Bid Rigging and Entry Deterrence in Public Procurement: Evidence from an Investigation into Collusion and Corruption in Quebec

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Workshop in Memory of Art Shneyerov

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Plan

1. Present a paper published with Art

2. Present some possible extensions

The paper

- Study some aspect of the **organization** of a specific **cartel**

- Focus on **procurement of asphalt** in Montreal and Quebec city for which we collect data and we have detailed info on how the cartel operated

- Leverage a **police investigation in 2009** that provided detailed info on the Montreal cartel (e.g., bid rigging, market segmentation, complementary bidding and corruption)

- First paper
  - for every auction we inspect the **patterns of entry** in the market**, participation and prices** before and after 2009

  - Estimate a structural model to quantify the relative importance of two key-aspects of the organization of the cartel: coordination/**collusion in prices** and entry **deterrence**

Source of Variation: Collapse of the Cartel After The Police Investigation

- October 15th 2009: Radio-Canada news show *Enquete* alleges collusion and corruption in the Montreal-area construction industry

- Allegations of:
  - Market segmentation - territories assigned to specific firms, and *entry deterrence*
  - Bid rigging - Pricing coordinated (using code fictitious golf game)
  - Complementary bidding - Non-winners informed of the winning bid and told to submit higher bids
  - Corruption: (hockey tickets, boat-trips with company, restaurant meals)

- October 23rd 2009: police investigation (*Operation Marteau*)

- Later on in 2011: government Commission formed and detailed report delivered--> confirmed the allegations in a specific **chapter on asphalt**
  - Note: chapter does not mention collusion in Quebec city market

The Data

- Bidding data:
  - Access to information requests at the Municipal Clerk's offices of Montreal and Quebec City Example
  - Borough-level asphalt contract data (19 boroughs in Montreal, 8/6 in Quebec City)
  - Information on all submitted bids (raw & transport charges)
  - winner's identity, firms' capacities (Montreal only)
  - Period: 2007-2013

- Delivery distance data:
  - Addresses of asphalt plants in Montreal and Quebec City (from MTQ)
  - Addresses of the central point of reception for each neighbourhood in the two cities

- Information on functioning of cartels:
  - TV *Enquete* broadcast
  - Transcripts of testimony from Charbonneau Commission

Institutional Details on Asphalt Procurement in Montreal and Quebec City

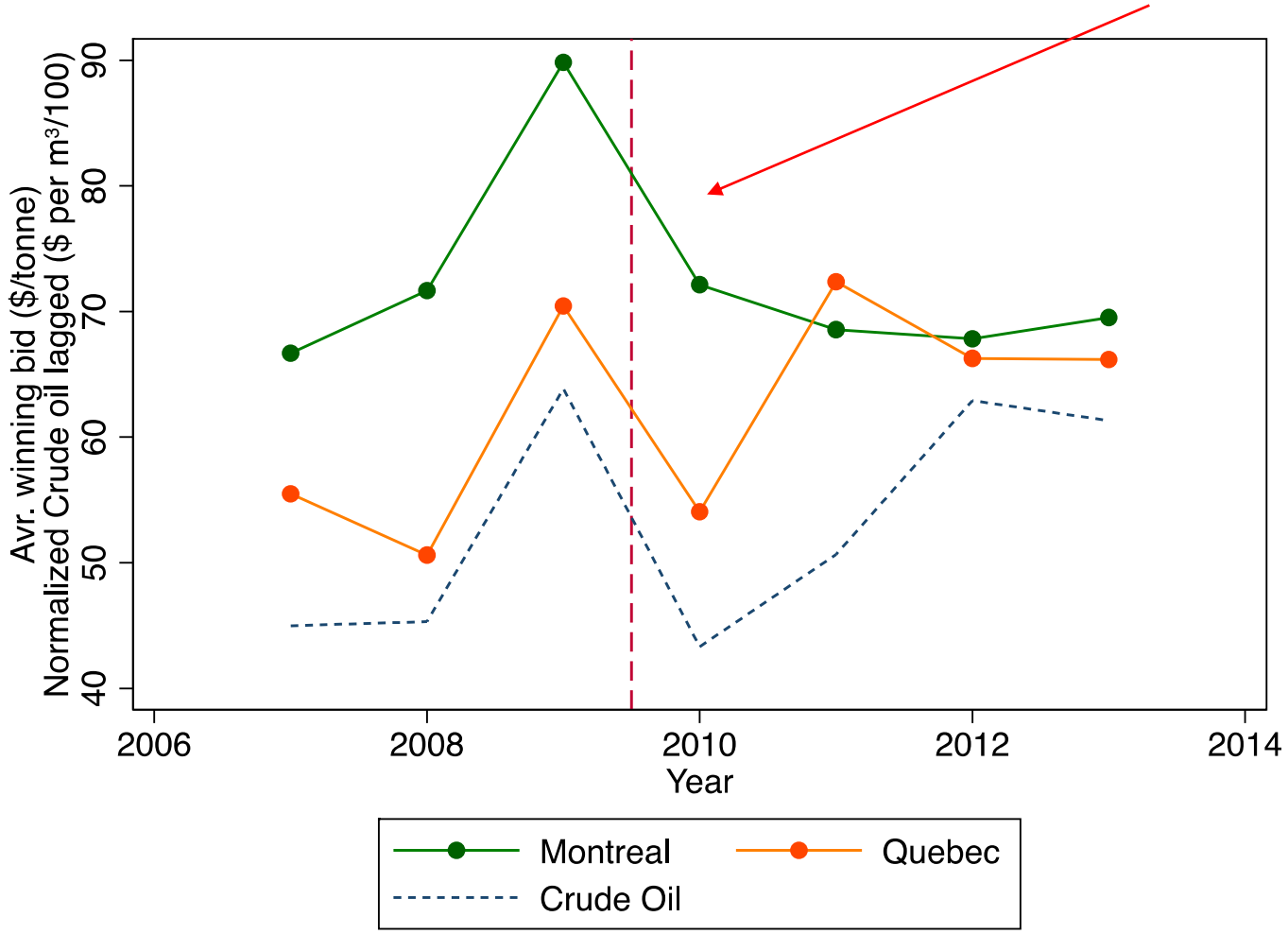
- Cities mostly buy asphalt, and provide manpower for road repair
- Contracts are to produce asphalt at plants and deliver it to reception points or have it picked-up
- Firms may submit bids f
- Bids have two components: unit price per metric ton (constrained to be common within types) and transportation charge (constrained to be common within boroughs)
- In Montreal, one auction per asphalt type per borough.
- In Quebec City, one auction per borough
- Auctions are first-price sealed bid and single-attribute (price).

Quebec city is not a perfect control

- Advantages:
  - No allegations of collusion and corruption
  - Located at a fair distance from Montreal
  - Comparable markets (size, number of firms)
- Disadvantages:
  - Many fewer auctions since contracts for different asphalt types aggregated at borough level
  - Borough amalgamation in 2010: Demand patterns could change, possibly favouring larger firms
- Resolution:
  - Ultimately check the goodness of having Quebec City as a control by testing for common trends pre-investigation
  - Extension: take the city of Levis as additional control (and Laval as an additional treated)

Prices

Price effect: graphical evidence



Average raw winning bids			
	Before	After	After-Before
Montreal	75.71	67.02	-8.69
Quebec City	57.63	62.61	4.98
Mtl-Qc	18.08	4.41	-13.67

Econometric model

Our main econometric specification is:

$$B_{i,a} = \alpha + \delta_1 Mtl_{i,a} * Marteau_{i,a} + \delta_2 Marteau_{i,a} + \delta_3 Mtl_{i,a} + \beta X_{i,a} + \epsilon_{i,a}$$

- $B_{i,a}$ is raw bids (for bidder i in auction a)
- $X_{i,a}$ includes
  1. *Con* the proportion of contracts in borough x won by firm i in year prior to a
  2. *Capacity* maximum potential quantity
  3. Crude oil lagged
  4. *Distance* between the production site and the delivery site
  5. *Quantity*
  6. *HHI*
- *Marteau* indicates the start of Opération Marteau in 2010
- *Mtl* is a dummy for Montreal.

Price effect: difference-in-difference estimates

Table III: Difference-in-difference for the submitted raw bids

Dependent Variable	Raw bids					
Sample	All bids (1)	All bids (2)	All bids (3)	Winning bid (4)	Winning bid (5)	Winning bid (6)
MontrealXMarteau	-10.677***	-8.679***	-8.693**	-13.670***	-10.770***	-10.231***
	(3.303)	(3.321)	(3.347)	(3.472)	(3.690)	(3.484)
Montreal	16.239***	9.411***	8.314***	18.078***	8.920***	6.141
	(2.953)	(1.913)	(2.991)	(3.104)	(1.822)	(4.766)
Marteau	4.760*	-5.678*	-6.042*	4.982*	-4.681	-5.472
	(2.674)	(3.188)	(3.633)	(2.862)	(3.623)	(3.960)
Crude_oil_lag		0.128***	0.133***		0.135***	0.132***
		(0.003)	(0.004)		(0.003)	(0.004)
Capacity			0.008			0.130***
			(0.023)			(0.036)
Quantity			-0.140			-0.217
			(0.135)			(0.155)
Distance			-0.017			-0.088**
			(0.025)			(0.036)
CON			-2.228***			1.389**
			(0.648)			(0.641)
HHI			-2.606			-7.747
			(4.423)			(4.921)
Borough effects	No	Yes	Yes	No	Yes	Yes
Year effects	No	Yes	Yes	No	Yes	Yes
Type effects	No	Yes	Yes	No	Yes	Yes
Observations	2,263	2,263	2,263	662	662	662
R-squared	0.128	0.726	0.731	0.213	0.893	0.913
Average outcome	70.92	70.92	70.92	69.37	69.37	69.37

Police investigation caused a reduction in price by 13%

Market structure

Market effect: difference-in-difference estimates

Table V: Difference-in-difference for market structure variables

Sample	All auctions		
Dependent variables	Number of Bidders	Number of Incumbents	Share of the Dominant firm
	(1)	(2)	(3)
MontrealXMarteau	1.598***	0.775**	-37.022***
	(0.323)	(0.304)	(9.588)
Montreal	0.189	-0.438	-40.861
	(0.370)	(0.680)	(30.947)
Marteau	-0.902**	-6.163**	-8.644
	(0.449)	(3.052)	(13.007)
Crude_oil_lag	-0.001	0.032*	0.008
	(0.001)	(0.017)	(0.029)
Capacity	-0.016***	0.001	-1.396
	(0.006)	(0.006)	(1.757)
Quantit	0.021	0.025	-16.630
	(0.025)	(0.023)	(10.303)
Distance	-0.006	-0.006	2.174
	(0.007)	(0.006)	(1.685)
CON	-0.354***	-0.272**	
	(0.135)	(0.122)	
HHI	-0.464	-0.971	
	(0.819)	(0.760)	
Year effects	Yes	Yes	No
Type effects	Yes	Yes	No
Observations	662	662	14
R-squared	0.697	0.592	0.796
Average outcome	3.418	3.418	49.64

Police investigation caused an increase in N.Bidders by 1.6, 61.36%

Reduction in the share of dominant firm by -64%

Cartel organization: coordination vs entry deterrence

Structural model: intuition

- In order to disentangle the entry-deterrence and coordination effects we simulate what bidding would have looked like had entry not occurred after the investigation
- Our approach is to estimate bidding strategies during the post-cartel period in Montreal when all N = 9 firms (incumbents and entrants) are present in the market to back out the costs of each firm
- We then simulate counter-factual bids under the scenario that the three entrants had not in fact entered the market
- We compare these prices to those estimated using our difference-in-difference approach in order to quantify the two effects

Counterfactual experiment

	Before	After	After-Before
Montreal	$P_{m,b}$	$\mathbf{P^{CF}_{m,a}}$	$P^{CF}_{m,a} - P_{m,b}$
Quebec City	$P_{q,b}$	$P_{q,a}$	$P^{w}_{q,a} - P_{q,b}$
Mtl-Qc	$P_{m,b} - P_{q,b}$	$P^{CF}_{m,a} - P_{q,a}$	**DiD**$(P^{CF}_{m,a})$

How to compute the counterfactual price in Mtl?

Different counterfactual prices depending on the auction model

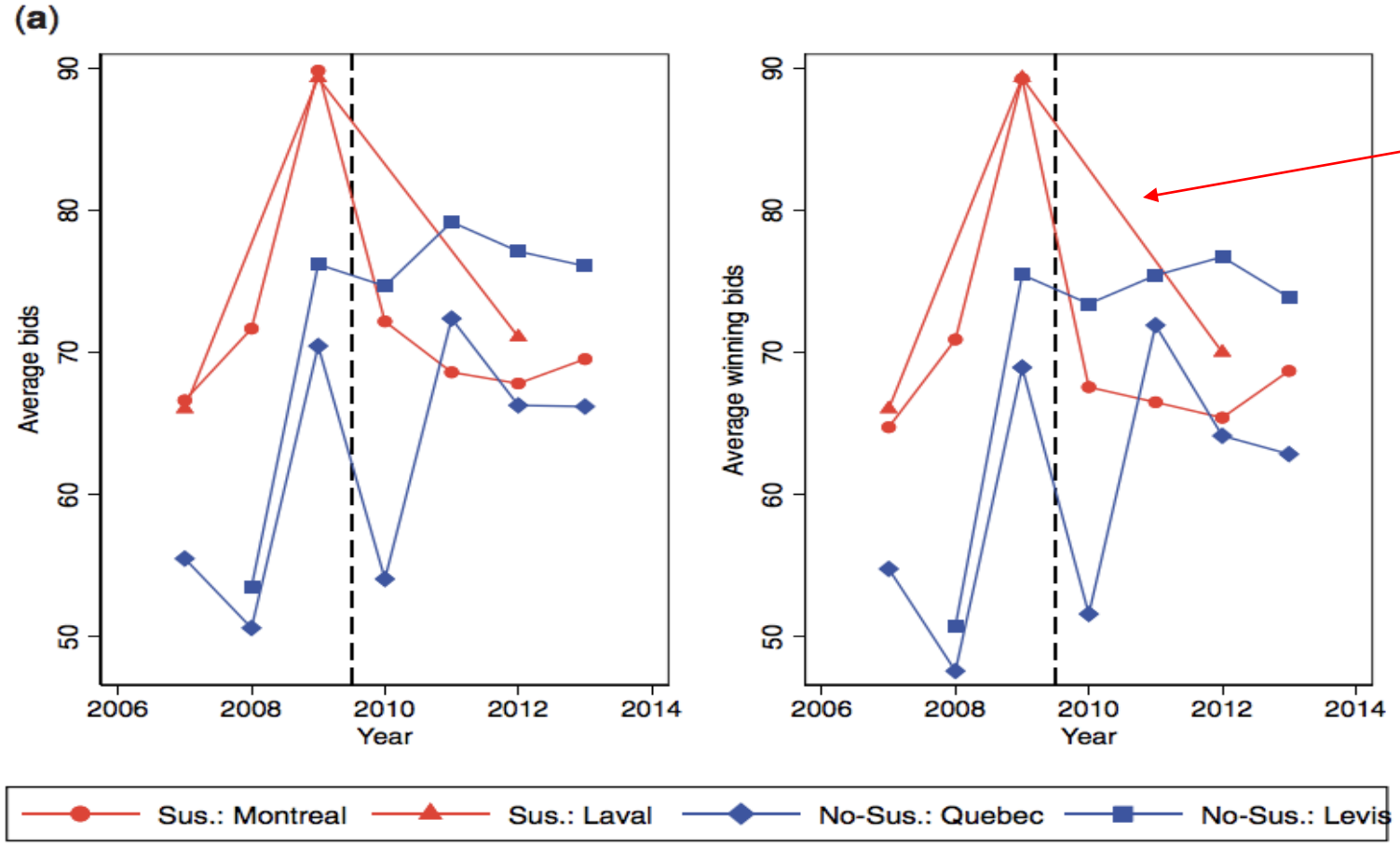
Lower bound: Levin and Smith entry in auction model→ entry deterrence plays a small role

Upper bound: Exogenous participation model→ entry deterrence explains up to 22% of the price variation

Extensions

1. City of Laval
2. Complementary bidding
3. Long-lasting cartels

Collusion in the City of Laval



Lawyers of Laval (neighbor city to Montreal) read our paper and contacted us….

Cartel extended its scope to the city of Laval

We used this additional data for the revision!

Complementary bidding

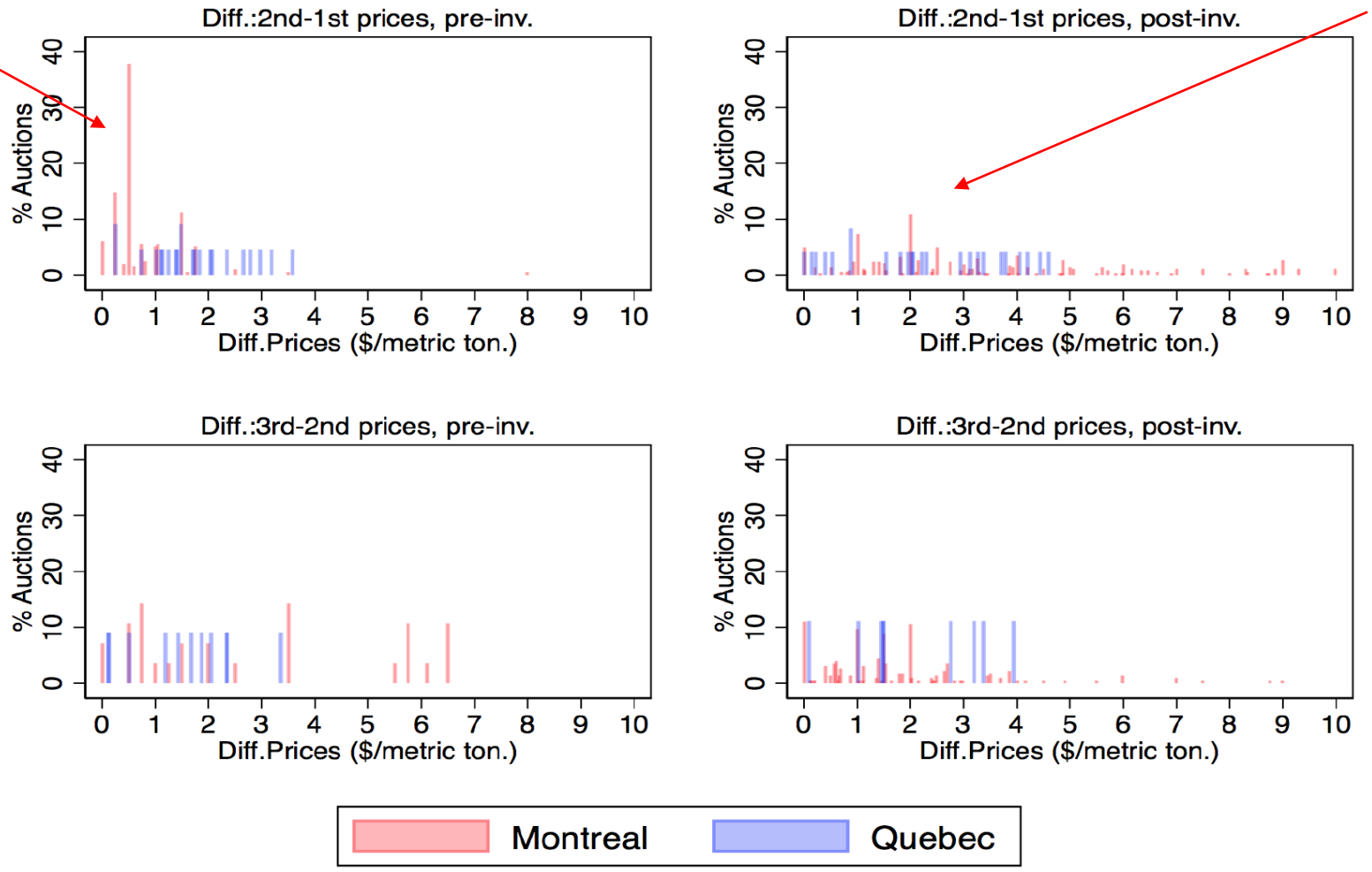
- The police investigation and chapter in the Commission Report revealed diffused complementary bidding → non-winning bidders informed of the winning bid and told how to submit bids (to sustain collusion)

- We try to inspect
  - To what extent can complementary bids be made to appear like competitive bids?
  - What are the correlates of complementary bids?

- Intuition: clustered bids are a marker for collusion (see Harrington, 2008)→ complementary bids should bunch near winning bids

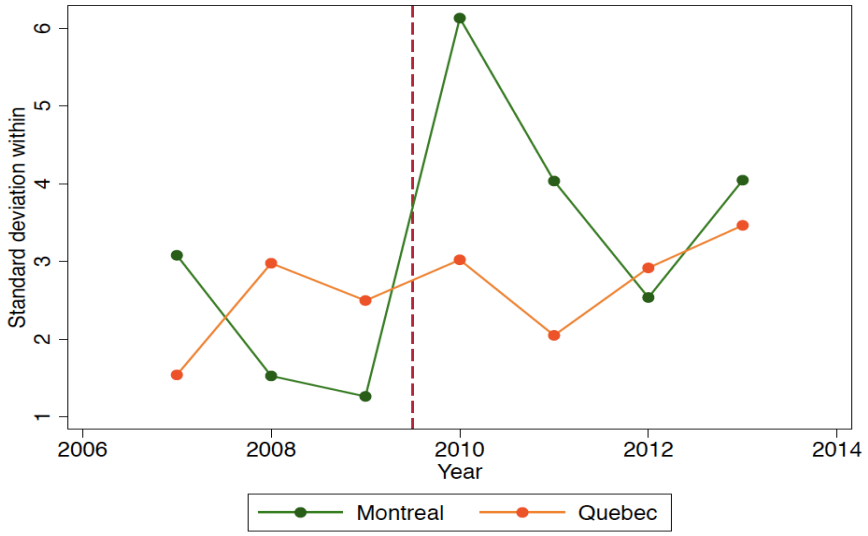
- Intuition: we have showed that mean price went down → Use same data to inspect other moments

Complementary bids before/after collapse of the cartel



Variance of bids

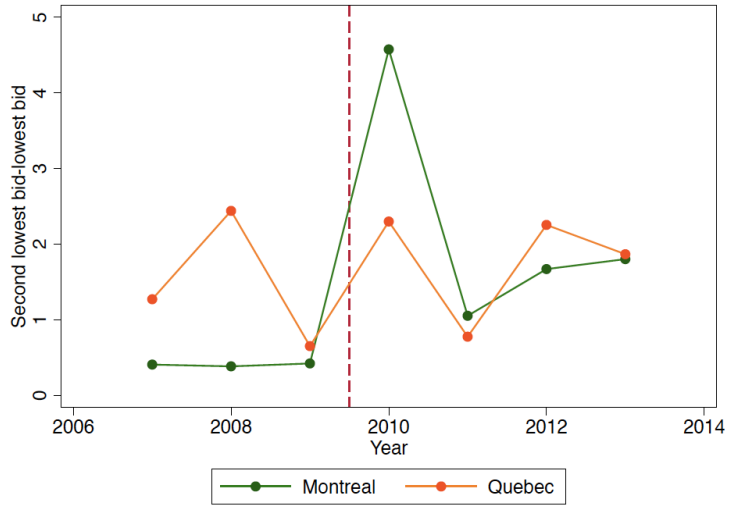
- Is there less variance within auctions in Montreal during the cartel period?



Average standard deviation within auctions			
	Before	After	After-Before
Montreal	2.05	4.73	2.68
Quebec City	2.35	2.89	0.54
Mtl-Qc	-0.30	1.84	2.14

Lowest – Second bid

- Is there less variance within auctions in Montreal during the cartel period?



Average difference between second lowest bid and lowest bid			
	Before	After	After-Before
Montreal	0.75	3.08	2.33
Quebec City	1.65	2.14	0.49
Mtl-Qc	-0.90	0.94	1.84

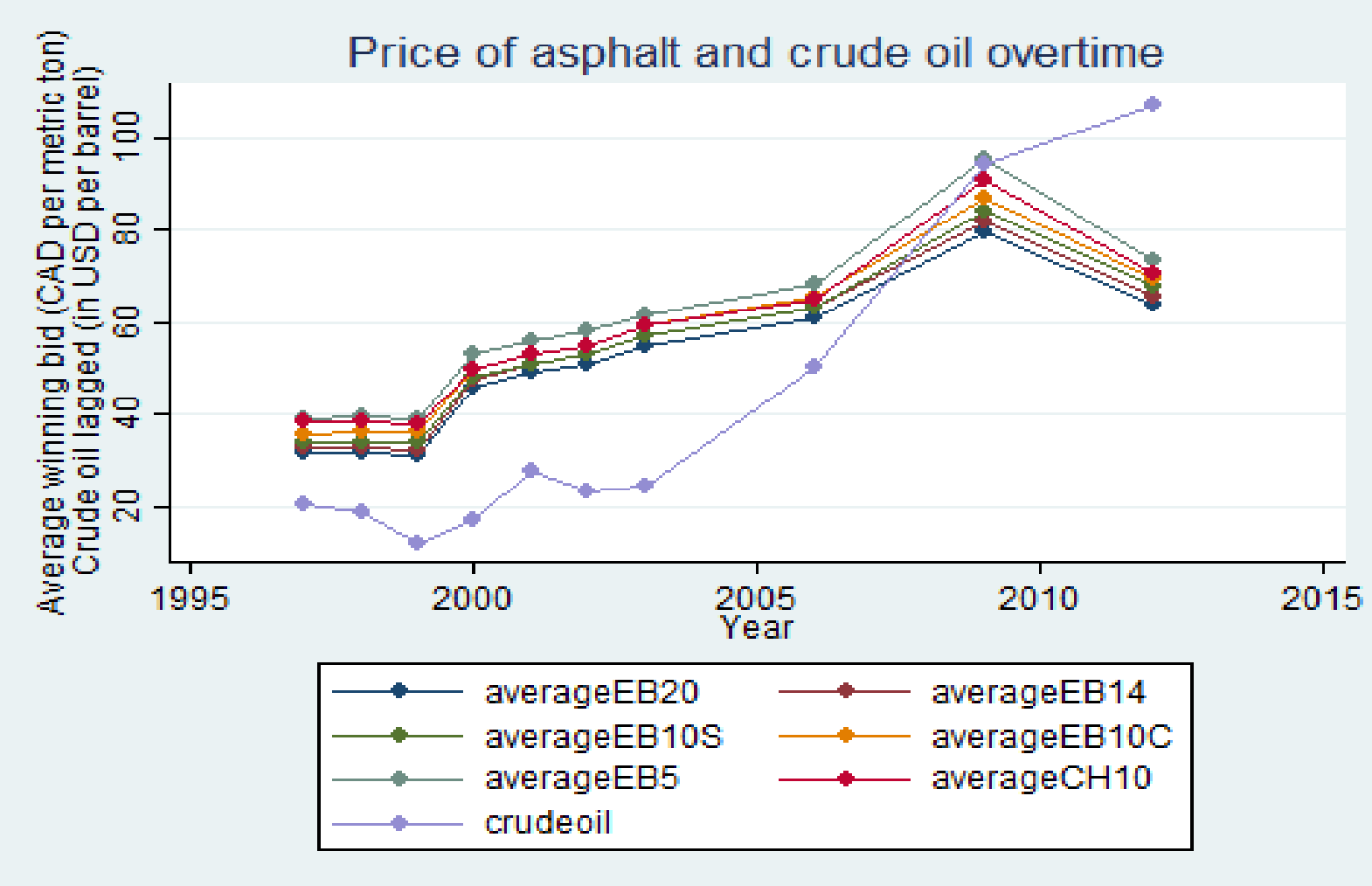
Correlates of bids

- we estimate the following model:

$$Bid_{it} = \alpha + \beta Crude - oil_{t-1} XPost_t + \delta X'_{it} + \varepsilon_{it}$$

Dep.Var.	(1) Winning bid	(2) Winning bid	(3) 2nd bid	(4) 2nd bid	(5) ⩾2nd bid	(6) ⩾2nd bid
Crude-oil$_{t-1}$ $XPost_t$	-0.0312***	-0.0440***	-0.0328***	-0.0371***	-0.0300***	-0.0320***
	(0.00145)	(0.00291)	(0.00157)	(0.00403)	(0.00179)	(0.00323)
CapacityXPost$_t$		0.198***		0.0749		0.0565
		(0.0406)		(0.0553)		(0.0347)
QuantityXPost$_t$		0.190		-0.167		-0.00836
		(0.195)		(0.290)		(0.188)
DistanceXPost$_t$		-0.00579		0.00896		-0.0244
		(0.0326)		(0.0344)		(0.0405)
Crude-oil$_{t-1}$	0.131***	0.135***	0.143***	0.143***	0.137***	0.137***
	(0.00248)	(0.00225)	(0.00325)	(0.00338)	(0.00377)	(0.00371)
Capacity	0.125***	0.00181	-0.0398	-0.0893*	0.0230	-0.0173
	(0.0307)	(0.0271)	(0.0329)	(0.0508)	(0.0254)	(0.0262)
Distance	-0.0783**	-0.0918**	-0.0393**	-0.0508*	0.00790	0.0273
	(0.0313)	(0.0376)	(0.0180)	(0.0300)	(0.0242)	(0.0353)
Quantity	-0.151	-0.307**	-0.163	-0.0508	-0.135	-0.133
	(0.124)	(0.135)	(0.172)	(0.213)	(0.0928)	(0.142)
CON	1.303**	0.479	-1.413*	-1.568**	-4.572***	-4.627***
	(0.510)	(0.529)	(0.719)	(0.731)	(0.739)	(0.746)
Observations	574	574	574	574	1,487	1,487
R-squared	0.940	0.945	0.909	0.910	0.758	0.759

Long-lasting cartels



Conclusion

- Documented that the police investigation reduced prices, and increased entry and participation in auctions
- Entry deterrence effect explain only a small part of the prices
- Presented two possible spin-offs
  1. Complementary bidding and correlates
  2. Long-lasting cartels
- Other extensions: sidewalks works also targeted by the cartel (second chapter of the Commission report)