + \gamma_4 E_t(P_{t+1}^e) + \gamma_5 W_t^r + \gamma_6 \text{Rain}_t + \eta_t^s \tag{4}$$

where σ_t^m are time fixed-effects, W_t^m is the livecattle price, P_t^{fuel} is kerosene price, $P_t^{\text{fertilizer}}$ is fertilizer price, $E_t(P_{t+1}^e)$ is expected meat export price[29], W_t^r is feeder cattle prices, Rain_t

[28] See Table A.1 for summary statistics.

[29] Additional detail about this variable. Ranchers -owners of livecattle- can decide if they want to sell their animals to meatpacking plants. Depending on their expectations about future prices, they might prefer to wait and sell in a different period. I am not explicitly modeling this dynamic behavior as for this I would need to know the number of livecattle that was not sold in time t. Therefore, a simplified approach is to construct a variable that captures the

is average rainfall and η_t^s is an unobserved supply livecattle variable.[30] Because W_t^m can correlate with η_t^s, the GMM-IV moment condition is $\mathbb{E}[Z_t^s \eta_t^s] = 0$, with Z_t^s the export meat price level, Chinese import demand, and the peso exchange rate, all uncorrelated with supply.

3.3.3 Pricing Equation

Lastly, using meatpacker-level data, I run the following regression

$$y_{jt} = W(Q_t^m) + \frac{\partial W}{\partial Q^m} \sum_{k \in O(j)} q_{kt}^m + \lambda_t \frac{\partial W}{\partial Q^m} \sum_{k \notin O(j)} q_{kt}^m + X_{jt}^c \beta^c + \eta_{jt}^c \tag{5}$$

with y_{jt} equal to $p_t^e + b$ if the meatpacking plant exports or $P'\left(Q_t^d\right) q_{jt}^d + P\left(Q_t^d\right) + b$ if it only sells meat domestically. Because serving the export market carries a cost that differs from serving the domestic one, the export price and domestic marginal revenue need not be equal in levels; X_{jt}^c therefore includes an export-channel indicator that absorbs this differential.

The term b is by-product revenue per unit of carcass. A slaughtered animal yields hides, offal and tallow beyond the cuts that p_t^e prices, and the livecattle price is paid for the whole animal. I calibrate b rather than estimate it, and $b = 0$ is one of the cases I report. It is not separately identified from the intercept of $X_{jt}^c \beta^c$. With the level of non-cattle marginal cost left free, the plant fixed effects in X_{jt}^c absorb a constant b one for one, so it shifts the implied cost level and nothing else. It changes the conduct estimates only once that level is itself pinned down. Section 4.3 sets out both calibrations and reports estimates with each imposed and omitted.[31] Rather than letting λ_t move freely period by period, I tie it to the two forces that shift buyer power over cattle in my sample, the intensity of Turkey's feeder cattle imports and the meatpacking consolidation. Specifically, I parametrize buyer conduct as

$$\lambda_t = \kappa_{base} + \kappa_{turkey}\, \text{TurkeyIntensity}_t + \kappa_{merger}\, \text{Merger}_t \tag{6}$$

where TurkeyIntensity_t is the (smoothed) national volume of feeder cattle that Turkey imports from Uruguay, in net weight of millions of tonnes -my measure of the strength of the outside competition for feeder cattle- and Merger_t is an indicator that turns on after the main

expectation that ranchers have about future prices but under a contemporaneous information set. I expect $\gamma_4 < 0$ as it will indicate that ranchers are less willing to sell if they expect future higher prices. For a detailed information on how this variable was constructed see Appendix S2.

[30] See Table A.1 for summary statistics.

[31] The average differential is absorbed by the export-channel indicator, so identification of buyer conduct needs the export price and domestic marginal revenue to comove rather than to match in levels; they do (Appendix C.6: smoothed correlation 0.71, strongest outside the 2013-2015 shock window). The residual, time-varying part of the differential enters the pricing residual η_{jt}^c.

meatpacking consolidation. Under this specification κ_{base} is a baseline level of internalization, κ_{turkey} measures how conduct responds to the supply shock (a negative value means firms internalize rivals more when Turkey buys less), and κ_{merger} captures the incremental change in conduct after consolidation.[32] I describe how these conduct coefficients are identified in Section 3.3.4.

3.3.4 Identification of Conduct

My parameter of interest is the buyer conduct λ_t in the pricing equation (5). It enters multiplying the term $\frac{\partial W}{\partial Q^m}\sum_{k\notin O(j)} q_{kt}^m$, so identifying λ_t amounts to isolating how firm j's pricing responds to rival firms' aggregate livecattle purchases $\sum_{k\notin O(j)} q_{kt}^m$. This regressor is endogenous. A common unobserved cost shock raises marginal costs and lowers purchases for firm j and its rivals at the same time, so $\sum_{k\notin O(j)} q_{kt}^m$ is correlated with η_{jt}^c and an OLS pricing regression would not recover λ_t. I therefore estimate λ_t from the moment condition $\mathbb{E}[Z_{jt}^m\, \eta_{jt}^c] = 0$, with an instrument Z_{jt}^m that shifts rivals' purchases but is excluded from firm j's own marginal cost.

The logic follows Berry and Haile (2014). Under non-cooperative (Nash) conduct ($\lambda_t = 0$) a change in rivals' purchases affects firm j only through the livecattle price. Under internalization ($\lambda_t > 0$) there is an additional channel through the conduct term. An instrument that shifts rivals' purchases and is excluded from own cost thus distinguishes the two.

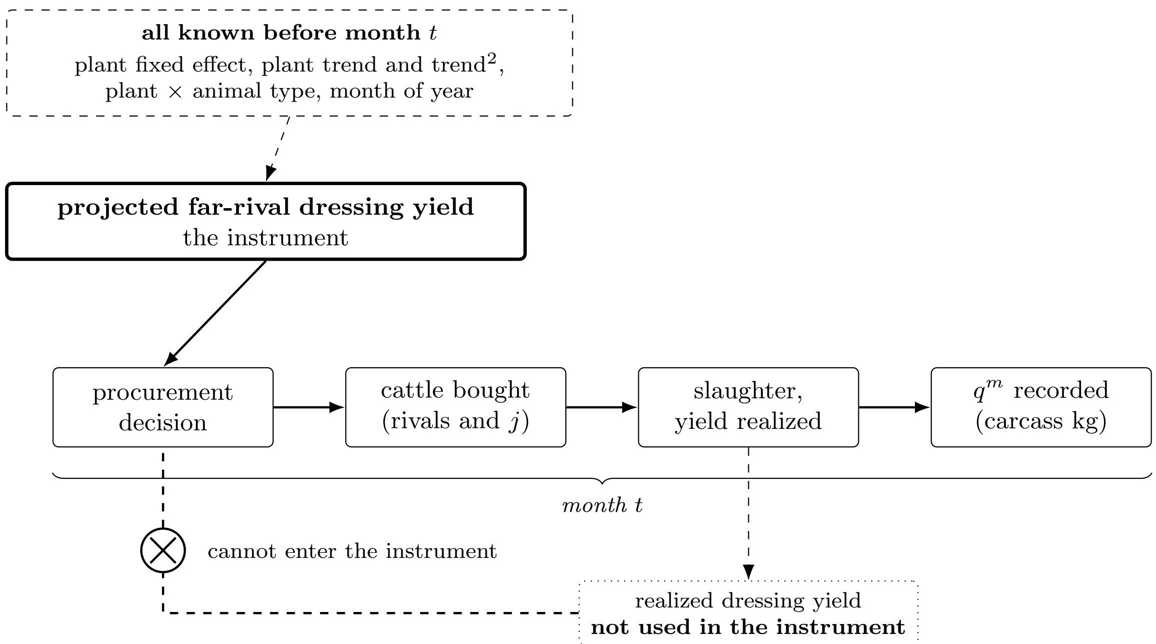
My instrument is the performance (meat yield per head) of *far* rival plants, by animal type $a = \{\text{steer}, \text{heifer}\}$, performance $(\text{rivals})_{jt}^a$ (Appendix B). Yield is determined at slaughter and, conditional on animal composition, differs across plants in ways that persist. Higher performance raises rivals' meat obtained per animal and shifts their livecattle purchases. Because quantities are strategic substitutes, this in turn moves firm j. Table A.4 reports this pattern in reduced form. Own performance enters positively and rivals' performance negatively ($\beta_1 < 0$), though neither is precise once plant fixed effects and the conduct-period trends absorb the persistent variation. Relevance for the estimation comes from the first stage of the conduct GMM, where the Kleibergen-Paap statistic is 184.7.

The instrument performance $(\text{rivals})_{jt}^a$ must also be uncorrelated with firm j's own unobserved marginal cost η_{jt}^c. Three features of the construction support this. First, I build the instrument only from *far* plants ($d_{jk} > \bar{d}$), which do not share firm j's local input and cattle-sourcing conditions, so their performance does not enter j's own cost. Second, yield is a rival-plant productivity measure rather than a price or a demand variable, so it is not a mechanical function of the domestic meat market that j operates in. Third, I do not

[32] See Table A.1 for summary statistics.

use realized yield. The instrument is the projected component of far-rival yield, the fitted value from a regression of plant dressing yield on plant fixed effects, plant-specific linear and quadratic trends, plant-by-animal-type levels and slopes, and month of year interacted with animal type. Every regressor is a deterministic function of plant identity, the calendar and animal type, so nothing realized at slaughter enters the instrument (Figure 3). What identifies conduct is the difference in persistent dressing performance across a plant's distant rivals. An alternative projection that also includes contemporaneous national yield gives a similar estimate, which I report in Appendix C.5.

Figure 3: Timing of the conduct instrument



Notes: The instrument is the projected component of far-rival dressing yield. Every regressor in that projection is a deterministic function of plant identity, the calendar and animal type, so it is known before the month's cattle are bought. Realized dressing yield, which is observed only at slaughter, is not used. Appendix C.5 reports an alternative projection that also includes contemporaneous national yield.

The sign of κ_{turkey} answers my first research question. A negative value means conduct rose during the low-import episode, with meatpackers internalizing rivals more when Turkey reduced its purchases. The κ_{merger} coefficient separates the low-import episode from the later consolidation.

4 Estimation Results

This section presents the results of demand (Equation 3), supply (Equation 4) and pricing equation (Equation 5).

4.1 Demand Estimates

Table 2 reports three demand estimations. Column 1 is OLS with only time fixed effects and Uruguayan GDP. The β_1 coefficient is -0.94, not significant, with a mean price-elasticity of -0.428. I instrument the domestic price P_t^d with feeder cattle prices W_t^r to address endogeneity. Column 2 gives a coefficient of -1.74 and an elasticity of -0.789. Column 3 adds prices of alternative products (pigs and lamb, P_t^{pigs}, P_t^{lamb}) and imports (P_t^i), all precisely estimated with expected signs. It lowers β_1 to -9.20, with a mean price-elasticity of -4.167, in line with other meat demand estimates.[33] Column 3 is my preferred model.

The domestic buyers of meatpackers' output are wholesalers, not final consumers, so this is a derived demand for a near-homogeneous intermediate good, which should be elastic.

Table 2: Demand Estimation

	OLS	IV	IV (preferred)
P_t^d	-0.94	-1.74^{*}	-9.20^{***}
	(0.85)	(1.00)	(2.59)
GDP	0.54	0.72^{**}	0.52
	(0.33)	(0.34)	(0.34)
P_t^{pigs}			8.87^{***}
			(2.77)
P_t^{lamb}			3.16^{***}
			(0.94)
P_t^i			0.75^{*}
			(0.43)
IV Var		2	2
Mean Elast.	-0.428	-0.789	-4.167
F(MP)		274.9	49.9
CS(AR)		(-3.83, 0.26)	(-15.46, -4.28)
R^2	0.09	0.08	0.04
Adj. R^2	0.05	0.04	-0.03
Num. obs.	132	132	132

Notes: All estimations include time fixed effects. Columns 2 and 3 are IV estimation with the calf price (level) as the instrument. F(MP) is the Montiel-Olea Pflueger effective F-statistic and CS(AR) the Anderson-Rubin confidence set for the coefficient on Pd, both heteroskedasticity-robust. Standard errors in parentheses. Data is at the monthly level.

[33] Gallet (2010) through meta-analysis reports that inelastic and elastic price-elasticity estimates. My work returns estimates that indicate meat as an elastic good, similarly to Huang (2022) using US data.

4.2 Supply Estimates

Table 3 contains the result of 3 different supply estimations. Column 1 is OLS, which suffers from the same endogeneity as demand. Column 2 instruments the livecattle price W_t^m with export meat prices. Instrumenting turns the slope positive and raises the implied elasticity (Table 3). Column 3 employs an extended model that includes expected future export prices $E(P_{t+1}^e|t)$, price of feeder cattle W^r, fuel prices and average rain. As seen, all these coefficients are significant -with exception of fuel prices- and with expected signs. With this specification, I obtain a significant value of β_1 equal to 16.65, which implies a mean supply price-elasticity of 1.273. Similarly to the demand estimation, I pick my preferred model based on realistic price-elasticity patterns.[34] In this sense I choose Column 3.

Because the slope $\hat{\gamma}_1$ governs the marginal effect of purchases on the livecattle price, and thus the markdown and the welfare split, I estimate it rather than impose perfectly inelastic supply. It is weakly identified, so I repeat the decomposition of Section 5.2 over supply elasticities from 0.5 to 2.0 in Appendix S4.4. Appendix S3 plots the implied demand and supply elasticities over the sample.

4.3 Conduct Estimates

With the previous results at hand, I proceed to estimate the pricing equation. My parameters of interest are the conduct coefficients in Equation (6). Two quantities in the pricing identity are not identified by the moments. The first is by-product revenue. A plant sells hides, offal and tallow beyond the carcass that P^e prices. I add this as a flat level b per unit of carcass weight, on both the domestic and the export channel. The second is the part of marginal cost that is not the animal. I impose $MC^{non-cattle} = 0.15\,W$. Table 4 crosses the two. Column (1) imposes neither and column (4) imposes both. I use column (4).

I do not choose either value to fit the model. The by-product level is 10% of the mean export price. This is the value share of the fifth quarter, documented in Appendix S4.2. The non-cattle share comes from a per-head account of the industrial stage prepared for the meatpacking industry chambers (CPA FERRERE, 2017), in 2016 US dollars for a typical steer. It splits gross output of 1,103 into 804 paid for cattle, 122 of intermediate inputs and 177 of direct value added. Within a month labour and capital are fixed, so only intermediate inputs are marginal. Non-cattle marginal cost is therefore $122/804 = 0.152$ times the cattle price. Two other sources bracket this figure. Huang (2022) puts materials at 90.7% of production cost in the 1909 US Census of Manufactures, a ratio of about 0.10. The national

[34] For example, Jeong (2019) finds a short run positive price-elasticity (1.813) using US data. For an alternative approach under perfectly inelastic supply, see Garrido *et al.* (2022).

Table 3: Supply Estimation

	OLS	IV	IV (preferred)
W_t	-0.26	4.29^{*}	16.65^{**}
	(1.04)	(2.32)	(7.94)
P^*_{t+1}			-9.05^{*}
			(4.63)
W^r_t			-13.72^{*}
			(7.61)
Fuel Price	300.08	-4702.48	1744.32
	(3986.91)	(4572.99)	(4778.10)
Fertilizer Price	-29.20^{**}	-30.48^{***}	-34.34^{**}
	(11.46)	(11.43)	(14.02)
Rain	-5.62^{**}	-5.75^{**}	-6.93^{***}
	(2.29)	(2.36)	(2.42)
Expectation	No	No	Yes
Mean Elast.	-0.020	0.328	1.273
F(MP)		53.4	9.0
CS(AR)		(4.31, 6.36)	(-0.23, 50.44)
Observations	132	132	132

Notes: Standard errors are HAC (Bartlett, bandwidth 2). Column 1 is OLS. Column 2 instruments the hook price with the export price interacted with period dummies; column 3 (preferred) with the export price level, Chinese import demand and the peso exchange rate. F(MP) is the Montiel-Olea Pflueger effective F-statistic and CS(AR) the Anderson-Rubin confidence set, both with the same HAC covariance.

activity survey for bovine slaughter puts cattle at 81.2% of variable cost, a ratio of about 0.23. I impose 0.15, the figure that account implies.

Under my preferred specification the baseline internalization is $\hat{\kappa}_{base} = 0.121$. Absent any shock, a firm internalizes a fraction 0.121 of the effect its rivals' livecattle purchases have on the price it pays. The coefficient on Turkey's import intensity is negative and significant, $\hat{\kappa}_{turkey} = -8.489$,[35] which is the central result behind my first research question. Buyer conduct rises when Turkey reduces its feeder cattle imports, that is, meatpackers internalize rivals' actions more when the outside competition for feeder cattle weakens.[36] The merger coefficient is small and not significant, $\hat{\kappa}_{merger} = -0.003$ with a standard error of 0.015. I cannot detect a further change in conduct after the consolidation.

The table also shows which levels the data identify. Columns (1) and (3) are identical. The cost block contains plant fixed effects, which span a constant, so a free cost level absorbs a flat b. Adding b then raises implied non-cattle marginal cost by the same amount and

[35] So $\hat{\kappa}_{turkey}$ is the change in λ_t per million tonnes. Turkey's monthly imports have a standard deviation of about 0.00298 million tonnes (2,980 tonnes), so a one-standard-deviation fall raises implied conduct by about 0.025.

[36] This is unlikely to be a shift in ranchers' bargaining power. Turkey buys feeder cattle from breeders, one stage above this market, so its withdrawal leaves ranchers' outside option when selling livecattle unchanged.

Table 4: Conduct estimation under the by-product and cost calibrations

	(1) Neither	(2) Cost only	(3) By-product only	(4) Preferred
Calibration				
By-product revenue b	None	None	$0.10\,\bar{p}^e$	$0.10\,\bar{p}^e$
Non-cattle marginal cost	Free	$0.15\,W$	Free	$0.15\,W$
Buyer conduct $\lambda_t = \kappa_{\text{base}} + \kappa_{\text{turkey}}\,\text{Turkey}_t + \kappa_{\text{merger}}\,\text{Merger}_t$				
Baseline κ_{base}	0.304^{***}	-0.047	0.304^{***}	0.121^{***}
	(0.079)	(0.035)	(0.079)	(0.035)
Turkey intensity κ_{turkey}	-9.643^{***}	-7.486^{***}	-9.643^{***}	-8.489^{***}
	(2.293)	(1.789)	(2.293)	(1.761)
Merger κ_{merger}	-0.026	0.018	-0.026	-0.003
	(0.021)	(0.015)	(0.021)	(0.015)
Diagnostics				
Median λ_t	0.253	-0.057	0.253	0.096
Non-cattle MC (% of output value)	-6.9	14.2	3.1	14.1
Implied MC < 0 (% of obs.)	91.6	4.2	30.4	2.4
Hansen J (df)	260 (4)	494 (5)	260 (4)	350 (5)
First-stage F (Kleibergen-Paap)	184.7	184.7	184.7	184.7
Observations	5,587	5,587	5,587	5,587

Notes: Buyer conduct λ_t is estimated by three-step GMM with period-specific trends. The excluded instruments are the far-rival dressing yield of the two animal types, from the plant-specific-trend projection, interacted with period indicators. Both calibrations are measured outside the model and are described in the text. Columns (1) and (3) coincide because plant fixed effects absorb a flat b whenever the cost level is free. Non-cattle MC as % of output value is the median implied non-cattle marginal cost relative to the mean export price. Sandwich standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level.

changes nothing else. Imposing the cost level removes this, so in columns (2) and (4) b changes the estimated markdown. The level of conduct is therefore not separately identified from the level of non-cattle marginal cost, and the calibrations pin the latter. Across the table $\hat{\kappa}_{base}$ ranges from -0.047 to 0.304 and $\hat{\kappa}_{merger}$ changes sign. $\hat{\kappa}_{turkey}$ does not depend on them. It lies between -9.643 and -7.486 in all four columns and is significant at the 1% level.

Imposing the calibration raises the Hansen J from 260 to 350, with one more degree of freedom. In return, implied non-cattle marginal cost is 14.1% of output value and 2.4% of observations are negative. Column (1) gives -6.9% and 91.6%.

Table 5 places my estimates against the non-cooperative (Nash) counterfactual for the low-import episode. Buyer conduct more than doubles the markdown, from 4.9% under Nash to 11.9%, and holds the livecattle price below its Nash level (\$3420 against \$3674 per tonne). Over the sample the markdown rises from before the shock to the low-import episode and stays elevated afterwards, as concentration increases (Section 2.1). The meat markup moves the other way. It is higher under estimated conduct (17.2%) than under Nash (9.1%), because buyer power lowers the cattle price and the cheaper input inflates the measured markup. Removing buyer conduct raises the cattle price and compresses the markup, consistent with meatpackers' rents being earned upstream in procurement rather than downstream.

Table 5: Estimated conduct versus non-cooperative (Nash) oligopsony

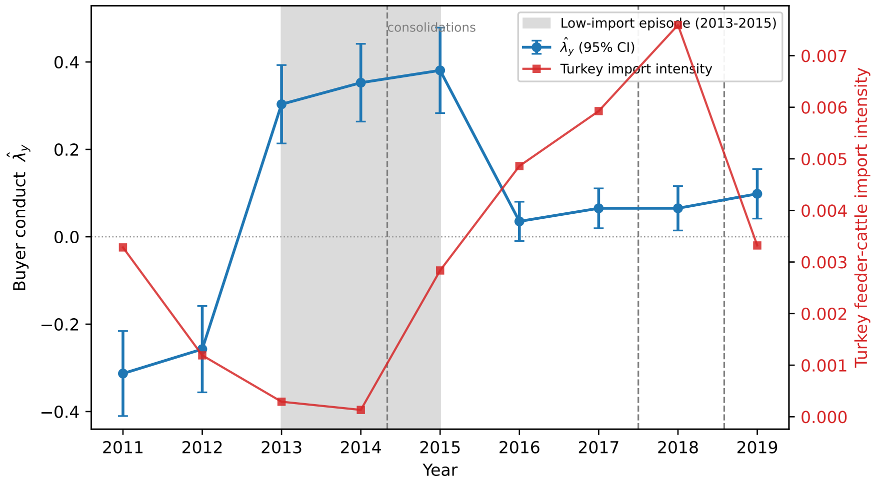
	Estimated conduct	Nash ($\lambda = 0$)
Markdown (%)	11.9	4.9
Markup (%)	17.2	9.1
Livecattle price (USD/tonne)	3420	3674

Notes: Averages over the low-import episode, from the counterfactual equilibrium under the preferred specification. "Estimated conduct" uses the estimated λ_t; "Nash" sets $\lambda = 0$, so firms keep their own-plant markdown but do not internalize rivals, with feeder cattle prices held at their observed values. Markdown is the wedge as a share of cattle's competitive value.

Because this first consolidation overlaps the low-import window, Appendix C.2 checks that $\hat{\kappa}_{turkey}$ is not merely absorbing the merger. Re-estimated on the window between the first and second mergers, where ownership is fixed by construction, it stays negative and significant. The instruments are strong (Kleibergen-Paap first-stage F of 184.7, with per-parameter Sanderson-Windmeijer F's in Table C.3), and the uncalibrated specification in column (1) gives the same sign and significance for $\hat{\kappa}_{turkey}$ (-9.643). Beyond estimating λ_t and its standard error, the Rivers-Vuong conduct test of Backus *et al.* (2021) prefers this time-varying internalization model over non-cooperative oligopsony (Appendix C.1).

The parametric λ_t is a linear function of Turkey's imports. To check the response is not an artifact of that form, I re-estimate a free λ_y for each calendar year, off the same rival-performance instrument interacted with year dummies. Figure 4 plots the annual estimates against Turkey's import intensity. The pattern is a step. Conduct averages -0.285 over the two pre-shock years, rises across the whole withdrawal to a peak of 0.381 in 2015, and falls back to 0.066 once imports recover. The rise therefore does not depend on the linear specification. The pre-shock years are significantly negative, which the linear form cannot produce, so I read the annual estimates as confirming the timing of the response rather than its level. I use the linear form as a parsimonious summary of the episode.

Figure 4: Flexible Annual Buyer Conduct



Notes: Buyer conduct $\hat{\lambda}_y$ estimated separately for each calendar year, with 95% confidence intervals (conduct type "year dummies"; the rival-performance instrument interacted with year). The shaded band is the 2013-2015 low-import episode; the dashed vertical lines mark the three ownership consolidations (May 2014, July 2017, August 2018). Turkey's feeder-cattle import intensity is plotted on the secondary axis.

5 Consequences of a Supply Shock

This section quantifies and isolates different effects arising from a supply shock. Section 5.1 describes my main counterfactuals and decomposition of effects and Section 5.2 shows results and explores underlying mechanisms.

5.1 Decomposition of a Supply Shock

Once I have answered my first research question, I turn to the redistributive effect of the increase in buyer conduct during the low import episode (second research question). To do this, I propose 2 counterfactuals:

- (CF1) no change in buyer conduct -over 2013-2015 Turkey's import intensity in the conduct equation is replaced by the greater of its observed value and its 2011-2012 mean, so λ_t does not rise with the shock- with observed feeder cattle prices ($W_t^r = W_t^{r,obs}$)[37]
- (CF2) no change in buyer conduct, and feeder cattle prices at their counterfactual pre-shock level ($W_t^r = W_t^{r,CF}$).

[37]Taking the greater of the two keeps the no-disruption world from having less Turkish competition than actually occurred. It binds in the months when Turkey's purchases had already recovered past their pre-shock norm, almost all of them in 2015, and there the counterfactual coincides with the observed series.

In each case I solve equation (5) for the domestic and exported quantities. The counterfactual feeder price $W_t^{r,CF}$ estimates what feeder prices would have been had Turkey not reduced its purchases.[38]

Define M^{obs}, M^{CF1}, M^{CF2} as an equilibrium variable of interest observed, under CF1 and under CF2. Then, the effect of the low import episode can be decomposed into[39]

$$\Delta M = M^{obs} - M^{CF2} = \underbrace{\left(M^{CF1} - M^{CF2}\right)}_{M(\Delta \text{Cost})} + \underbrace{\left(M^{obs} - M^{CF1}\right)}_{M(\Delta \text{Conduct})}$$

For a specific equilibrium variable M, the supply shock effect decomposes into 2 different components: $M(\Delta\text{Cost})$ which corresponds purely to changes related to low feeder cattle imports from Turkey, while keeping buyer conduct constant. $M(\Delta\text{Conduct})$ -conditional on the cost effect- measures variation arising from buyers' change in their conduct.

For example, applied to consumer surplus, a positive $CS(\Delta\text{Cost})$ and a negative $CS(\Delta\text{Conduct})$ mean the conduct change partially offsets the benefit consumers get from cheaper cattle.

5.2 Quantitative Results

The baseline counterfactual reproduces the observed equilibrium by construction. The unobserved cost term η_{jt}^c is the residual that makes each firm's first-order conditions hold at the observed data, so re-solving the model at the estimated parameters returns the observed prices and quantities (Appendix S5.2).

Table 6 decomposes the low-import episode into a cost effect (ΔInput), a conduct effect (ΔConduct), and their sum (ΔTotal), each row an outcome in percent or millions of USD. Cheaper cattle alone would have helped the industry. The conduct response offsets that gain in full and turns the episode into a transfer from ranchers to meatpackers.

The cost effect is efficiency-improving. Lower feeder and livecattle prices raise meatpackers' purchases by 0.979%, more in exports than domestically since meatpackers have no market power abroad, and cut livecattle prices by 0.092%. Ranchers and meatpackers gain (\$35.985 and \$9.980 million), breeders lose, and domestic consumers are essentially unchanged, for a total surplus gain of 0.581%.[40]

[38] For a detailed description on how this variable is estimated see Appendix S4.5.

[39] Alternatively, in percentage terms:

$$\Delta\% M = \frac{M^{obs} - M^{CF2}}{M^{CF2}} = \underbrace{\frac{\left(M^{CF1} - M^{CF2}\right)}{M^{CF2}}}_{M(\Delta\%\text{Cost})} + \underbrace{\frac{\left(M^{obs} - M^{CF1}\right)}{M^{CF2}}}_{M(\Delta\%\text{Conduct})}$$

[40] Throughout, breeder surplus is an approximate object -the change in the value of breeders' feeder-cattle sales

Table 6: Supply Shock Decomposition

	ΔInput	ΔConduct	ΔTotal
Δ Q^m (in %)	0.979 (0.030)	−1.046 (0.154)	−0.066 (0.183)
Δ Q^d (in %)	0.029 (0.009)	−0.066 (0.012)	−0.037 (0.010)
Δ Q^e (in %)	1.368 (0.039)	−1.447 (0.216)	−0.079 (0.255)
Δ W^m (in %)	−0.092 (0.002)	−0.772 (0.067)	−0.863 (0.067)
Δ P^d (in %)	−0.008 (0.002)	0.020 (0.002)	0.011 (0.003)
Δ CS (in mill-USD)	0.153 (0.042)	−0.355 (0.035)	−0.203 (0.045)
Δ PS Rancher (in mill-USD)	35.985 (11.879)	−39.176 (3.446)	−3.191 (8.457)
Δ PS Breeder (in mill-USD)	−12.944 (2.471)	−29.771 (2.656)	−42.715 (5.125)
Δ PS MP (in mill-USD)	9.980 (0.255)	35.497 (4.540)	45.477 (4.476)
Δ TS (in mill-USD)	33.173 (9.365)	−33.805 (1.577)	−0.631 (7.824)
Δ TS (in %)	0.581 (0.164)	−0.592 (0.028)	−0.011 (0.137)
Δ TS excl. breeder (mill-USD)	46.117	−4.034	42.084

Notes: Decomposition of the 2013-2015 low-import episode (Section 5.1). ΔInput holds conduct fixed, and ΔConduct adds the change in buyer conduct. PS Rancher is fattener surplus, PS Breeder the approximate breeder surplus and PS MP meatpacker profit. Standard errors in parentheses come from a parametric bootstrap of the demand and supply slopes, using 120 draws with implied supply elasticity in $[0.7, 1.6]$ (Appendix S5.3).

The conduct effect works the other way. As meatpackers internalize rivals more, they cut purchases and push livecattle prices down a further 0.772%, so every agent loses except meatpackers, whose profit rises by \$35.497 million. Total surplus falls by 0.592%.

The two effects sum to a 0.863% fall in livecattle prices, most of it from conduct, so the change in conduct matters more than the cheaper input, and the meatpacker gain from conduct is about three and a half times the gain from the cost saving. Net total surplus changes by only −0.011%, not distinguishable from zero, and this near-neutrality is driven by the breeder term. Excluding it, the cost channel is a clear gain of 46.117 million and the conduct channel is a near-pure transfer, meatpackers gaining about what ranchers lose, so the with-breeder and excluding-breeder totals bracket the truth. What does not depend on

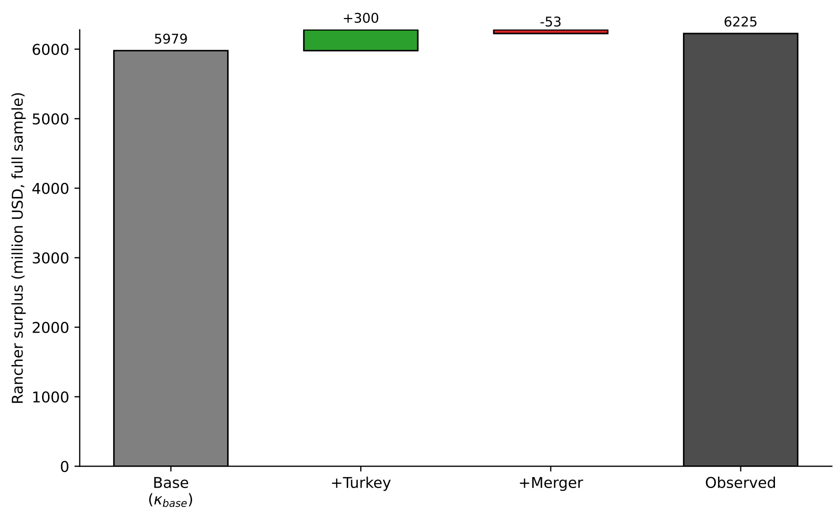
implied by the feeder-price pass-through- rather than a fully structural surplus, since I do not estimate a feeder-cattle supply curve (Appendix S5.2). Its sign is robust, though its magnitude should be read as approximate. Approximating an upstream producer-surplus component in this way is common in structural welfare analyses. Ciliberto *et al.* (2019), for example, report an *imputed* measure of farmers' net returns and treat cropland as approximately fixed.

the breeder term, or on the supply elasticity, is the redistribution. The conduct response redirects roughly \$35 million from ranchers to meatpackers (Appendix S4.4).

5.3 Transitory versus Permanent Effects: Input Competition and the Merger

The decomposition above isolates a single *transitory* episode, the fall in Turkey's feeder cattle imports and the conduct response it triggered. I now place it alongside the *permanent* change in market structure, the meatpacking consolidation, to compare the disciplining role of outside competition for feeder cattle with the harm from the merger. Both act on buyer power over cattle, Turkey through outside demand and the merger through domestic ownership and conduct. Table 7 and Figure 5 report a full-sample (2011-2019) decomposition, with the Turkey column holding feeder prices at their observed values (its separate effect on the *level* of feeder prices is not included) and the merger columns split into the *unilateral* (ownership) and *coordinated* (κ_{merger}) effects.[41]

Figure 5: Rancher-surplus waterfall



Notes: Full-sample (2011-2019) decomposition under the preferred specification. Base (κ_{base} only) $\rightarrow$ +Turkey $\rightarrow$ +Merger = Observed; bar heights are the change in rancher surplus attributable to each channel, in million USD.

Outside competition for feeder cattle is welfare-enhancing for ranchers. When Turkey competes for feeder cattle, livecattle prices are 1.823% higher and ranchers gain \$299.6 million, while meatpackers lose. The merger works in the opposite direction and is much smaller.

[41] I find no coordinated step. $\hat{\kappa}_{merger}$ is -0.003 with a standard error of 0.015, so the merger column is almost entirely the unilateral ownership change. Appendix S4.1 plots the monthly paths behind this decomposition, showing the Turkey channel switching on and off with the shock while the merger channels load permanently onto the second half of the sample.

Table 7: Turkey and the merger: full-sample decomposition

	Δ Turkey	Δ Merger		
		Unilateral	Coordinated	Total
Δ Q^m (%)	2.338 (0.327)	−0.583 (0.022)	0.182 (0.273)	−0.401 (0.294)
Δ Q^d (%)	0.202 (0.033)	0.186 (0.094)	0.013 (0.021)	0.199 (0.084)
Δ Q^e (%)	3.022 (0.426)	−0.828 (0.044)	0.237 (0.354)	−0.592 (0.396)
Δ W^m (%)	1.823 (0.206)	−0.485 (0.166)	0.143 (0.258)	−0.342 (0.423)
Δ P^d (%)	−0.059 (0.008)	−0.029 (0.015)	−0.004 (0.006)	−0.032 (0.011)
Δ CS (mill-USD)	2.411 (0.385)	1.433 (0.681)	0.152 (0.254)	1.585 (0.527)
Δ PS Rancher (mill-USD)	299.577 (31.678)	−76.995 (26.295)	23.626 (42.237)	−53.369 (68.426)
Δ PS Breeder (mill-USD)	203.981 (19.990)	−50.992 (17.130)	15.639 (27.908)	−35.352 (44.966)
Δ PS MP (mill-USD)	−277.629 (39.454)	−141.494 (43.018)	−22.219 (40.751)	−163.713 (8.424)
Δ TS (mill-USD)	228.340 (12.173)	−268.048 (85.776)	17.199 (29.673)	−250.849 (115.204)
Δ TS (%)	1.259 (0.067)	−1.478 (0.473)	0.095 (0.164)	−1.383 (0.635)

Notes: Full-sample (2011-2019) decomposition. The Turkey column holds feeder cattle prices at their observed values. The merger columns split the merger's effect into the ownership change (unilateral) and κ_{merger} (coordinated), measured with Turkey's conduct effect in place. Standard errors in parentheses come from a parametric bootstrap of the demand and supply slopes, using 120 draws with implied supply elasticity in $[0.7, 1.6]$ (Appendix S5.3).

Livecattle prices fall 0.342% and ranchers lose \$53.4 million. On both margins the trade channel is about five times the merger, though merger control is the lever a competition authority actually holds. As in Section 5.2, the total-surplus comparison leans on the approximate breeder term, so I compare the two on livecattle prices and rancher surplus, which do not depend on it.

I do not model the decision to merge. I take the observed ownership change as given and ask what it did to cattle prices and to rancher surplus.

The merger can act through two channels. Acquiring a plant moves its purchases from the rival term, which carries weight λ_t, into the own-firm term, which carries weight one. This is the unilateral channel. It lowers the livecattle price by 0.485% and rancher surplus by \$77.0 million. The second channel is a change in conduct toward the remaining rivals, which κ_{merger} measures. The estimate is -0.003 with a standard error of 0.015, and the channel moves livecattle prices by 0.143%, which is not distinguishable from zero.

So the merger moves cattle prices through the ownership change alone. Setting κ_{merger} to zero would give -0.485% rather than -0.342%, and the difference between the two is within sampling noise. The size of the unilateral channel is $(1 - \lambda_t)$ times the acquired plant's purchases times the slope of livecattle supply. It is largest when baseline conduct is lowest, that is, when firms were competing hardest before the deal.

The counterfactual holds marginal cost fixed, so it grants the merger no variable-cost efficiency. Under that assumption the plants that combine give up \$385.7 million of variable profit over the 5.7 years the deal is observed, while the plants that stay outside gain \$222.0 million. The merged firm contracts its purchases and rivals expand at the lower cattle price. This is the merger paradox of Salant *et al.* (1983) on the buyer side, large by construction with three plants out of about fifty, and a property of quantity setting rather than a result about this industry. Any offsetting saving would have to sit in fixed costs, which enter no first-order condition and so change no quantity and no price. It would need to be about \$68.1 million a year. Whether it was is not something I can measure, and nothing above depends on the answer.

This matters for merger review, since a saving that reaches consumers need not reach the cattle price, and a fixed saving reaches neither.[42] It also says how to read the counterfactual. To the extent the savings were fixed, holding marginal cost fixed is the right assumption and the harm to ranchers is an estimate. To the extent they were variable, marginal cost would fall, some of the saving would reach the cattle price, and the estimate is an upper bound. I cannot separate the two, so I report the harm under no variable-cost efficiency and note the direction of the bias.

6 Conclusion

I study how buyer power responds to trade in the Uruguayan meatpacking industry. A few meatpackers buy livecattle from many small ranchers. One stage upstream, Turkey is the main foreign buyer of feeder cattle, and it cut its purchases sharply and unexpectedly between 2013 and 2015. I treat that reduction as a natural experiment and estimate a structural model of demand and supply. In it, buyer conduct is not fixed. I let it respond to trade and to consolidation, and identify it from an instrument built on the slaughter performance of distant rival plants.

Three findings follow. First, buyer conduct responds to the trade shock. Meatpackers

[42] Article 43 of Decree 404/007 admits efficiencies only if they arise directly from the concentration and are *trasladables al consumidor*. In the 2024 review the parties claimed operational savings and synergies, organizational improvements and financial synergies, and the authority noted that multiplant operation shows no cost advantage over single-plant firms (Resolución 66/024).

internalized their rivals more as foreign demand receded, and by more than the fall in input prices alone would explain. A Rivers-Vuong test prefers this internalization model to non-cooperative oligopsony. Second, this response is largely a transfer. Cheaper cattle alone would have raised total surplus by about 0.581%, but the conduct response hands about \$35 million to meatpackers, close to one-for-one with the ranchers' loss, so the cost saving does not pass through to ranchers. The net effect on total surplus depends on the approximate breeder loss and is near zero, but the redistribution toward meatpackers is robust to it and to the supply elasticity. Third, on the buyer-power margin trade discipline is the larger force. Turkey's competition for feeder cattle and the merger push livecattle prices and rancher surplus in opposite directions, but by very different amounts (about +1.8% and +\$300 million against −0.3% and −\$53 million). The merger works through ownership rather than through coordinated conduct. It is worth doing for the firms involved only if it saved fixed costs. Such a saving does not reach the cattle price, so ranchers lose however efficient the merger was.

The results are also relevant for policies that restrict exports of raw agricultural inputs to promote domestic processing. Many such markets share the structure I study. Concentrated processors buy from many small farmers, and part of the crop -coffee, cocoa, cotton, sugar, dairy- can be sold raw to a foreign buyer. Mozambique's raw cashew restriction is the documented case (McMillan *et al.*, 2003). The standard prescription is to restrict raw-input exports so that more processing happens at home (Piermartini, 2004; Fung and Korinek, 2013; OECD, 2025).[43] My findings suggest such a restriction would remove the foreign demand that disciplines processor buyer power, and could therefore strengthen that power and transfer surplus from primary producers to the processing sector. I do not estimate the equilibrium effect of a permanent export restriction, so I offer this as an implication of the mechanism rather than an evaluated policy counterfactual.

More broadly, because buyer conduct responds to foreign demand and expands when that demand weakens, cost-reducing shocks need not pass through to suppliers, and firms that widen markdowns when input prices fall are harder for antitrust authorities to detect. How buyer conduct responds to trade and other market conditions across industries is a promising avenue for future research.

[43] Uruguay is itself a case. The meatpacking chambers commissioned CPA FERRERE (2017), which puts the value added lost to live cattle exports at USD 480 million over 2008-2016 and states that the outside market improves breeders' position relative to fatteners and meatpackers. The competition authority reaches the same conclusion for an earlier episode, reporting that when live exports opened in the 1990s producers gained bargaining power (Informe 172/2023), and the merging parties in the 2024 review argued that the option to export live cattle weakens the scope for coordination (Informe 50/024).

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A Data Management and Reduced Form Evidence

A.1 Data Sources and Construction

Plant-level dressing yield is reported by INAC from 2013 onward. For earlier months the projection described in Appendix B supplies fitted values from each plant's own later performance, so the conduct instrument before 2013 is a backward projection rather than a measurement.

Plant purchases are built from head counts rather than weights. INAC reports monthly slaughter by plant and animal category, and I convert these to kilograms of carcass using the industry-average carcass weight for each category in that month. The variable sums steers, cows and heifers, and excludes bulls and calves. For some plant-months the implied domestic quantity, purchases net of that plant's exports, is negative. I reallocate the shortfall across the remaining plants within the month in proportion to their purchase shares, holding the market total fixed.

I use information from different data sources. First, livecattle prices (W_t^m), domestic meat prices (P_t^d) and slaughtered quantities at the monthly level (q_{jt}^m) and export prices (P_t^e) can found in INAC (Instituto Nacional de Carne del Uruguay). Second, exported prices (P_{jt}^e) and quantities (q_{jt}^e) for meatpackers was obtain from the Uruguayan Customs Authority (provided by Penta-Transaction). Third, import prices (P_t^i) and quantities (Q_t^i) was obtain from the Uruguayan Customs Authority (provided by Penta-Transaction). Fourth, calves prices (W_t^r) was obtained from ACG (Asociacion de Consignatarios Ganaderos del Uruguay). Fifth, information about worldwide feeder cattle exports can be found in Trademap. Other variables related to costs, macroeconomic variables and weather were obtained from INE (Instituto Nacional de Estadística), BCU (Banco Central del Uruguay) and INUMET (Instituto Uruguayo de Metereología).

Table A.1: Summary Statistics

Variable	Min	Max	Mean	Std
Market Level (N = 132)				
P_t^d (in USD per tonne)	2223.18	4921.75	3834.00	562.75
Q_t^d (in tonnes)	1019.45	21086.60	11131.65	3903.44
UY GDP per capita (in USD)	9451.93	18703.86	15642.73	2724.53
P_t^{pigs} (in USD per tonne)	1290.00	2520.00	2017.35	326.98
P_t^{lamb} (in USD per tonne)	2371.75	6894.35	5201.43	890.36
P_t^i (in USD per tonne)	0.00	4351.17	703.63	1500.57
W_t^m (in USD per tonne)	1774.57	4227.01	3211.66	529.39
Q_t^m (in tonnes)	28660.97	56827.60	43175.39	6436.89
$E(P_{t+1}^e \vert t)$ (in USD per tonne)	2329.45	4380.39	3581.62	445.68
Fuel (in USD per gallon)	0.69	1.61	1.17	0.25
Fertilizer (in USD per tonne)	142.63	513.13	287.84	78.47
P^e (in USD per tonne)	2391.39	4478.00	3567.16	472.51
Rain (in mm)	88.90	1048.20	386.06	200.71
Plant Level (N = 5587)				
Q_j^m (in tonnes)	0.46	5909.60	1438.42	1202.59
Q_j^e (in tonnes)	0.00	5901.40	1057.78	1071.50
Q_j^d (in tonnes)	0.00	2884.21	375.67	384.47
P_j^e (in USD per tonne)	0.00	10456.27	2757.46	1741.12

A.2 Turkey's Import Policy: Chronology and Exogeneity

This appendix documents the policy nature and timing of the Turkish import switch that identifies my supply shock, drawing on the Turkish-language chronology in Akin *et al.* (2020), the red-meat price study of Ganioglu (2019), and a contemporaneous U.S. trade report (USDA Foreign Agriculture Service, 2015).

Turkey's cattle and red-meat imports are governed by tariff-quota decrees published in the Official Gazette (*Resmi Gazete*) and executed by state agencies. The Meat and Fish Authority (EBK), reorganized and renamed ESK (*Et ve Sut Kurumu*) in 2013, handles cattle and beef, and TIGEM handles breeding stock. Imports were financed through subsidized, interest-free state loans to producers and carried out at zero customs duty, with the explicit aim of dampening domestic red-meat inflation (Akin *et al.*, 2020).

The move from PRE to LOW is not a single ban but a tariff and authorization squeeze. On the cattle side, *Resmi Gazete* No. 28156 (28.12.2011) extended EBK's non-breeding cattle import authorization *only through the end of 2012*, so the state cattle channel sunsets at end-2012. On the carcass side, No. 28452 (30.10.2012) raised the carcass-meat import duty from 75% to 100%, making imported carcass unprofitable (Akin *et al.*, 2020; USDA Foreign Agriculture Service, 2015). The last full years with Turkey buying are thus 2011-2012.

The move from LOW to POST happens in steps. A feeder-cattle window opened in September 2014 (fattening cattle ≤ 300 kg, under one year, 15% duty, capped at 40% of domestic beef-cattle assets), and carcass and EU-origin openings followed in 2015 (No. 29445, 14.08.2015; No. 29459, 28.08.2015). The large cattle reopening is *Resmi Gazete* No. 29701 (03.05.2016), which authorized ESK to import 400,000 head of beef cattle and TIGEM 150,000 breeding heifers at zero customs, and made ESK the sole authority for beef-cattle imports (Akin *et al.*, 2020).

The trigger is Turkish price inflation and not Uruguayan cattle supply. Retail beef prices, flat at about 24 TL/kg through 2012-2013, rose from 25.9 TL/kg in January 2014 to 40.2 TL/kg by August 2015 (USDA Foreign Agriculture Service, 2015), and the Turkish authorities granted the 2015 import permissions expressly on account of rapidly rising prices. Ganioglu (2019) dates explosive episodes in the Turkish cattle and beef price indices that straddle the reopening decrees. The switch is therefore plausibly exogenous to Uruguay's cattle market.

The import path troughs in 2014. Table A.2 reports Turkey's annual cattle imports (all source countries) from Akin *et al.* (2020). The series does not show a flat 2013-2015 trough. It falls to a deep floor in 2014 (24,396 head, a 94% drop from 2012), with 2013 a wind-down and 2015 a rebound year. This shape is consistent with the closure biting through end-2012 and the reopening starting in September 2014, and it implies that the second half of 2015 is best read as a transition into POST rather than as part of the LOW window.

A.3 Evidence of Turkey's Impact on Feeder Cattle Prices

I run the following regression

$$W_t^r = \sigma_t + \beta_1 P_t^e + \beta_2 P^{*,urea} + \beta_3 P^{*,gas} + \beta_4 \text{Turkey}_t + \epsilon_t$$

where W_t^r is the price of feeder cattle (in USD per tonne), σ_t are variables controlling time trends (linear and quadratic trends and dummies for 2011-2016 and 2017-2019), $P^{*,urea}$ and $P^{*,gas}$ are input prices that control for supply factors, P_t^e are meat export prices (in USD

Table A.2: Turkey's cattle and red-meat imports (all sources), 2010-2018

Year	Live cattle (head)	Carcass/piece meat (t)
2010	120,021	50,658
2011	392,231	110,731
2012	422,869	26,436
2013	159,766	6,141
2014	24,396	640
2015	154,194	17,574
2016	430,180	5,659
2017	775,741	18,857
2018	1,344,563	55,752
Total	3,823,961	292,448

Notes: Turkey's annual live-slaughter/feeder cattle imports (head) and carcass/piece-meat imports (tonnes), all source countries, from Akin *et al.* (2020), Table 1 (p. 86).

per tonne) and Turkey is a variable measuring the impact of Turkey's imports. $\beta_4 > 0$ will indicate that Turkey's imports have a positive effect on prices. Table A.3 shows results.

Table A.3: Turkey's Imports and Feeder Cattle Prices

	Turkey (dummy)	Turkey (tonnes)	Both
Turkey (dummy)	143.48***		182.62***
	(34.80)		(46.23)
Turkey Imports (tonnes)		0.01**	−0.01
		(0.00)	(0.00)
Export Price P_t^e	0.31***	0.34***	0.31***
	(0.07)	(0.07)	(0.06)
Fuel Price	539.48***	415.74***	561.13***
	(117.68)	(116.70)	(119.28)
Fertilizer Price	0.37	0.38	0.36
	(0.26)	(0.29)	(0.26)
Trend	−0.86	−1.41	−0.34
	(3.49)	(3.71)	(3.57)
Trend^2	0.02	0.02	0.02
	(0.02)	(0.02)	(0.02)
Period 2011-2016	133.25	218.38	98.20
	(123.41)	(134.02)	(131.51)
Period 2017-2019	95.00	215.14	63.22
	(134.33)	(140.93)	(143.48)
Constant	148.75	212.34	129.38
	(177.22)	(194.08)	(178.55)
Observations	132	132	132
R^2	0.78	0.76	0.78

Notes: Standard errors in parentheses. Dependent variable is the calf price. Period dummies mark 2011-2016 and 2017-2019, with 2009-2010 as the base. *, **, *** denote significance at the 10%, 5%, and 1% level.

The first column uses a dummy equal to one in each month Turkey imports cattle. Feeder cattle prices are about 143.5 USD per tonne higher in those months, around 6.5% of the mean price. The second column measures the impact by imported tonnes. An additional imported tonne raises the price by about 0.010 USD, an elasticity of about 0.014 at the sample means. Both results show a positive effect, so lower Turkish imports should mean lower feeder cattle prices. The third column includes both variables. The effect of an import month rises to about 182.6 USD (around 8.3%), while the coefficient on tonnes is negative and not statistically significant.

A.4 Reduced-Form Evidence of Buyer Conduct

The evidence above shows that Turkey's imports move feeder cattle prices, the input channel of the shock. I now provide a reduced-form counterpart for the conduct channel that my structural model identifies. As Section 2.2 notes, if buyer conduct rises when Turkey reduces its imports, the strategic-substitute response of own purchases to *rival* performance -the object that identifies conduct- should itself strengthen (become more negative) as Turkey's imports fall, since a firm that internalizes its rivals offsets an increase in their purchases more than a non-cooperative one. I test this directly by interacting rival performance with a continuous measure of Turkey's import intensity (feeder cattle imports in millions of kilograms, smoothed with a centered three-month moving average and standardized, built exactly as in the structural estimation).

Table A.4: Reduced-Form Evidence of Buyer Conduct

	(1) Baseline	(2) Full 2011-2019	(3) Pre-merger 2011-Apr 2014
Performance (Own)	1.1779	1.0734	−6.0778
	(3.5315)	(3.4965)	(4.0677)
Performance (Rival)	−4.5326	−4.4188	−0.4487
	(3.9469)	(3.9107)	(4.1257)
Performance (Rival) × Turkey intensity		0.0481*	0.2667**
		(0.0267)	(0.0981)
Observations	4,944	4,944	1,781
R2	0.8725	0.8726	0.9095
Price controls	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes
Conduct trends	Yes	Yes	Yes

Notes: OLS of log live-cattle purchases on own and rival slaughter performance. Turkey intensity is feeder-cattle imports in millions of kg, as a centered three-month moving average, standardized. Column (3) uses the pre-merger window, where Turkey is the only conduct shifter. Price controls are the export-price lead and calf, lamb and pig prices. Standard errors clustered by plant in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level.

Table A.4 reports the results. Column (1) reproduces the relevance specification. Own performance raises own purchases and rival performance lowers them ($\beta_1 < 0$). Column (2) adds the interaction over the full sample.[44] The interaction is positive and significant at the

[44] Turkey's import intensity is a market-level series whose level is already absorbed by the conduct-period trends,

10% level (0.048). The rival-performance response is stronger (more negative) when Turkey imports less, precisely the pattern implied by my structural finding that conduct rises when Turkey reduces its purchases. Because the merger episode also shifts conduct and overlaps with the later years, column (3) restricts the sample to the pre-merger window (2011 to April 2014), where the only conduct shifter is Turkey; there the interaction is larger (0.267) and significant at the 5% level, consistent with my structural finding that the conduct response to Turkey is, if anything, stronger where no merger is present. I therefore read this exercise as consistent with the *direction* of my structural estimate -buyer conduct rises as competition for feeder cattle falls- while emphasizing that the *magnitude* of conduct is identified through the structural model.

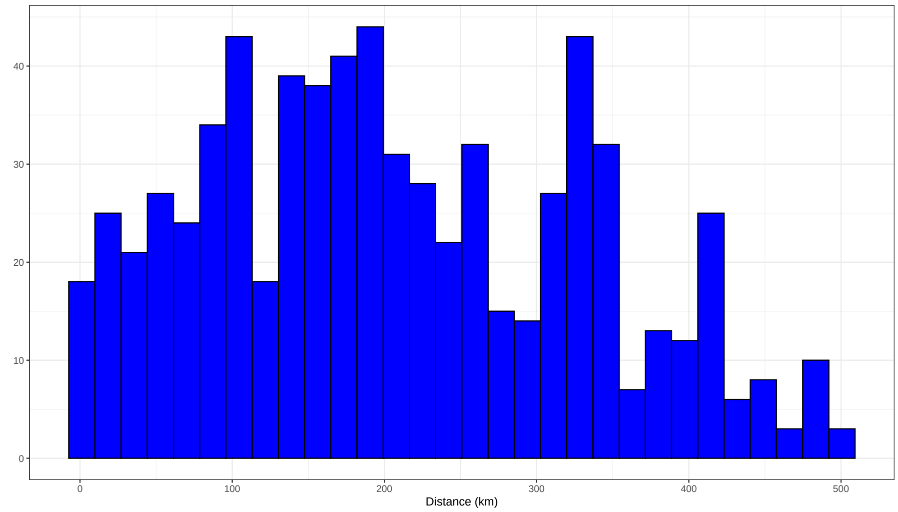
B Construction of the Conduct Instruments

I describe how I construct the instruments for conduct. Performance is the dressing yield defined in Section 2.1, and it is the persistent cross-plant component that is informative here. Suppose that in a given period rival meatpackers have higher performance. Because quantities are strategic substitutes, I expect own purchases to fall, and how much they fall identifies conduct. Under no internalization ($\lambda = 0$), the rivals' higher performance reaches firm j only through higher livecattle prices, which lowers its own purchases. When $\lambda > 0$ there is an additional channel, so I expect a stronger reduction in own purchases.

I proceed in the following way. From disaggregated performance data, I obtain weighted average performance $\text{performance}^a_{jt}$ for meatpacking plant j in month m for animal $a = \{\text{steer}, \text{heifer}\}$. Additionally, given different meatpacking plant locations, I define d_{jk} as the distance between meatpacking plants j and k. My goal is to use both $\text{performance}^a_{jt}$ and d_{jk} to construct an instrument from the performance of geographically distant rival plants (see Figure B.1 for a histogram of pairwise distances).

so it enters only through the interaction with rival performance.

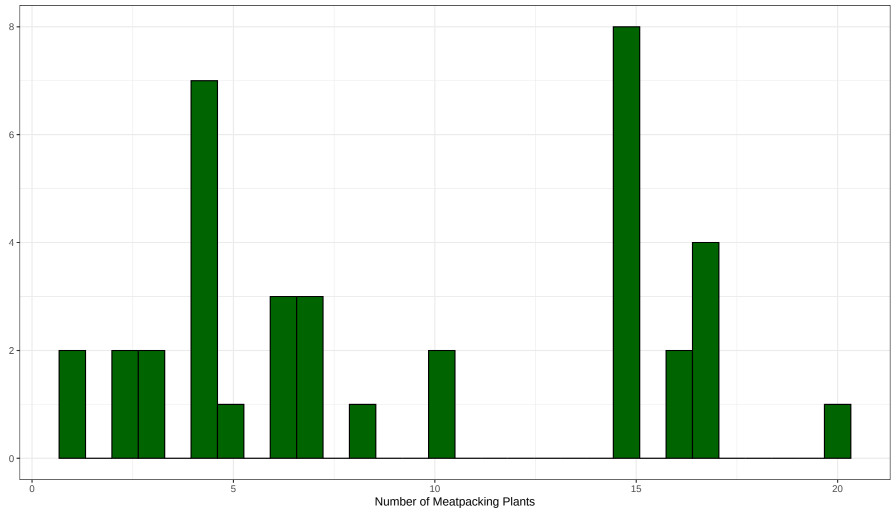
Figure B.1: Distribution Pairs of Distances



Notes: Only for d_{jk} such that $j \neq k$. Percentiles (km): $p_{10} = 46.945$, $p_{25} = 107.050$, $p_{50} = 191.460$, $p_{75} = 311.960$ and $p_{90} = 382.120$.

I first define a threshold distance $\bar{d}$. For a given j, plants within $d_{jk} \leq \bar{d}$ are treated as local (Figure B.2 reports how many plants fall inside $\bar{d} = 50$km), and I build the instrument from the complementary set of *far* rivals, $d_{jk} > \bar{d}$, which do not share j's local input and cattle-sourcing conditions.

Figure B.2: Local Competition: Number of Meatpacking Plants



Notes: Number of meatpacking plants at $\bar{d} = 50$km (or less) distance. Percentiles (number of meatpacking plants): $p_{10} = 2.7$, $p_{25} = 4.0$, $p_{50} = 7.0$, $p_{75} = 15.0$ and $p_{90} = 17.0$.

I continue and proceed to define an instrument

$$\text{performance (rivals)}^a_{jt} = \sum_{k \in G(j;\bar{d})} \text{performance (own)}^a_{kt}$$

with $G(j;\bar{d})$ as the group of k meatpacking plants at least $\bar{d}$ distance from meatpacking plant j. In this way I define 2 IVs (one for heifers performance $(\text{rivals})^h_{jt}$ and another for steers performance $(\text{rivals})^s_{jt}$). In order to observe how relevant is this instrument for livecattle purchases, let's define the following regression:

$$\begin{aligned} q^m_{jt} =& \sigma_j + \sigma_t + \beta_0 \text{Performance (Own)}^a_{jt} + \beta_1 \text{Performance (Rivals)}^a_{jt} + \\ & \text{Demand Factors}_{jt} + \text{Supply Factors}_{jt} + \eta_{jt} \end{aligned}$$

estimated in logs.[45]

Column (1) of Table A.4 estimates this equation with plant fixed effects and conduct-period trends. Own performance enters positively and rival performance negatively ($\beta_1 < 0$), the sign the strategic-substitute argument predicts, but neither is precise once the fixed effects and trends absorb the persistent variation. Relevance for the structural estimation rests on

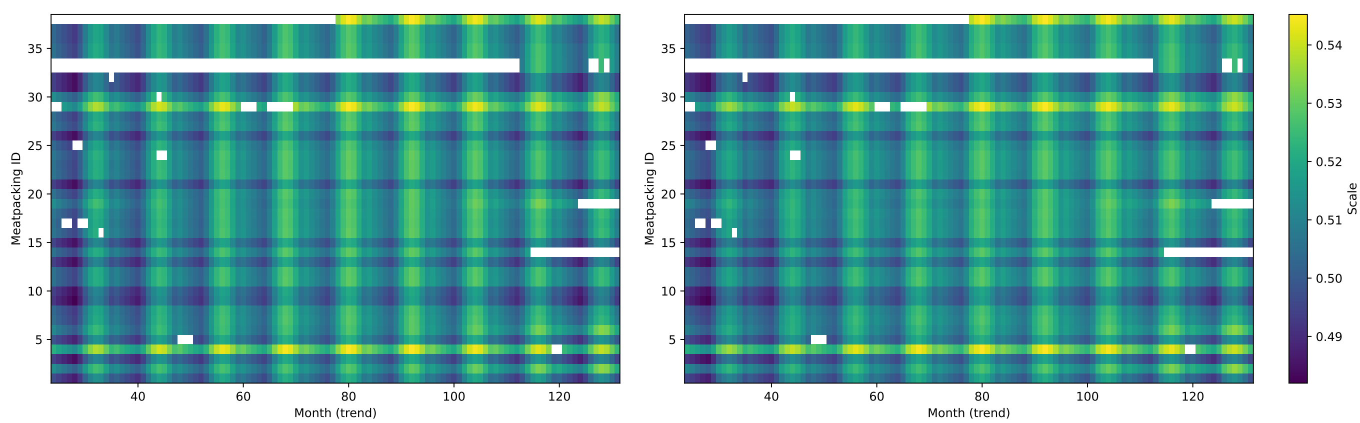
[45]Shown for heifers. Results for steers are similar qualitatively.

the first stage of the conduct GMM, where the Kleibergen-Paap statistic is 184.7.

For the structural conduct estimation I do not use realized far-rival performance. I use its projected component, the fitted value from a regression of plant dressing yield on plant fixed effects, plant-specific linear and quadratic trends, plant-by-animal-type levels and slopes, and month of year interacted with animal type, averaged over rivals beyond 50 km. The projection uses no contemporaneous input, so it is a function of plant identity, the calendar and animal type alone. It is the systematic part of a plant's dressing performance, which is what a rival can form expectations about when deciding how much cattle to buy. The relevance shown above carries over, with a strong first stage (Kleibergen-Paap F of 184.7, Table C.3).

Figure B.3 plots the two instruments across plants and months. They are used as constructed, with no further demeaning.

Figure B.3: Conduct Instrumental Variables



(a) Performance (Rivals, Heifers) (b) Performance (Rivals, Steers)

Notes: Data is at the meatpacker and monthly level. Values are the projected far-rival dressing yield as used in estimation, with no demeaning.

Finally, to identify the three conduct coefficients (κ_{base}, κ_{turkey}, κ_{merger}) I interact these rival-performance instruments with period indicators, which yields more moment conditions than the three conduct coefficients and identifies the parametrization of buyer conduct in Equation (6).

C Additional Structural Estimation Results

C.1 A Conduct Test: Internalization versus Non-Cooperative Oligopsony

My conduct estimates report a parameter and its standard error. As a complementary check I ask a model-selection question. Do the data prefer a model in which firms internalize their rivals over one of non-cooperative (Nash) oligopsony? I use the Rivers-Vuong test as implemented by Backus *et al.* (2021), which compares the fit of two *non-nested* conduct models and is more robust to misspecification of the cost function than the nested t-test on $\hat{\lambda}$. I stress that the $\lambda = 0$ benchmark is Nash oligopsony, *not* price-taking. The own-price markdown $\frac{\partial W}{\partial Q^m} q_j^m$ is present in both models, so what the test isolates is the *rival-internalization* (coordinated) component of buyer conduct on top of each firm's unilateral market power.

I fix conduct in each model rather than estimating it, so the two are non-nested points rather than a parameter restriction. In the *non-cooperative* model I impose $\lambda = 0$ -each firm exercises its own buyer power in procurement but does not internalize rivals- and re-estimate only the cost parameters; in the *internalization* model I impose the full estimated path $\hat{\lambda}_t = \hat{\kappa}_{base} + \hat{\kappa}_{turkey}\text{Turkey}_t + \hat{\kappa}_{merger}\text{Merger}_t$. For each model m I form the sample moment $\hat{g}_m = n^{-1} Z' \hat{\eta}_m$ (with Z the rival-performance instruments and $\hat{\eta}_m$ the implied marginal-cost residual) and the lack of fit $Q_m = \hat{g}_m' W \hat{g}_m$ on the common two-stage-least-squares metric $W = (Z'Z/n)^{-1}$. The Rivers-Vuong statistic $T_{RV} = \sqrt{n}\,(Q_P - Q_B)/\hat{\sigma}$ is asymptotically standard normal under equal fit; $T_{RV} > 0$ favors buyer power.

Table C.1 reports the result. The non-cooperative model fits worse ($Q_P = 2{,}932$ versus $Q_B = 2{,}259$) and the difference is large. $T_{RV} = 4.21$, so the data reject equal fit in favor of the internalization model at any conventional level. Intuitively, the rival-performance instruments -which are strong for estimation (Kleibergen-Paap $F = 184.7$)- are systematically correlated with what the non-cooperative model must attribute to unobserved cost.

C.2 Separating the Turkey and Merger Channels

The first meatpacking consolidation (May 2014) falls inside the low-import window, so in the full sample the Turkey and merger conduct coefficients are identified from an overlapping stretch and their separation rests on the linear parametrization of Equation (6). A natural concern is that $\hat{\kappa}_{turkey}$ absorbs merger-driven coordination that happens to comove with the import trough. I address this by re-estimating buyer conduct on windows where market structure is constant by construction, so that κ_{turkey} is identified with the merger held fixed by design rather than by functional form.

Table C.1: Rivers-Vuong conduct test: internalization versus non-cooperative oligopsony

	Nash oligopsony ($\lambda = 0$)	Internalization ($\hat{\lambda}_t$)
Lack of fit Q_m	2932	2259
Rivers-Vuong: $T_{RV} = 4.21$ (internalization preferred)		
Kleibergen-Paap first-stage $F = 185$; $N = 5587$; 52 moment conditions.		

Notes: Lack of fit $Q_m = \hat{g}_m' W \hat{g}_m$ with $\hat{g}_m = n^{-1} Z' \hat{\eta}_m$ and $W = (Z'Z/n)^{-1}$ (a common metric for both models). The $\lambda = 0$ column is non-cooperative (Nash) oligopsony. The internalization column imposes the estimated path $\hat{\lambda}_t$. $T_{RV} = \sqrt{n}\,(Q_P - Q_B)/\hat{\sigma}$. Positive values favor internalization. Preferred specification, with the by-product level and the non-cattle cost share calibrated as in Section 4.3. The non-cooperative model re-estimates its own cost coefficients freely, so the comparison is over conduct and not over cost.

Table C.2 reports the result. I use one window, the reopening window (May 2014 to June 2017), between the first and second consolidations, where ownership is fixed while Turkey's imports recover. There I drop the merger term and estimate base and Turkey conduct only, since a single window cannot identify the instrument interactions. As a benchmark I also drop the merger term from the full sample. I do not estimate a pre-merger window. Plant-level dressing yield is reported only from 2013, so before 2014 the instrument would be a backward projection of each plant's later performance, and it has no first-stage power there.

Dropping the merger term from the full sample leaves $\hat{\kappa}_{turkey}$ at -8.489 with the term in and -8.826 with it out, so the estimate is not absorbing merger-driven coordination. In the reopening window, where ownership is fixed by construction, it is -10.122 and remains significant at the 1% level. The sign and significance therefore do not rest on the linear parametrization that separates the two channels in the full sample.

C.3 Instrument Strength

Table C.3 reports weak-instrument diagnostics for the interacted instrument set constructed in Appendix B. The per-parameter Sanderson-Windmeijer F statistics are large for all three conduct coefficients, and the Kleibergen-Paap F over the conduct block is 184.7.

C.4 Robustness of the Conduct Estimates

The preferred specification in Section 4.3 makes two choices beyond the two calibrations reported there. It controls for time with period-specific trends, and it averages the instrument over rivals more than 50 km away. This appendix varies each in turn, holding everything else fixed. Both tables are estimated without the calibrations, so they isolate the choice being varied.

Table C.4 changes the time controls. $\hat{\kappa}_{turkey}$ is negative in all four columns. It is largest

Table C.2: Buyer conduct in windows with constant market structure

	Full (pooled)	Full (base+Turkey)	Reopening (2014-2017)
κ_{base}	0.121^{***}	0.120^{***}	0.155^{***}
	(0.035)	(0.018)	(0.018)
κ_{turkey}	-8.489^{***}	-8.826^{***}	-10.122^{***}
	(1.761)	(0.989)	(2.069)
κ_{merger}	-0.003		
	(0.015)		
Kleibergen-Paap F	184.7	178.8	34.4
N (obs.)	5587	5587	2019

Notes: Buyer-conduct estimates by sample. Column 1 is the pooled specification (base, Turkey, merger) on the full sample; column 2 drops the merger term; column 3 estimates base and Turkey conduct on the reopening window, between the first and second mergers, where ownership is fixed while Turkey's imports recover. A pre-merger window is not reported: plant-level dressing yield is available only from 2013, so an instrument built from it has no first-stage power before 2014. κ_{turkey} is the coefficient on Turkey's feeder-cattle imports in the conduct equation. Sandwich standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level.

Table C.3: Conduct Estimation: First-stage Instrument Strength

	First-stage F
Baseline κ_{base}	322.6
Turkey intensity κ_{turkey}	283.3
Merger κ_{merger}	408.7
Kleibergen-Paap F	184.7

Notes: Weak-instrument diagnostics for the conduct GMM (Equation 5). The excluded instruments are far-rival performance interacted with period dummies. Per-parameter rows report the Sanderson-Windmeijer first-stage F, net of the other conduct regressors. Both statistics are heteroskedasticity-robust, like the conduct standard errors.

with no trend, where the level of Turkey's imports is not absorbed. It is smallest and insignificant under year dummies, which absorb most of the variation the shock provides. Period-specific trends lie between the two. The merger term moves across these columns, which is why Section 4.3 does not rely on it.

Table C.4: Conduct estimates across time controls

	(1) Uncalibrated	(2) No trend	(3) Linear trend	(4) Year FE
Specification				
Time controls	Period trends	None	Linear	Year dummies
Buyer conduct $\lambda_t = \kappa_{\text{base}} + \kappa_{\text{turkey}}\,\text{Turkey}_t + \kappa_{\text{merger}}\,\text{Merger}_t$				
Baseline κ_{base}	0.294^{***}	0.338^{***}	-0.001	0.318^{***}
	(0.079)	(0.094)	(0.176)	(0.075)
Turkey intensity κ_{turkey}	-10.150^{***}	-20.088^{***}	-7.592^{***}	-11.138^{***}
	(2.293)	(1.348)	(2.118)	(3.997)
Merger κ_{merger}	-0.032	0.046^{***}	0.150^{***}	-0.079
	(0.021)	(0.006)	(0.052)	(0.060)
Diagnostics				
Non-cattle MC (% of output value)	-2.2	-0.5	14.6	4.4
Implied MC < 0 (% of obs.)	61	56	7	37
Hansen J (df)	231 (4)	139 (4)	308 (4)	94 (4)
First-stage F (Kleibergen-Paap)	184.7	103.2	37.3	12.2
Observations	5,587	5,587	5,587	5,587

Notes: Each column changes only the time controls in the pricing equation, holding the instrument fixed. Column (1) is the preferred equation WITHOUT the two calibrations of Section 4.3, so it is not the preferred specification and its levels differ from the body table. Buyer conduct λ_t is estimated by three-step GMM. The excluded instruments are the far-rival dressing yield of the two animal types, from the plant-specific-trend projection, interacted with period indicators. No substitute-meat price instruments are used. Non-cattle MC as % of output value is the implied non-cattle marginal cost relative to the mean export price. Sandwich standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level.

Table C.5 changes the set of rivals the instrument averages over, from all plants beyond 50 km to distance bands and to the nearest three or five. The estimates are almost unchanged. The instrument therefore works through market-wide yield variation and not through any particular neighbour.

Table C.5: Conduct estimates across rival sets

	(1) Uncalibrated	(2) 50-150 km	(3) 50-200 km	(4) 5 nearest	(5) 3 nearest
Specification					
Rival set	> 50 km	50-150 km	50-200 km	5 nearest > 50 km	3 nearest > 50 km
Buyer conduct $\lambda_t = \kappa_{\text{base}} + \kappa_{\text{turkey}}\,\text{Turkey}_t + \kappa_{\text{merger}}\,\text{Merger}_t$					
Baseline κ_{base}	0.294***	0.403***	0.336***	0.419***	0.427*
	(0.079)	(0.088)	(0.050)	(0.075)	(0.249)
Turkey intensity κ_{turkey}	−10.150***	−12.188***	−9.488***	−12.873***	−11.076***
	(2.293)	(1.785)	(1.595)	(1.854)	(2.494)
Merger κ_{merger}	−0.032	−0.060***	−0.067***	−0.060***	−0.079***
	(0.021)	(0.014)	(0.012)	(0.015)	(0.018)
Diagnostics					
Non-cattle MC (% of output value)	-2.2	-1.9	2.2	-2.8	-2.9
Implied MC < 0 (% of obs.)	61	61	48	64	64
Hansen J (df)	231 (4)	121 (4)	149 (4)	142 (4)	64 (4)
First-stage F (Kleibergen-Paap)	184.7	46.9	66.8	40.9	23.7
Observations	5,587	5,587	5,587	5,587	5,587

Notes: Each column changes only the set of rivals the instrument averages over, holding the time controls fixed at period-specific trends. Column (1) is the preferred equation without the two calibrations of Section 4.3. Buyer conduct λ_t is estimated by three-step GMM. The excluded instruments are the far-rival dressing yield of the two animal types, from the plant-specific-trend projection, interacted with period indicators. No substitute-meat price instruments are used. Non-cattle MC as % of output value is the implied non-cattle marginal cost relative to the mean export price. Sandwich standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level.

C.5 The Projection Behind the Yield Instrument

I identify λ_t off far-rival dressing yield, projected on predetermined plant and animal-type structure alone. This appendix asks whether the estimate depends on that choice, and in particular on excluding contemporaneous national yield from the projection. Table C.6 reports the preferred instrument alongside an alternative projection of the same yield over the same rival set. Neither uses substitute-meat prices. The estimates agree. $\hat{\kappa}_{turkey}$ is -8.489 under the preferred instrument and -8.629 under the alternative, and $\hat{\kappa}_{base}$ and $\hat{\kappa}_{merger}$ are effectively unchanged. The preferred instrument has the stronger first stage, with a Kleibergen-Paap F of 184.7 against 44.0. The instrument therefore carries persistent variation in rival scale, which is the variation a sustained shift in outside demand produces.

Table C.6: Conduct estimates under alternative projections of far-rival yield

	Preferred (plant-trend projection)	Alternative projection (national-yield projection)
κ_{base}	0.121***	0.048
	(0.035)	(0.031)
κ_{turkey}	−8.489***	−8.629***
	(1.761)	(2.375)
κ_{merger}	−0.003	0.105***
	(0.015)	(0.025)
Kleibergen-Paap F	184.7	44.0
N (obs.)	5587	5587

Notes: Conduct estimates under alternative excluded instruments (preferred specification, full sample). Column 1 is the preferred instrument. Column 2 is the earlier projection, which includes contemporaneous national yield and plant fixed effects but no plant-specific trends, and which uses observed plant yield where it is recorded. κ_{turkey} is the coefficient on Turkey's feeder-cattle imports in the conduct equation. Sandwich standard errors in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% level.

C.6 The Export Price and Domestic Marginal Revenue

Under the pricing first-order conditions, an exporting plant equates both its export price and its domestic marginal revenue to marginal cost. As discussed in Section 4.3, serving the export market carries a differential cost relative to the domestic market -logistics, certification, chilling and freezing, and the export-cut composition- so the two objects are equal only up to that differential, $p^e_t = \mathrm{MR}^d_{jt} + c^e$. I absorb the average differential c^e with an export-channel indicator in the pricing regression, so identification of buyer conduct does not rely on the two series being equal in levels; what it requires is that they *comove*, since both track marginal cost.

They do. The monthly export price and the median domestic marginal revenue implied by my demand estimates comove positively over the full sample (correlation 0.68 in levels, 0.71 after a centered three-month moving average), and the comovement is strong in the years outside the shock (0.90-0.95 over 2016-2019). It weakens during the 2013-2015 shock window, where the two temporarily decouple; at the firm level this is driven by a small number of plants with unusually high export unit values. Because the export-channel indicator differences out only the *average* wedge, this within-window, time-varying part of the differential is absorbed into the pricing residual η^c_{jt}, the same residual that, folded into implied cost, accounts for the export-row negative non-cattle marginal costs discussed in Section 4.3. Since buyer conduct is identified from the rival-performance instruments rather than from this wedge, the decoupling loads onto implied cost, not onto the conduct estimates, and the counterfactuals use the realized cost (with η included), so they reproduce the observed equilibrium regardless.

D Why Buyer Conduct Can Rise under a Persistent Supply Shock

This appendix develops the model I use to interpret the increase in buyer conduct I estimate in Section 4. It is a repeated Cournot duopsony with three features that match my industry (Section 2). Buyer market power upstream, an export outlet at an exogenous price, and a per-period cost of sustaining collusion. I model the shock as a persistent shift in the inverse supply curve rather than as an i.i.d. draw, to match the three-year reduction in Turkish feeder cattle purchases that I exploit.

The purpose of this model is limited. It shows that a persistent reduction in Turkish demand can make coordination easier to sustain in a repeated oligopsony when coordination involves a fixed per-period cost. I do not use this model to impose restrictions on the empirical specification.

D.1 Setup

Two symmetric firms $i \in \{1, 2\}$ purchase livecattle and sell meat either domestically or abroad. In the upstream market they face the inverse supply curve

$$W(Q^m) = z + xQ^m, \qquad x > 0, \tag{7}$$

where $Q^m = q^m_1 + q^m_2$ is aggregate livecattle purchases and z is a supply shifter. Downstream, firms face the domestic inverse demand curve $P(Q^d) = a - bQ^d$ with $Q^d = q^d_1 + q^d_2$, and can export any quantity at the exogenous price P^e, with $a > P^e$. Each unit purchased upstream is sold either domestically or abroad, so $q_i^d + q_i^e = q_i^m$. Per-period profits are

$$\pi_i = P(Q^d)q_i^d + P^e q_i^e - W(Q^m)q_i^m. \tag{8}$$

The parameter z indexes the regime. Turkish demand for feeder cattle raises the price of the calves that ranchers place on feed and therefore shifts the livecattle supply curve upward; its reduction shifts the curve down. I write z^T for the regime in which Turkey purchases and $z^{NT} < z^T$ for the regime in which it does not, and treat each regime as permanent from the point of view of the firms.[46]

Firms sustain collusion with grim-trigger strategies and share the discount factor $\delta \in (0, 1)$. Sustaining the arrangement costs each firm $F > 0$ per period on the collusive path; the cost is not incurred following a deviation. Such costs are documented in the cartel literature and include internal organization (Baker and Faulkner, 1993), coordination and monitoring of allocations (Harrington Jr, 2006), detection avoidance (Harrington Jr, 2004, 2005; Harrington Jr and Chen, 2006) and concealment effort (Avramovich, 2010, 2020). The industry provides direct evidence that F is positive. Producer complaints about the formation of livecattle prices during the low-import period led the competition authority to commission external analyses of pass-through from export to producer prices (Section 2.1). Following Harrington Jr (2021), firms need not be sanctioned for such costs to be economically relevant; the exposure to scrutiny and the resources absorbed by responding to it are themselves realizations of F. That this scrutiny arose during the period in which I estimate conduct to have been strongest is what the model implies, since F is incurred on the collusive path and not following a deviation.

I hold F constant across regimes throughout.[47] All that Proposition 1 requires is that the cost of sustaining coordination not scale with the size of the market; the entire comparative static then operates through the surplus available to be divided.

[46] This is the substantive departure from Rotemberg and Saloner (1986), in which the state is drawn i.i.d. each period and the relevant comparison is across states *within* a single stochastic environment. In that formulation the deviation temptation scales with the current state while the punishment scales with the unconditional mean, so the constraint binds hardest in the state with the largest surplus, which here would be the low-import regime, the opposite of what I find. Because the reduction in Turkish purchases lasted three years and was driven by a sequence of decrees rather than by recurrent commercial fluctuation (Section 2.1), the persistent-regime formulation is both the better description of the setting and the one that delivers the correct sign without further assumptions.

[47] One could instead allow the coordination cost to depend on the regime, and in particular to fall when Turkish purchases fall sharply. A visible and legitimate reason for livecattle prices to decline may reduce the probability that a further reduction is read as an unlikely realization by ranchers or by the competition authority, in the sense of Harrington Jr and Chen (2006). Allowing $F_{NT} < F_T$ reinforces the comparative static of Proposition 1 but is not needed for it, and I do not rely on it. Note also that the scrutiny described above materialized during the low-import period, which cuts against this channel.

D.2 Separation of Downstream and Procurement Decisions

Substituting $q_i^e = q_i^m - q_i^d$ into (8) and collecting terms gives the following decomposition.

Lemma 1. *Let $A \equiv a - P^e$ and let $m \equiv P^e - z$ denote the procurement margin. Then*

$$\pi_i = \underbrace{\left(A - bQ^d\right) q_i^d}_{\textit{downstream block}} + \underbrace{\left(m - xQ^m\right) q_i^m}_{\textit{procurement block}}. \tag{9}$$

The two blocks share no choice variable. Provided both firms export at the margin, the equilibrium of the two-market game is the product of the equilibria of two independent Cournot games. A selling game with intercept A and slope b, and a buying game with intercept m and slope x.

Three implications are worth stating. First, the export price plays a dual role: downstream it is the opportunity cost of selling at home, and upstream it is the marginal revenue product of a head of cattle. Second, the supply shifter z enters *only* through the procurement margin $m = P^e - z$, so the entire mechanism operates in the buying game. Third, domestic demand parameters do not appear in the procurement block at all. Downstream market power is inframarginal because the export market absorbs the marginal animal, which is why I can identify buyer conduct without taking a stand on seller conduct.

Lemma 1 holds only where the export market is the marginal outlet, and I state that as an assumption maintained throughout the appendix.

Assumption 1 (Exporting at the margin)**.** *Each firm exports a positive quantity in every configuration considered, $q_i^e = q_i^m - q_i^d > 0$.*

Assumption 1 is a restriction on parameters, not an additional restriction on behavior. Under non-cooperative behavior it holds when $m/(3x) > A/(3b)$, that is $mb > Ax$; under collusion in the buying game the purchased quantity falls and the condition tightens to $mb > (4/3)Ax$. Given that exports account for the large majority of Uruguayan production over my sample (Section 2.1), I treat it as satisfied throughout. A collusive arrangement severe enough to push purchases below domestic requirements would relink the two blocks, so the assumption also bounds the range of conduct over which the model applies.

Because of Lemma 1, the remainder of this appendix works exclusively with the procurement block, whose per-period profit is $\pi_i = (m - xQ^m)q_i^m$.

D.3 Collusion with a Fixed Cost

Solving the buying game in the three relevant configurations - non-cooperative play, joint profit maximization, and optimal one-shot deviation from joint profit maximization - gives the per-firm outcomes in Table D.1.

Table D.1: Per-firm outcomes in the procurement block, $n = 2$

	Non-cooperative	Collusive	Deviation
Quantity q_i^m	$\dfrac{m}{3x}$	$\dfrac{m}{4x}$	$\dfrac{3m}{8x}$
Profit π_i	$\dfrac{m^2}{9x}$	$\dfrac{m^2}{8x}$	$\dfrac{9m^2}{64x}$

One implication is immediate and requires no further structure. The value of coordinating,

$$\pi^M - \pi^N = \frac{m^2}{72x}, \tag{10}$$

is strictly increasing in the procurement margin. The reduction in Turkish purchases raises $m = P^e - z$ and therefore raises the payoff to colluding. Whether it also relaxes the constraint on sustaining collusion is a separate question, and one that a frictionless model answers in the negative.[48]

I now introduce the per-period cost $F > 0$ of sustaining the arrangement. The incentive constraint for joint profit maximization is

$$\frac{\pi^M - F}{1-\delta} \;\geq\; \pi^D + \frac{\delta \pi^N}{1-\delta}, \tag{11}$$

where the left-hand side is the value of colluding forever net of the coordination cost and the right-hand side is the value of the optimal one-shot deviation followed by non-cooperative play. Note that the relevant deviation payoff is the best response against the collusive quantity of the rival, $\pi^D = 9m^2/64x$, and not the non-cooperative payoff π^N.

Proposition 1. *Joint profit maximization is sustainable if and only if*

$$\delta \;\geq\; \bar{\delta}(m) \;=\; \underbrace{\frac{9}{17}}_{\textit{frictionless benchmark}} \;+\; \underbrace{\frac{576\,x\,F}{17\,m^2}}_{\textit{friction term}}\;. \tag{12}$$

The threshold is strictly decreasing in the procurement margin m, strictly increasing in F

[48]With $F = 0$, joint profit maximization is sustainable if and only if $\delta \geq (\pi^D - \pi^M)/(\pi^D - \pi^N) = 9/17$. Every entry in the second row of Table D.1 is homogeneous of degree two in m and of degree minus one in x, so both cancel from the ratio and the threshold is independent of z, x, a, b and P^e; with n symmetric firms it equals $(n+1)^2/(n^2+6n+1)$, a function of n alone. A downward shift of the supply curve enlarges the collusive prize and the deviation temptation in exactly the same proportion. The same is true of any specification in which the Turkish episode operates through the level or the slope of the supply curve. Sustainability can therefore move only if some element of the problem does not scale with the size of the market, which is the role played by F below.

and in the supply slope x, and converges to $9/17$ from above as m grows. Moreover $\bar{\delta}(m) < 1$ if and only if

$$\pi^M - \pi^N > F \qquad \Longleftrightarrow \qquad m > m^* \equiv \sqrt{72\,x\,F}, \tag{13}$$

so the discount factor threshold is finite exactly when the collusive prize covers the cost of coordinating.

Proof. Rearranging (11) gives $\delta(\pi^D - \pi^N) \geq \pi^D - \pi^M + F$. From Table D.1, $\pi^D - \pi^M = m^2/(64x)$ and $\pi^D - \pi^N = 17m^2/(576x)$. Dividing yields (12). Setting $\bar{\delta}(m) < 1$ gives $576xF/m^2 < 8$, that is $m^2 > 72xF$, which by (10) is $\pi^M - \pi^N > F$. □

The collusive prize and the deviation temptation both scale with m^2, but the coordination cost does not scale at all. A larger procurement margin therefore shrinks the friction relative to the surplus at stake, and the constraint slackens. The reduction in Turkey's purchases raises $m = P^e - z$ and lowers $\bar{\delta}$.

Proposition 1 has two implications. First, the result requires no assumption about F changing across regimes; the shock operates entirely through the surplus available to be divided. Second, the threshold is bounded below by the frictionless benchmark, so the model does not predict that arbitrarily large shocks make collusion arbitrarily easy. The comparative static attenuates as m grows, and the marginal effect of the shock is largest when the industry begins near the floor m^*.

Condition (13) also delivers an extensive margin. If Turkish purchases hold m below m^*, no discount factor sustains collusion, and the reduction moves the industry from a regime in which coordination is infeasible to one in which it is feasible. This is a discrete switch rather than a tightening, and it points the same way as the tightening itself.

A persistent reduction in Turkish demand widens the procurement margin, and because the cost of coordinating does not widen with it, coordination that was previously unsustainable can be sustained. This is the direction my conduct estimates recover. The magnitudes are an empirical matter, and I do not read them off a two-firm symmetric example.

Supplementary Appendix

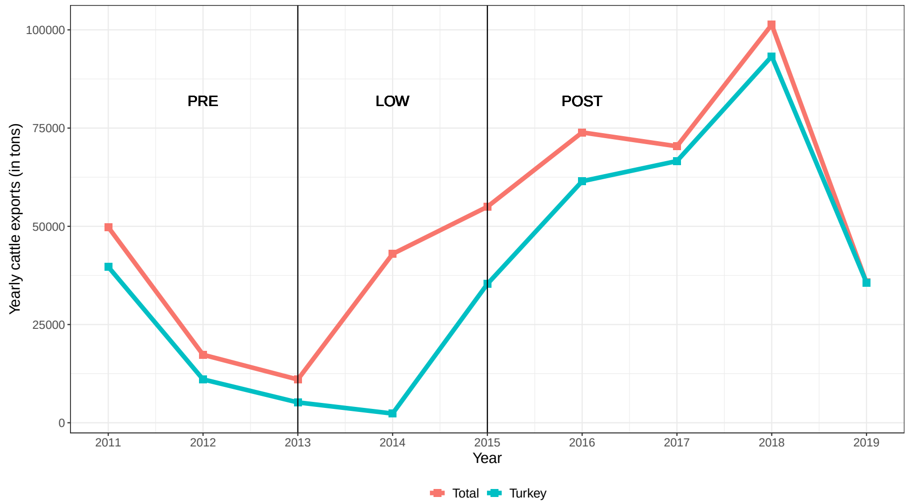
Contents

S1 Additional Market Description

This appendix collects descriptive industry figures referenced in Section 2.1: cattle exports and Turkey's share (Figure S1.1), production and export shares (Figure S1.2), the meatpacking plants (Figure S1.3), and the evolution of prices (Figure S1.4).

Figure S1.4 shows main price trends. In this figure I observe price for feeder cattle (W^r), price for livecattle (W^m), export meat price (P^e), domestic meat price (P^d) and import meat price (P^i). First, it is important to notice that W^r is around 50% of the W^m. Therefore, changes in W^r will be relevant in the supply conditions for W^m. Second, both P^d and P^e are above W^m, which makes sense as from meatpackers point of view, W^m is an input price. Third, imports start around year 2017 and at prices that closely match export prices (P^i similar to P^e). Fourth, all prices seems to have the same trends. An initial phase of high rate increase, followed by a plateau and reduction and toward the end of sample another high

Figure S1.1: Cattle Exports



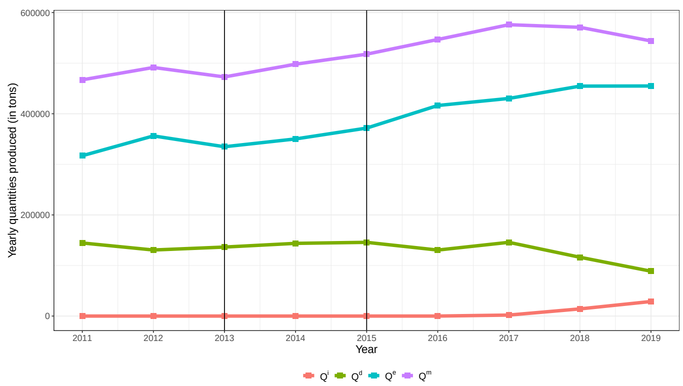
Notes: Cattle exports includes both recently-weaned heifers and steers. Vertical lines indicate the beginning and end of strong reduction period in cattle purchases from Turkey (2013-2015).

rate growth episode. Fifth, and relevant to this paper is that between 2013-2015 P^e seems to increase an deviate from the W^m and W^r.

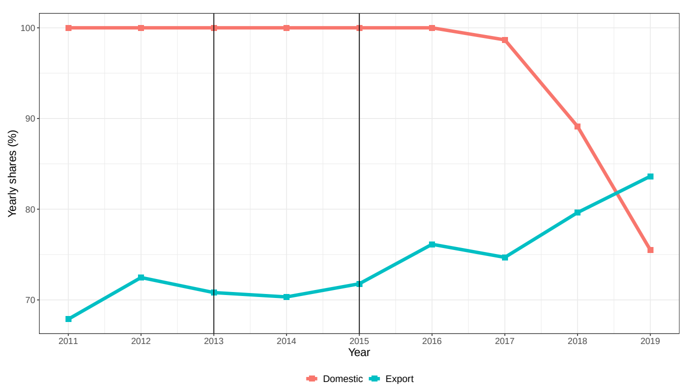
Around half of all meatpacking plants are in the south of the country, near the River Plate and Montevideo, on the land most suited to agriculture, and not every *departamento* has a plant.

Figure S1.5 shows the share of yearly livecattle purchases over plants of different capital origin. As seen, National plants slaughter around 40% of total slaughter. The rest of plants are covered by capital of Argentinian, Brazilian, Chinese and Japanese origin. In particular, these shares have remained stable with exception of plants of Japanese origin which entered the market in 2011.

Figure S1.2: Production, Purchases and Exports



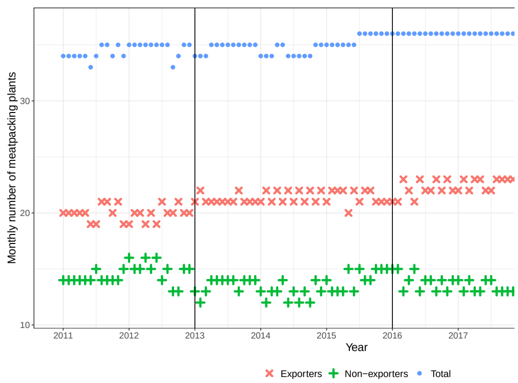
(a) Quantities



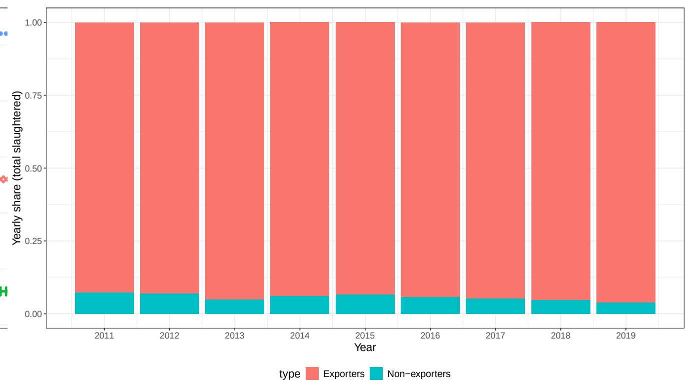
(b) Shares

Notes: *Top*: tonnes in carcass-weight equivalents. *Bottom*: the domestic share of produced meat, $Q_t^d/(Q_t^d + Q_t^i)$, and the export share, Q_t^e/Q_t^m. Vertical lines mark the 2013-2015 low-import window.

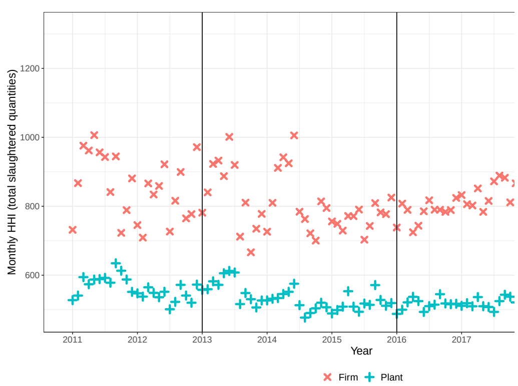
Figure S1.3: Meatpacking Plants



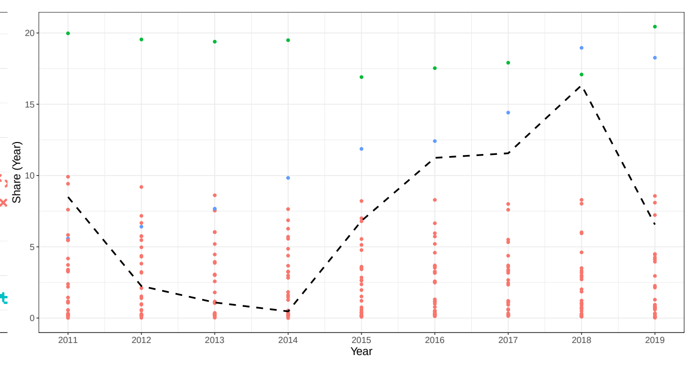
(a) Active Meatpacking Plants by Type



(b) Share of Q_t^m by Type



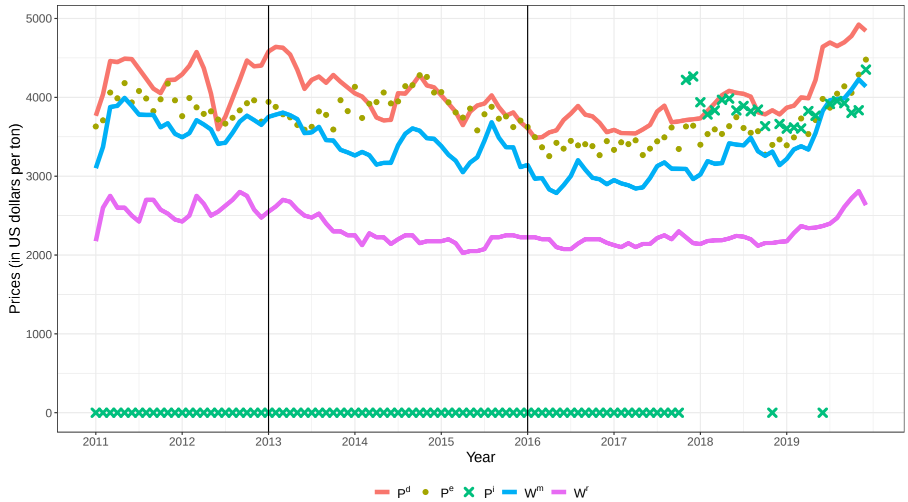
(c) HHI



(d) Share per plant vs. Turkey

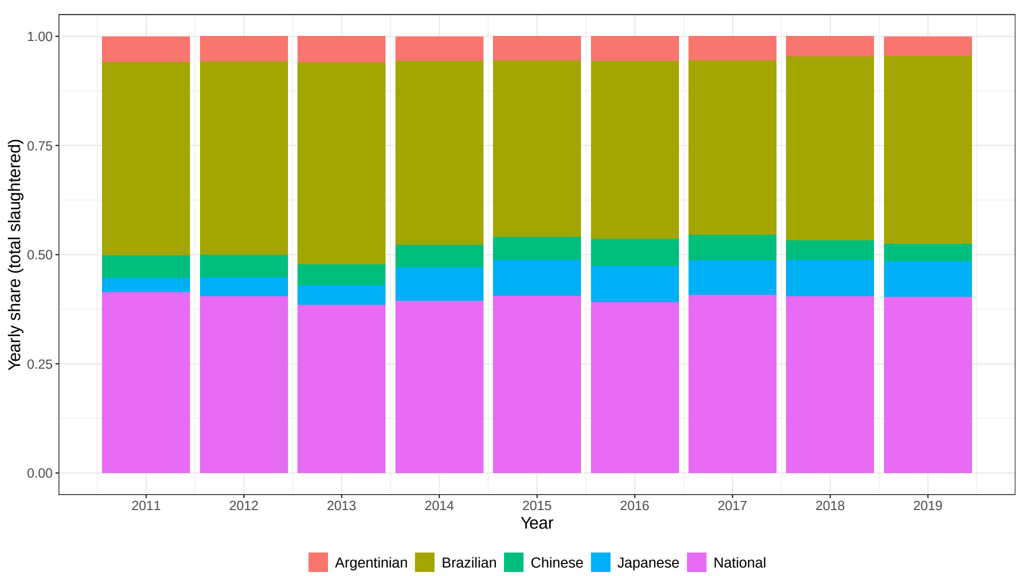
Notes: *Top left*: number of active plants per month (positive livecattle purchases); a plant is an exporter if it exports that month (customs data). *Top right*: yearly shares of livecattle purchases by type. *Bottom left*: HHI at the plant level (red) and firm level (blue), based on livecattle purchases q_{jt}^m. *Bottom right*: yearly livecattle-purchase shares by firm, with MINERVA and MARFRIG marked; the dashed line adds Turkey's feeder purchases in the same units, for scale only (Turkey buys feeder cattle one stage upstream and is not a participant in this livecattle market). Vertical lines mark the 2013-2015 low-import window.

Figure S1.4: Evolution of prices



Notes: All prices measured in USD per tonne of meat (carcass weight equivalent). P^d is price paid by domestic wholesalers to meatpackers. P^e is the weighted average of all export transactions. P^i is the domestic price of imported meat. W^m is the price by meatpackers for livecatle. W^r is the price paid by ranchers calves. Vertical lines indicate the beginning and end of strong reduction period in cattle purchases from Turkey (2013-2015).

Figure S1.5: Share Quantities Capital



Notes: Shares are defined over total of livecattle purchases in a year by capital origin.

Table S1.1 shows the contribution of different factors like product characteristics, destination, periods of time and meatpacking identify in explaining transaction-level exports of processed meat from Uruguay.

Table S1.1: Contribution of Fixed Effects to Export Price Variation

	(1)	(2)	(3)
R2	0.6549	0.6840	0.6876
Product-FE	Yes	Yes	Yes
Destination-FE	Yes	Yes	Yes
Time-FE	No	Yes	Yes
Meatpacking-FE	No	No	Yes
Obs	238317	238317	238317

Notes: Data aggregated at product type (i), meatpacker (j), destination (d) and period (t).

In particular, I specify the following regression

$$P^e_{idjt} = \sigma_i + \sigma_j + \sigma_d + \sigma_t + \epsilon_{ijt}$$

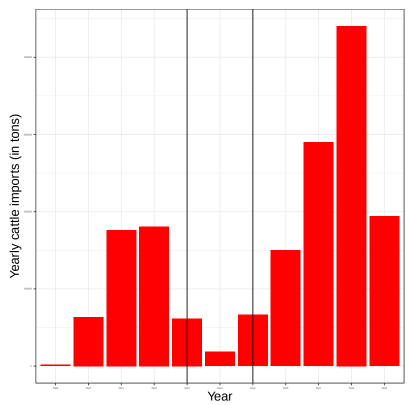
such that σ_i are product characteristics fixed effects, σ_j are meatpacking plant fixed effects, σ_d are destination fixed effects and σ_t are monthly and year fixed effects. The first column of Table S1.1 shows the R2 when regressing only using product characteristics and destination fixed effects. As seen, it has a value of 0.6549. The second column adds time fixed effects and R2 increases to 0.6840. The third column add meatpacking plant fixed effects and R2 increases only marginally to 0.6876. Therefore, contribution of meatpacking identify is only marginal when explaining price.

Finally, Figure S1.6 shows the slowdown in Turkey's imports worldwide.

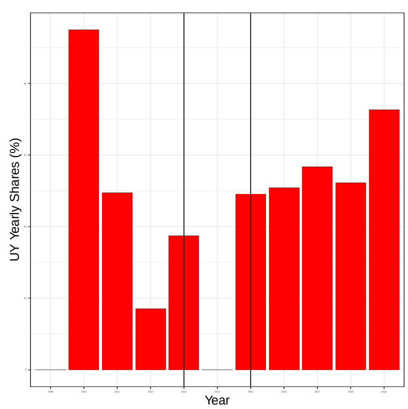
S2 Prediction of Lead Export Prices

Figure S2.1 shows actual and predicted lead meat export prices. Prediction is based on the following variables: time fixed effects (quarterly and yearly), demand factors (international beef prices, international cattle prices, China exchange rate with USD), supply factors (international urea prices, international dap prices, oil index at WTI, US T-bill interest rates).

Figure S1.6: Evolution of Imports to Turkey



(a) Turkey Feeder Cattle Imports



(b) Feeder Cattle Imports from Uruguay

Notes: Top panel: In tonnes. Bottom panel: In percentage. Years 2013-2015 mark the period of strong reduction of feeder cattle purchases.

Figure S2.1: Lead Export Prices: Actual and Predicted

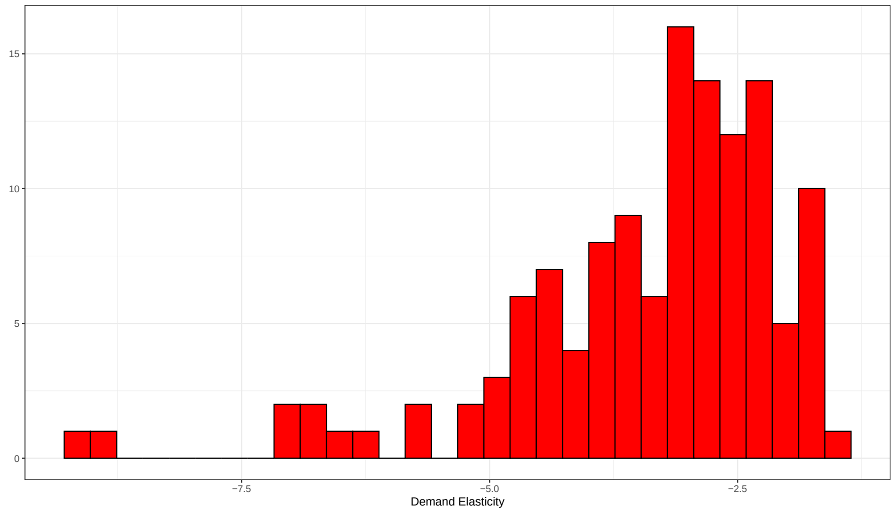
Notes: Vertical lines indicate the beginning and end of strong reduction period in cattle purchases from Turkey (2013-2015).

This prediction will be use in the supply estimation. These predicted prices act as a forecast in period t of future demand conditions. In this way, ranchers internalize future conditions when deciding to sell their product.

S3 Elasticities of Demand and Supply

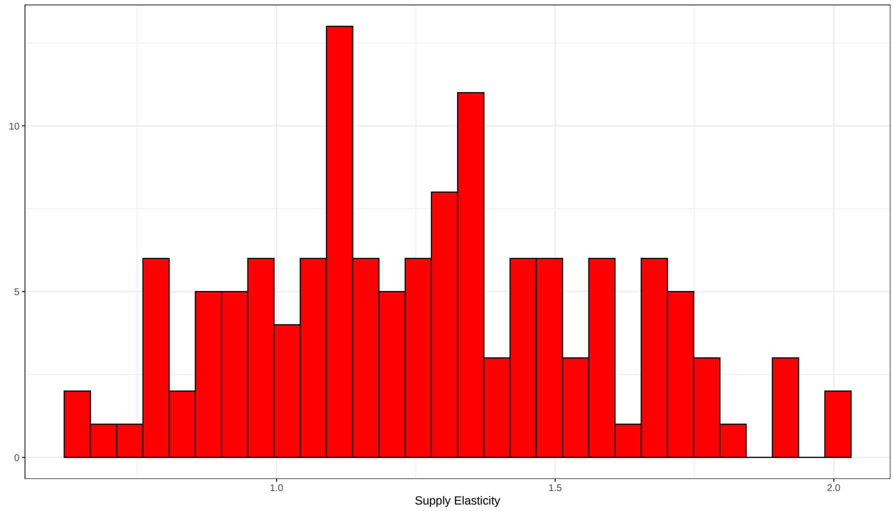
Figures S3.1 and S3.2 plot the implied demand and supply elasticities over the sample, from the estimates in Tables 2 and 3.

Figure S3.1: Demand Elasticity



Notes: Based on results from Table 2.

Figure S3.2: Supply Elasticity



Notes: Based on results from Table 3.

S4 Additional Counterfactual Exercises

S4.1 Monthly Counterfactual Paths

Figure S4.1 plots the monthly paths behind this decomposition. The Turkey channel (Base vs. "+ Turkey") is state-dependent. The two livecattle-price paths coincide during the 2013-2015 low-import episode (shaded) and separate when Turkey competes for feeder cattle, so the disciplining of markdowns switches on and off with the shock. The merger channels are permanent and load onto the second half of the sample. The unilateral effect ("+ Unilateral") carries the merger, and adding the coordinated effect ("+ Coordinated", the observed path) moves the paths very little, the time-series counterpart of $\hat{\kappa}_{merger}$ being indistinguishable from zero in Table 7.

S4.2 The By-product Level and the Non-cattle Cost Share

Two constants enter the pricing identity from outside the model (Section 4.3). One is on the revenue side and one is on the cost side. This appendix documents both.

By-product revenue. A slaughtered animal yields more than the carcass that P^e prices. The hides, offal, tallow and rendering are the "fifth quarter", and the livecattle price the plant pays is for the whole animal. Three independent estimates put that share between 8 and 12%.

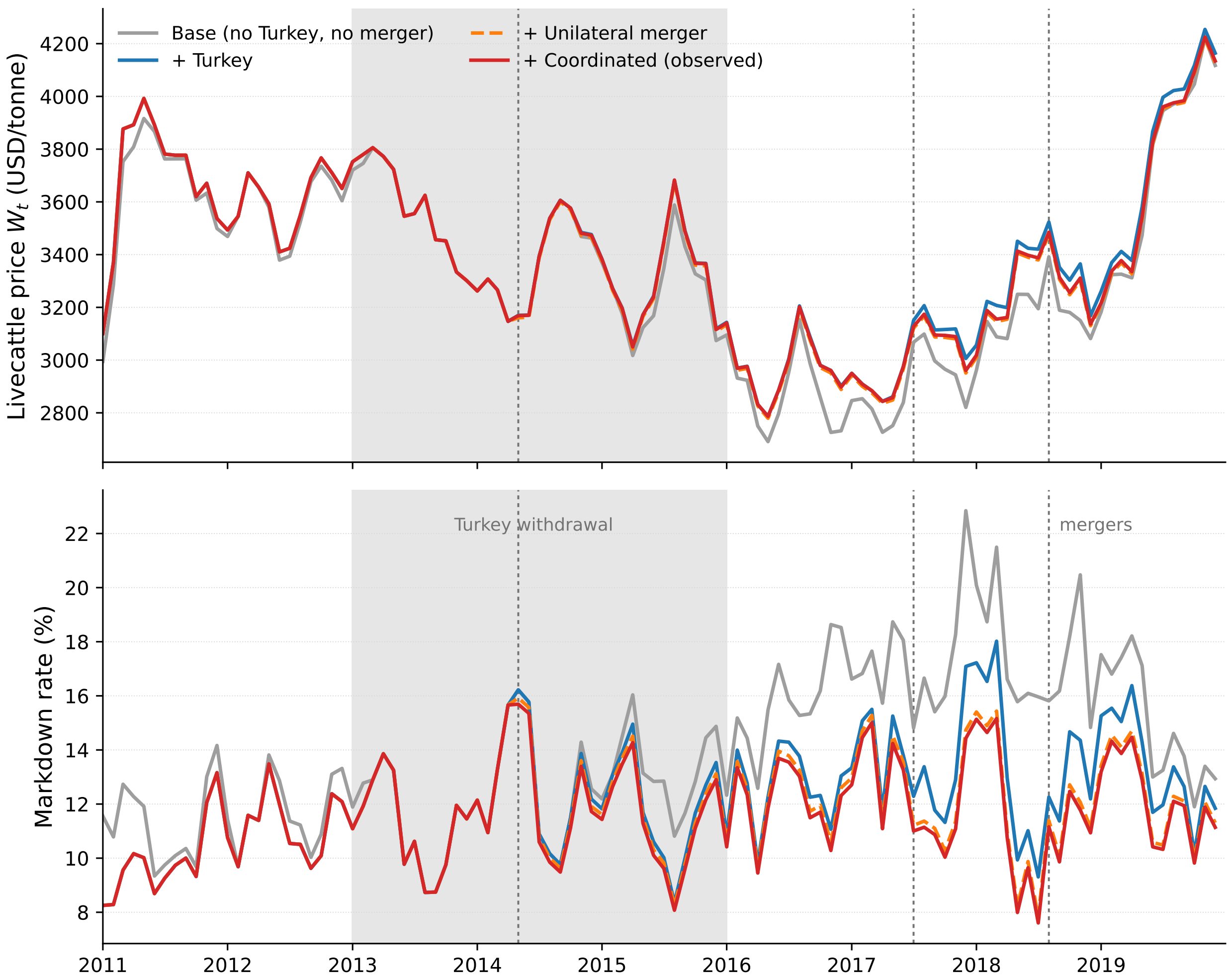
USDA drop value. The United States Department of Agriculture publishes a weekly By-product Drop Value, the wholesale value of hides plus edible and inedible offal recovered at slaughter. In recent data this is on the order of \$13.8 per hundredweight of live steer, which on a carcass basis is approximately 8-10% of carcass value.

Uruguay (INAC). The Instituto Nacional de Carnes reports that edible bovine offal alone is about 9% of beef export value and that non-hide by-products together are about 15%. Hides are excluded from these figures, since they clear under a separate customs chapter, and world hide prices were substantially higher over my 2011-2019 sample than in recent years. Both push the share above these figures.

Competition authority. The per-head account of the industrial stage puts gross output at 1,103 against 804 paid for the animal. Part of that difference is non-carcass revenue.

I use 10% of the mean export price. I enter it as a flat level b per unit of carcass weight, on both the domestic and the export channel. It is a level and not a proportion because the fifth quarter is recovered per animal at slaughter. It applies to both channels because the same animal yields the same hide whether the meat is sold at home or abroad. Applying it only to export rows would give the two channels different revenue definitions for the same

Figure S4.1: Monthly paths of the livecattle price W_t (top) and the markdown (bottom) under additive scenarios: Base, +Turkey, +Unilateral merger, and +Coordinated (the observed equilibrium). The 2013-2015 low-import window is shaded and the dotted lines mark the three consolidations (May 2014, July 2017, August 2018). Because the first consolidation coincides with the low-import episode, the two channels are separated *structurally* -Turkey loads on import intensity, the merger on the consolidation dummy- not by timing.



input.

Non-cattle marginal cost. The same industry-commissioned account, in 2016 US dollars per head for a typical steer, splits gross output of 1,103 into 804 paid for cattle, 122 of intermediate inputs and 177 of direct value added. Within a month labour and capital are fixed, so only intermediate inputs are marginal. This gives a non-cattle marginal cost of $122/804 = 0.152$ times the cattle price. Two other sources bracket this figure. Huang (2022) puts non-fuel materials at 90.7% of production cost and wages at 5.4% in the 1909 US Census of Manufactures, a ratio of about 0.10. The national activity survey for bovine slaughter covers roughly forty firms over 2014-2018 and puts cattle at 81.2% of variable cost, a ratio of about 0.23. That figure is stable across the five years. I impose 0.15, the competition authority figure, as a restriction on the mean level of the fitted cost block.

I estimate neither constant. Table 4 reports the conduct estimates with each one imposed and omitted. Appendix S4.3 varies both over the ranges the evidence supports.

S4.3 Robustness of the Supply-Shock Decomposition to the Calibrations

Section 4.3 calibrates two constants rather than estimating them. Here I vary each over the range the evidence supports. The by-product level b takes the values 5, 10 and 15% of the mean export price. The non-cattle cost share takes 0.10, 0.15 and 0.23. The first comes from Huang (2022) and the last from the national activity survey. At each node I re-fit conduct and non-cattle marginal cost, re-solve the three scenarios, and compute a standard error at that node by perturbing the demand and supply slopes by one standard error each and re-fitting at every perturbation. Table S4.1 reports the result.

The conduct channel is stable and precise. At the preferred calibration it is -0.592% of total surplus. Over the whole range it stays between -0.638 and -0.526, a spread of 0.112 points. Its smallest t-ratio in the sweep is 9.54. The input channel is also stable, within 0.023 points, but it is less precisely estimated.

The total is the sum of the two channels, which are larger and of opposite sign. It is therefore small, and it changes sign over the range, from -0.049 to 0.041. The largest t-ratio on the total at any node is 0.17, so it is not distinguishable from zero at any calibration in the range. The spread across calibrations is also smaller than the standard error at every node. I report the decomposition through the two channels and not through their total.

S4.4 Robustness of the Decomposition to the Supply Elasticity

The Input/Conduct/Total decomposition is conditional on the cattle supply slope $\hat{\gamma}_1$, which is weakly identified (Section 4.2). Rather than only reporting bootstrap bands disciplined to

Table S4.1: Sensitivity of the supply-shock decomposition to the calibrations

	Δ Input	Δ Conduct	Δ Total
		Total surplus (% of observed)	
By-product level b			
5%	0.571	−0.547	0.025
	(0.346)	(0.056)	(0.291)
10% (preferred)	0.581	−0.592	−0.011
	(0.347)	(0.057)	(0.290)
15%	0.589	−0.638	−0.049
	(0.348)	(0.059)	(0.289)
Non-cattle marginal cost			
0.10	0.588	−0.633	−0.045
	(0.348)	(0.059)	(0.289)
0.15 (preferred)	0.581	−0.592	−0.011
	(0.347)	(0.057)	(0.290)
0.23	0.567	−0.526	0.041
	(0.346)	(0.055)	(0.291)

Notes: Each row re-fits buyer conduct and non-cattle marginal cost at the stated calibration and re-solves the three supply-shock scenarios, varying one constant at a time around the preferred point. The by-product level b is a flat amount per unit of carcass weight on both channels, stated as a share of the mean export price. Non-cattle marginal cost is imposed as a multiple of the cattle price, over the range the cost evidence supports, from 0.10 in Huang (2022) to 0.23 in the national activity survey. Entries are percentages of observed total surplus, measured against the preferred baseline so the rows are comparable. Sampling uncertainty at a fixed calibration is the standard error in parentheses. It is computed separately at every node, by perturbing the demand and supply slopes by one standard error each and re-fitting conduct and non-cattle cost at each perturbation. That is a separate question from the sensitivity across rows.

an elasticity range, I make the decomposition an explicit function of the supply elasticity. I build a grid of supply elasticities from 0.5 to 2.0 and, at each node, change *only* the own-price slope $\hat{\gamma}_1$ -holding the demand side and the feeder-price pass-through at their point estimates- re-estimate buyer conduct consistent with the imposed slope, and re-solve the full counterfactual (CF_0, CF_1, CF_2). Re-estimating conduct at each node matters. The pricing first-order condition scales the conduct term by $\partial W/\partial Q^m = 1/\hat{\gamma}_1$, so the estimated κ's move with the slope by construction. Figure S4.2 shows this dependence. The estimate $\hat{\kappa}_{turkey}$ ranges from about -4.32 at an elasticity of 0.5 to -12.39 at 2.0, passing through -8.49 at my point estimate. Its *sign* is negative throughout, so the finding that conduct rises when Turkey reduces its purchases is robust to the slope; only the *magnitude* of the response scales with it.

The welfare decomposition is stable across the same grid. The input-cost effect stays positive and moves little, between 0.54% and 0.63%. The conduct effect is negative throughout, between -0.32% and -0.81%, and grows in absolute value as the elasticity rises. The net effect on total surplus is therefore small everywhere. It never leaves $[-0.27\%, +0.31\%]$ and straddles zero over the disciplined band $[0.7, 1.6]$, crossing from positive to negative at an elasticity of 1.24. Net of the approximate breeder term the total stays positive over the whole range, between 0.62% and 0.82%, so the near-zero total is driven by that imputed component and not by the shock itself. What the slope governs is the sign of a small residual. Below the crossing the cost effect slightly dominates, above it the conduct effect does.

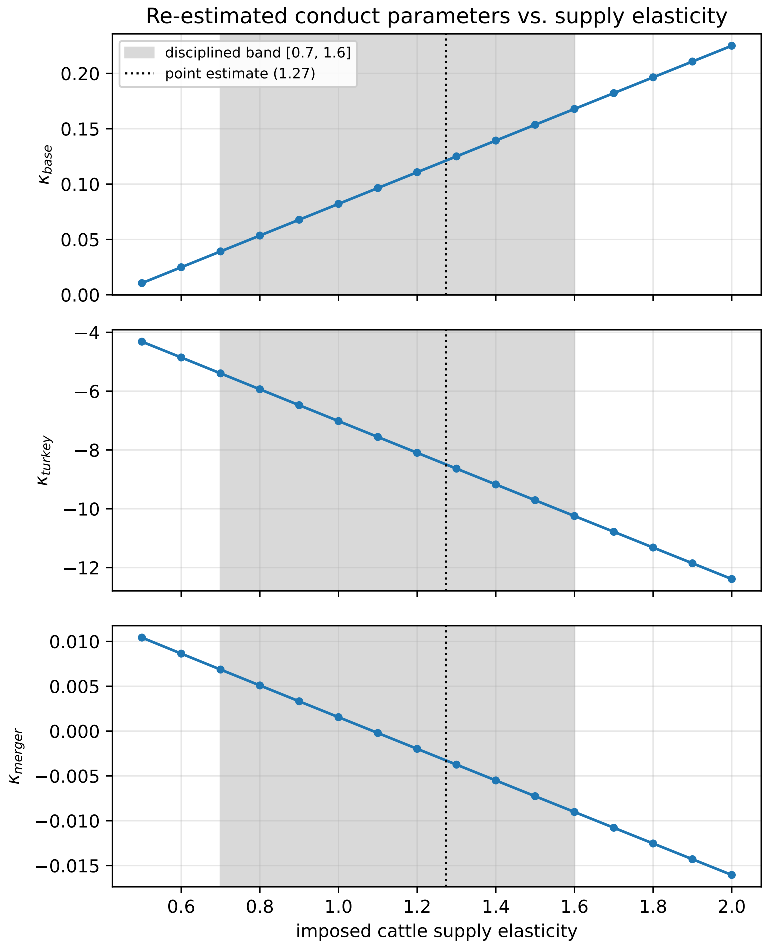
The distribution is more robust than the net. Meatpackers gain at every slope, between \$37 and \$64 million, and breeders lose at every slope, between \$35 and \$68 million. The transfer from breeders to meatpackers that my point estimate reports holds throughout. Ranchers are the one group whose sign depends on the slope. They gain when supply is inelastic, below an elasticity of about 1.15, where the cheaper-input channel dominates, and lose at my point estimate and above. The elasticity therefore governs magnitudes. Conduct rises when Turkey withdraws and the redistribution toward meatpackers remains, while the sign of the small total-surplus effect changes across plausible supply elasticities.

S4.5 Construction of Counterfactual W^r

In this subsection I describe how to construct the counterfactual value of feeder cattle W^r. As described in Section 2, Turkey's imports generated an increase in this price. My goal is to construct the counterfactual price of W^r if Turkey maintain their imports and did not decrease them as happened during 2013-2015.

First, I need the counterfactual level of Turkey's feeder cattle imports (Q_t^{turkey}) during

Figure S4.2: Re-estimated conduct parameters as a function of the supply elasticity



Notes: Each panel plots a re-estimated conduct coefficient (κ_{base}, κ_{turkey}, κ_{merger}) as the imposed cattle supply elasticity varies over $[0.5, 2.0]$. At each node only the own-price supply slope is changed; conduct and non-cattle marginal cost are re-estimated consistently, and the counterfactual is re-solved. The dotted vertical line marks the point estimate (1.27) and the shaded band the disciplined range $[0.7, 1.6]$.

2013-2015, that is, the quantity Turkey would have purchased had it not reduced its purchases. Over that window I take it to be the greater of the observed value and Turkey's pre-shock (2011-2012) monthly mean, so the no-disruption world never has less Turkish competition than actually occurred. It binds in the months when Turkey's purchases had already recovered past their pre-shock norm, almost all of them in 2015. Outside the window the counterfactual coincides with the observed series. Table S4.2 reports the relevant magnitudes.

Table S4.2: Observed and counterfactual Turkey feeder cattle imports (2013-2015 window)

	Cattle to Turkey (tonnes/month)
Pre-shock mean (2011-2012)	$2,113.6$
Observed mean (2013-2015)	$1,190.1$
Counterfactual (2013-2015, no disruption)	$2,113.6$
Implied disruption (observed − counterfactual)	-923.5

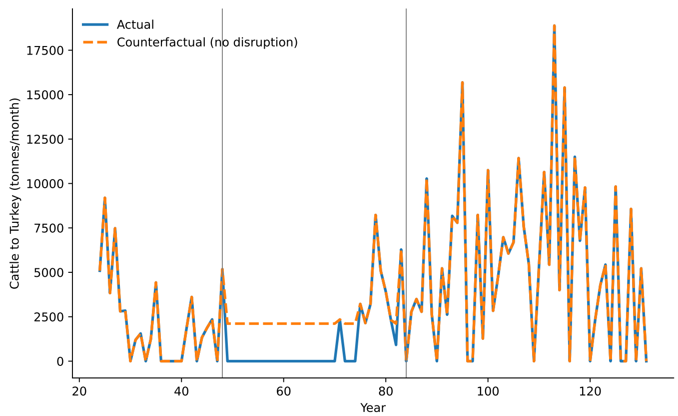
Notes: The counterfactual assumes that, absent the disruption, Turkish live-cattle purchases over 2013-2015 equal the pre-shock (2011-2012) monthly mean. This is the level imposed in the hold-preshock counterfactual. Cattle measured in carcass-weight tonnes per month.

As the table shows, Turkey purchased on average 2,113.6 tonnes per month before the shock but only 1,190.1 tonnes per month during 2013-2015, an implied disruption of −923.5 tonnes per month. The counterfactual imports are therefore

$$Q_t^{turkey,CF} = \begin{cases} \overline{Q}_{\text{pre}}^{turkey} & t \in \{2013, \ldots, 2015\} \\ Q_t^{turkey} & \text{otherwise,} \end{cases}$$

where $\overline{Q}_{\text{pre}}^{turkey}$ is Turkey's 2011-2012 monthly mean. Figure S4.3 shows the observed imports together with this counterfactual.

Figure S4.3: Observed and Counterfactual Cattle Exports to Turkey



Notes: Based on procedure described in Appendix S4.5. Vertical lines indicate the beginning and end of strong reduction period in cattle purchases from Turkey (2013-2015).

Then, I re-run the feeder cattle price regression on different subsamples, to check whether the effect of Turkey's imports on prices is stable over time,

$$W_t^r = \beta_0 + \beta_1 P_t^e + \beta_2 P_t^{*,gas} + \beta_3 Q_t^{turkey} + \beta_4 \,\text{trend}_t + \epsilon_t$$

where Q_t^{turkey} is Turkey's feeder cattle imports (in tonnes). Results are shown in Table S4.3 for four samples: the pre-shock period (Model 1), the post-shock period (Model 2), the two combined excluding the 2013-2015 low-import episode (Model 3), and the full sample (Model 4).

Table S4.3: Turkey's feeder cattle imports and feeder cattle prices, by subsample

	Pre	Post	Pre and Post	Full
Turkey Imports (tonnes)	0.02^{**}	0.00	0.00	0.01^{**}
	(0.01)	(0.00)	(0.00)	(0.00)
Export Price P_t^e	0.18^{*}	0.33^{***}	0.57^{***}	0.41^{***}
	(0.10)	(0.07)	(0.05)	(0.05)
Fuel Price	867.60^{***}	-679.63^{***}	461.76^{***}	537.21^{***}
	(271.69)	(158.99)	(109.82)	(99.07)
Trend	12.05^{***}	8.09^{***}	1.04^{*}	1.55^{***}
	(4.04)	(1.96)	(0.58)	(0.52)
Constant	123.38	883.63^{***}	-368.43^{***}	1.35
	(190.25)	(199.83)	(121.29)	(133.31)
Observations	48	48	96	132
R^2	0.93	0.83	0.87	0.74

Notes: Standard errors in parentheses. PRE is 2009-2012, POST is 2016-2019, and Full is the whole sample including the 2013-2015 Turkish withdrawal.

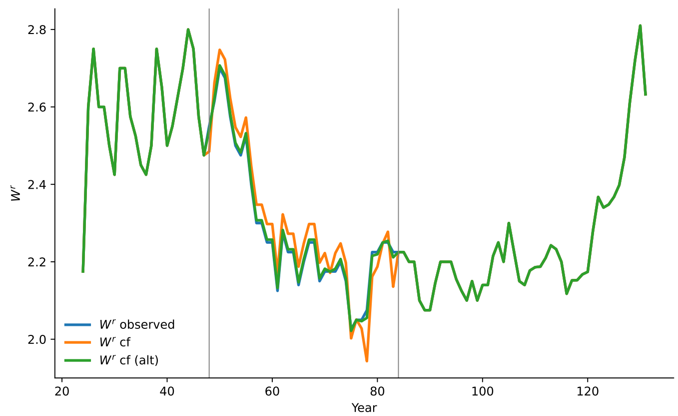
The table shows that the effect of Turkey's imports on feeder cattle prices is positive and significant in the pre-shock period ($\hat{\beta}_3 = 0.02$, Model 1) and in the full sample ($\hat{\beta}_3 = 0.01$, Model 4), but it is small and not significant in the post-shock period (Models 2 and 3). I therefore take the pre-shock estimate as the structural relationship between Turkey's imports and feeder cattle prices, and use it to build the counterfactual price.

Finally, I construct the counterfactual feeder cattle price using the pre-shock estimate $\hat{\beta}_3$ (Model 1 of Table S4.3) as

$$W_t^{r,CF} = W_t^r + \mathrm{LOW}_t\, \hat{\beta}_3 \left(Q_t^{turkey,CF} - Q_t^{turkey} \right)$$

that is, during the low import window (2013-2015) I add to the observed price the pre-shock price impact of the extra imports Turkey would have made absent the reduction, where $Q_t^{turkey,CF}$ are the counterfactual imports defined above. Outside this window the counterfactual price equals the observed one. For comparison of the actual and counterfactual values see Figure S4.4

Figure S4.4: Actual and counterfactual feeder cattle price W^r



Notes: Prices in US dollars per tonne of meat. Actual indicates observed values and CF is a counterfactual as explained in this section. Vertical lines indicate the beginning and end of strong reduction period in cattle purchases from Turkey (2013-2015).

S5 Details on Estimation and Counterfactual Algorithm

In this section I will detail steps for the estimation of demand, supply and conduct and additional procedures for counterfactuals.

S5.1 Estimation Details

For aggregate demand $\theta^D = (\beta_1, \beta_2, \beta_3, \beta_4, \beta_5)$ and for supply $\theta^S = (\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5)$ I proceed as in standard GMM-IV. As discussed in Section 3.3, for demand estimation I use the feeder cattle price W_t^r as an instrument for the domestic meat price P_t^d; for supply estimation I use the market-level export meat price P_t^e as an instrument for the livecattle price W_t^m. With these estimates in hand, I estimate conduct.

I parametrize buyer conduct as in Equation (6), $\lambda_t = \kappa_{base} + \kappa_{turkey}\,\text{TurkeyIntensity}_t + \kappa_{merger}\,\text{Merger}_t$, so the parameters of the pricing stage are $\theta^P = (\kappa_{base}, \kappa_{turkey}, \kappa_{merger}, \beta^c)$. Given $\hat{\theta}^D$ and $\hat{\theta}^S$ I proceed in the following steps.

1. From the estimated inverse demand curve, compute domestic marginal revenue

$$\hat{\text{MR}}_{jt} = P\left(Q_t^d\right) + \left(1/\hat{\beta}_1\right) q_{jt}^d.$$

2. Given $\hat{\theta}^S$ and a candidate θ^P, compute the implied marginal cost

$$\hat{\mathrm{MC}}_{jt} = W\left(Q_t^m\right) + (1/\hat{\gamma}_1) \sum_{k \in O(j)} q_{kt}^m + \lambda_t\, (1/\hat{\gamma}_1) \sum_{k \notin O(j)} q_{kt}^m + X_{jt}^c \beta^c,$$

with λ_t given by Equation (6). The vector X_{jt}^c collects the non-cattle cost shifters and the export-channel indicator that absorbs the average export-domestic wedge (Section 3.2).

3. Define the structural error as

$$\eta_{jt}^c\left(\hat{\theta}^D, \hat{\theta}^S, \theta^P\right) = \begin{cases} \hat{\mathrm{MR}}_{jt} + b - \hat{\mathrm{MC}}_{jt} & \text{if the plant sells domestically,} \\ p_t^e + b - \hat{\mathrm{MC}}_{jt} & \text{if the plant exports,} \end{cases}$$

matching the definition of y_{jt} in Equation (5).

4. Through GMM-IV I obtain $\hat{\theta}^P$ as

$$\hat{\theta}^P = \underset{\theta^P}{\operatorname{argmin}} \left(Z_P' \eta^c(\theta^P)\right)' \hat{W}_P \left(Z_P' \eta^c(\theta^P)\right),$$

where $\hat{W}_P$ is an estimate of the asymptotically efficient weighting matrix based on first-stage residuals. As instruments Z_P I use the rival-performance measure -the projected far-rival dressing yield- described in Section 3.3.4 and constructed in Appendix B.

S5.2 Counterfactual Details

A counterfactual is a market equilibrium solved at the estimated parameters. Given the demand, supply and conduct estimates $\hat{\theta}^D$, $\hat{\theta}^S$ and $\hat{\theta}^P$ (with the domestic side modeled as Cournot, each firm internalizing only its own effect on the domestic price; see Appendix C.6), I solve, separately for each month t of the shock window (2013-2015), for the firm-level livecattle purchases and exports (q_{jt}^m, q_{jt}^e) that satisfy every firm's first-order conditions at once. Domestic marginal revenue equals marginal cost on the units a firm sells at home, and the export price equals marginal cost on the units it exports,

$$\begin{aligned} MR_{jt}\left(q_{jt}^d; \hat{\theta}^D\right) &= MC_{jt}\left(q_{jt}^m; \lambda_t, \hat{\theta}^S, W_t^r\right), \\ P_t^e &= MC_{jt}\left(q_{jt}^m; \lambda_t, \hat{\theta}^S, W_t^r\right), \end{aligned}$$

with $q_{jt}^d = q_{jt}^m - q_{jt}^e$. Given the resulting aggregate quantities, the livecattle price $W(Q_t^m)$ and the domestic meat price $P^d(Q_t^d)$ are read off the estimated inverse supply and demand curves. Because some firms only export and all quantities must stay non-negative, I solve this as a constrained root-finding problem within each market. Evaluated at the estimated parameters and the observed shifters the procedure reproduces the observed equilibrium - the unobserved marginal cost term η^c_{jt} absorbs any residual- and I take that solution as the baseline.

From each solved economy I compute the surplus of every agent. Meatpacker profit is

$$\Pi_t = \sum_j \left[P^d_t q^d_{jt} + P^e_t q^e_{jt} - (W_t + mc_{jt})\, q^m_{jt} \right],$$

where mc_{jt} is the estimated non-cattle marginal cost. Under the linear demand and supply curves, consumer surplus and fattener (rancher) surplus are the usual triangles, $CS_t = (Q^d_t)^2/(2|\hat{\beta}_1|)$ and $PS^f_t = (Q^m_t)^2/(2\hat{\gamma}_1)$, where $\hat{\beta}_1$ and $\hat{\gamma}_1$ are the estimated demand and supply slopes (Equations 3 and 4). For breeders I report an approximate object rather than a fully structural surplus. I do not estimate a feeder-cattle supply curve, so there is no micro-founded breeder optimization problem behind it. I instead measure the change in the value of breeders' feeder-cattle sales implied by the pass-through of the feeder price into livecattle supply, $PS^b_t = -\left(\hat{\gamma}_5\, W^r_t/\hat{\gamma}_1\right) Q^m_t$, where $\hat{\gamma}_5$ is the estimated feeder-price coefficient of the livecattle supply equation. This should be read as a first-order approximation to breeders' welfare change. Its sign is unambiguous -breeders are better off when the demand for feeder cattle, and hence its price, is higher- but its magnitude rests on the estimated pass-through and should be interpreted with caution. Total surplus is $TS_t = \Pi_t + CS_t + PS^f_t + PS^b_t$.

To decompose the effect of Turkey's reduction, note that Turkey enters the model through two channels. It lowers feeder cattle prices (the input or *cost* channel) and, through Equation (6), it raises buyer conduct (the *conduct* channel). I turn each channel off in turn. I hold the conduct channel at its pre-shock level by setting TurkeyIntensity_t in Equation (6) to its pre-shock value, which fixes the implied conduct at λ^{CF}_t; and I hold the cost channel fixed by replacing the observed feeder cattle price W^r_t with the counterfactual price $W^{r,CF}_t$ that would have prevailed had Turkey not reduced its purchases (Appendix S4.5). Re-solving the equilibrium above under different combinations of these two changes gives three economies:

- CF_0: both channels active, the observed equilibrium $(\lambda_t,\, W^r_t)$;
- CF_1: conduct held fixed, feeder prices observed $(\lambda^{CF}_t,\, W^r_t)$;
- CF_2: conduct held fixed and feeder prices counterfactual $(\lambda^{CF}_t,\, W^{r,CF}_t)$.

CF_0 is the observed baseline, CF_1 turns off only the conduct channel, and CF_2 turns off both. Differencing the surpluses across these economies isolates each channel. The *input* (cost) effect is $\mathrm{CF}_1 - \mathrm{CF}_2$ (feeder prices move from their counterfactual to their observed level, conduct held fixed); the *conduct* effect is $\mathrm{CF}_0 - \mathrm{CF}_1$ (conduct moves with Turkey, feeder prices at their observed level); and the two add up exactly to the total change $\mathrm{CF}_0 - \mathrm{CF}_2$. With this convention a positive value means the channel raised the outcome and a negative value means it lowered it, as reported in the ΔInput, ΔConduct, and ΔTotal columns of Table 6.

S5.3 Standard Errors for the Counterfactuals

The decomposition is solved at estimated parameters, so every statistic in it inherits their sampling error. I propagate the error in the two slopes the counterfactual is most sensitive to, the demand slope b_d and the supply slope b_s, each estimated in a separate regression.

The bands are a parametric bootstrap. I draw b_d and b_s independently from their estimated sampling distributions. At each draw I re-estimate buyer conduct and non-cattle marginal cost at the drawn slopes, so the pricing first-order conditions stay internally consistent, then re-solve the scenarios and recompute every statistic with the formulas used for the table. The figure in parentheses is the standard deviation across draws.

Two restrictions matter for how to read it. Draws whose implied supply elasticity falls outside the disciplined range of Section 4.2 are rejected before the solve, so the reported dispersion is conditional on an economically sensible slope rather than unconditional. And the exercise propagates slope uncertainty only. It does not propagate the sampling error in the conduct coefficients themselves, in the counterfactual feeder price $W_t^{r,CF}$, or in the two calibrated constants. The sensitivity of the decomposition to those constants is reported separately in Appendix S4.3, and to the supply elasticity in Appendix S4.4.

The same procedure produces the bands for the full-sample Turkey-versus-merger decomposition of Section 5.3, drawing the same two slopes and re-solving its four scenarios over the full sample at every draw. Each table reports its own number of draws.

S6 Ownership Reassignments

Table S6.1 lists the within-sample ownership changes, detected from transitions in each plant's economic-group identifier (id_var) in the data. At each date the acquired plant's livecattle purchases move from the rival term (weighted by λ_t) into the acquirer's own-firm sum $O(j)$, where they are internalized fully -the *unilateral* merger effect discussed in Section 3.2. The pooled merger indicator Merger_t switches on at the first reassignment (May 2014).

Table S6.1: Ownership Reassignments (Mergers) in the Sample

Date	Acquired plant	Acquiring firm
May 2014 (trend 64)	CATER	MINERVA
July 2017 (trend 102)	Frigorífico Canelones	MINERVA
August 2018 (trend 115)	Lorsinal	Rondatel

Notes: Within-sample ownership reassignments, detected from changes in each plant's economic-group identifier in the estimation data. Trend indexes calendar months (trend 24 = January 2011). These are the transitions that enlarge the acquirer's ownership set $O(j)$ and drive the unilateral merger effect; the pooled Merger_t indicator switches on at the first (May 2014).