Online appendix for the paper "Scarcity without Leviathan: The Violent Effects of Cocaine Supply Shortages in the Mexican Drug War."

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Online Appendix A: Time series properties of the high frequency variation exploited in the paper.

In this appendix we document the key time series properties of the homicide rate in Mexico and seizures in Colombia. We focus on the detrended series obtained after removing a cubic polynomial on time and year dummies, which corresponds to the high frequency variation exploited in the paper.

First, we focus on the seizures series. The detrended series is presented in Figure 4 in the main text. Figure A1 presents a correlogram of the series. We plot the OLS estimate of the j-th lag on its contemporary level for $j = 1, 2, \ldots, 15$ and its 95% confidence interval. As the figure reveals, there is no evidence of any type of serial correlation in the high-frequency variation in seizures. Thus, we can treat the high frequency variation in seizures as independently distributed over time, as we did in the main text.

We now turn to the high frequency variation in Mexican homicides. The detrended series is also presented in Figure 4 of the main text. A correlogram of the series is presented in figure A2, with the OLS estimate of the j-th lag on its contemporary level for $j = 1, 2, \ldots, 15$, as well as a 95% confidence interval. There is no evidence of any type of serial correlation in the high-frequency variation in Mexican homicides. Thus, we can treat the high frequency variation in homicides as independently distributed over time, as we did in the main text.

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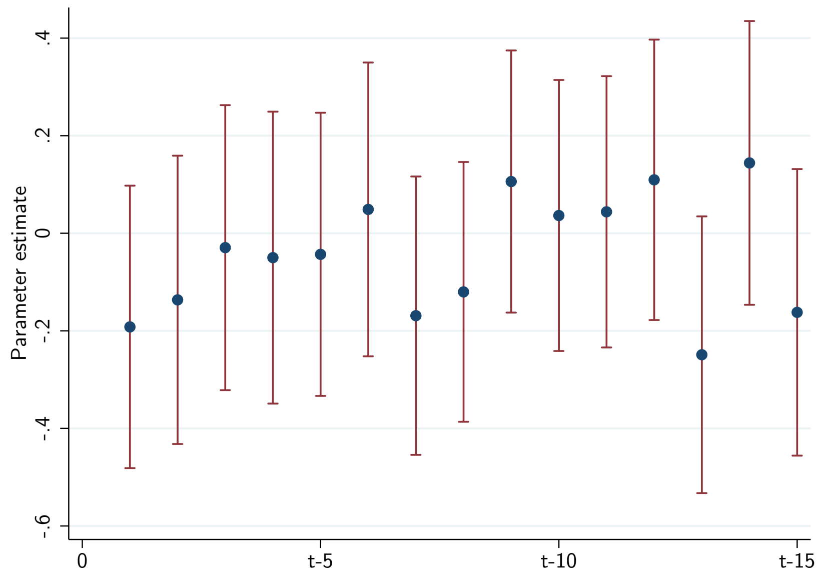

FIGURE A1: Correlogram for the high-frequency variation in cocaine seizures in Colombia.

We also ran several unit root tests (Dickey-Fuller, Phillips-Perron and a GLS version of Dickey-Fuller) and were able to reject the non-stationarity of both series in all of them at the 1% confidence level. Table A1 summarizes the test statistics and p-values for these tests. We conclude that the assumption of stationary, which we used throughout the main text, is not rejected by the data.

TABLE A1: Test for unit roots and non-stationarity

	Test statistic (1)	1% critical value (2)
	Cocaine seizures in Colombia	
Dickey-Fuller test	-8.194	-3.594
Phillips-Perron test	-8.521	-3.594
GLS variant of the Dickey-Fuller test	-5.504	-3.770
	Homicide rate in Mexico	
Dickey-Fuller test	-6.859	-3.594
Phillips-Perron test	-6.859	-3.594
GLS variant of the Dickey-Fuller test	-4.352	-3.770

Overall, the findings in this section imply that our estimates in the main text are

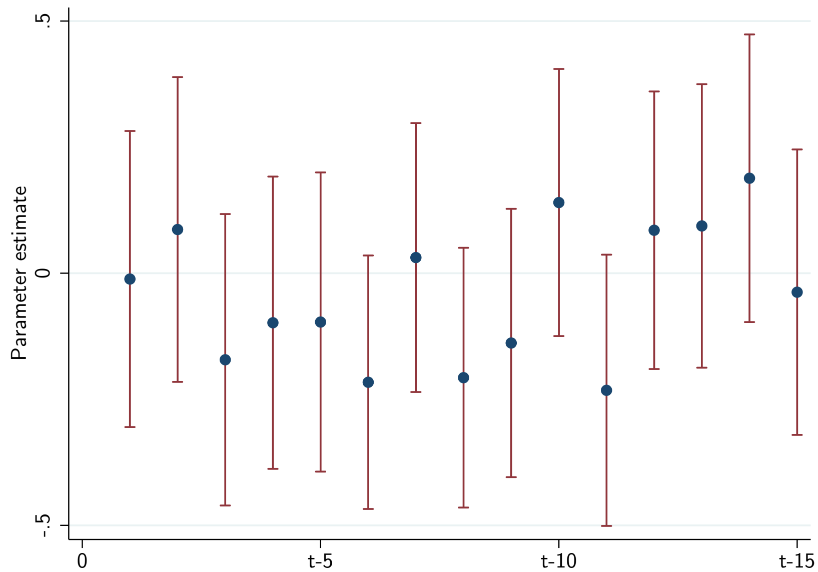

FIGURE A2: Correlogram for the high-frequency variation in the Mexican homicide rate.

consistent and the usual standard errors provide valid inference.

ONLINE APPENDIX B: SPATIAL CORRELATION.

This appendix explores how our standard errors change when we allow for spatial correlation in the error term of equation (5) in the main text.

We start by presenting different sets of standard errors for our model in column 1 of Table 4 in the main text, which explored if cocaine seizures in Colombia had a larger effect on violence in municipalities closer to the U.S. border. Table A2 presents our results from these exercises. The top panel presents results in which we compute standard errors that are robust to different levels of clustering. Column 1 presents results in which we assume there is clustering within a municipality over time but not across municipalities, as we assumed in the main text. In column 2 we assume there is clustering among municipalities in the same metropolitan area and over time, which yields 2,335 clusters. Column 3 assumes there is clustering among municipalities in the same state and year but not across years, which yields 160 clusters. Column 4 presents results in which we assume there is clustering among municipalities in the same state and over time, which yields 32 clusters.

The remaining panels present Conley standard errors (Conley, 1999, 2008), which allow for spatial correlation among municipalities within a pre-specified radius. We vary

Table A2: Estimates of the standard errors of our main specification under alternative assumptions about spatial correlation.

	Dep. var. $\ln(p + x)$, with x the homicide rate			
	(1)	(2)	(3)	(4)
	Estimates for different levels of clustering			
Seizures in Colombia × Proximity to the U.S.	0.014***	0.014***	0.014**	0.014**
	(0.0044)	(0.0044)	(0.0061)	(0.0068)
Observations	120,296	120,296	120,296	120,296
Number of clusters	2,456	2,335	160	32
	Estimates with Conley standard errors			
Seizures in Colombia × Proximity to the U.S.	0.014***	0.014***	0.014**	0.014**
	(0.0048)	(0.0051)	(0.0056)	(0.0067)
Observations	120,296	120,296	120,296	120,296
Spatial correlation within:	50km	100km	200km	500km
	Estimates with Conley standard errors which also allow for AR1 autocorrelation			
Seizures in Colombia × Proximity to the U.S.	0.014***	0.014***	0.014**	0.014**
	(0.0048)	(0.0051)	(0.0056)	(0.0066)
Observations	120,296	120,296	120,296	120,296
Spatial correlation within:	50km	100km	200km	500km

Note.- The table presents estimates of the interaction between cocaine seizures in Colombia (measured at the monthly level in logs) and proximity to U.S. entry points (measured in 100km) on violence in Mexico. The dependent variable is the homicide rate. All estimates include a full set of municipality and time fixed effects, as well as a differential cubic trend by distance from U.S. entry points. Each panel indicates the type of standard errors estimated. Coefficients with *** are significant at the 1% level, ** only at the 5% level, and * only at the 10% level.

this radius from 50km in column 1 to 500 km in column 4, as indicated below each model. Finally, the bottom panel presents a variant of the Conley standard errors which also allows for first-order autocorrelation within municipalities. In line with the fact that there is little autocorrelation in the high-frequency homicide variation, we obtained very similar results to the ones presented in the middle panel.

These exercises reveal that, even under the most conservative set of standard errors, we are able to reject the null hypothesis of no heterogeneous effects at the 5% confidence level.

We now turn to our estimates that explored the role of cartels and PAN policies, and which we presented in Table 6 in the main text. Table A2 presents our results from these exercises, in which we re-estimate the standard errors for the model in column 3 of Table 6 of the main text but allowing for spatial correlation. The left panel presents results in which we compute standard errors that are robust against different levels of clustering. Column 1 presents results in which we assume there is clustering within a municipality over time but not across municipalities, as we assumed in the main text. Column 2 presents results in which we assume there is clustering among municipalities in the same metropolitan area and over time, which yields 2,335 clusters. Column 3 presents results in which we assume there is clustering among municipalities in the same state and year but not across years, which yields 160 clusters. Column 4 presents results in which we assume there is clustering among municipalities in the same state and over time, which yields 32 clusters. The remaining panels present Conley standard errors, with different radius of spatial correlation specified in each column. Finally, the right panel presents a variant of the Conley standard errors which also allows for first-order autocorrelation within municipalities. In line with the fact that there is little autocorrelation in the high-frequency homicide variation, we obtained very similar results to the ones presented in the middle panel.

These exercises also reveal that, even under the most conservative set of standard errors, our main results in the main text remain significant. Cocaine shortages had a detrimental impact on violence only in municipalities that have several cartels, and especially in the North of Mexico. Both of these interactions are significant at the 5% level in all specifications. Finally, cocaine shortages had a the most detrimental impact on violence in municipalities with high PAN support, and this difference is significant at the 10% level in all but one specification. In the most conservative specification, the triple interaction term, which indicates whether high PAN support amplified more the effect of cocaine shortages in municipalities in the North of Mexico, is significant at the 12% level.

References

Conley, T.G., "GMM estimation with cross sectional dependence," *Journal of Econometrics*, 1999, *92* (1), 1 – 45.

Conley, Timothy G., "Spatial Econometrics," in Steven N. Durlauf and Lawrence E. Blume, eds., *The New Palgrave Dictionary of Economics*, Basingstoke: Palgrave Macmillan, 2008.

Table A3: Estimates of the standard errors of our cartel and PAN specification under alternative assumptions about spatial correlation.

	Dep. var. $\ln(p+x)$, with x the homicide rate											
	Estimates for different levels of clustering				Estimates with Conley standard errors				Estimates with Conley standard errors which also allow for AR1 autocorrelation			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Seizures in Colombia × Proximity to the U.S.	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
	(0.0057)	(0.0057)	(0.0055)	(0.0050)	(0.0064)	(0.0066)	(0.0069)	(0.0074)	(0.0063)	(0.0065)	(0.0068)	(0.0073)
Seizures in Colombia × Cartel presence	-0.034	-0.034	-0.034	-0.034	-0.034	-0.034	-0.034	-0.034	-0.034	-0.034	-0.034	-0.034
	(0.0816)	(0.0812)	(0.0869)	(0.0407)	(0.0876)	(0.0906)	(0.0946)	(0.0919)	(0.0876)	(0.0906)	(0.0946)	(0.0919)
Seizures in Colombia × Proximity to the U.S. × Cartel presence	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004
	(0.0103)	(0.0103)	(0.0108)	(0.0061)	(0.0109)	(0.0112)	(0.0117)	(0.0113)	(0.0109)	(0.0112)	(0.0117)	(0.0113)
Seizures in Colombia × Various cartels	0.242***	0.242***	0.242***	0.242***	0.242**	0.242**	0.242**	0.242**	0.242**	0.242**	0.242**	0.242**
	(0.0935)	(0.0931)	(0.0925)	(0.0537)	(0.1002)	(0.1002)	(0.0990)	(0.0981)	(0.1003)	(0.1003)	(0.0991)	(0.0982)
Seizures in Colombia × Proximity to the U.S. × Various cartels	0.033***	0.033***	0.033**	0.033***	0.033**	0.033**	0.033**	0.033**	0.033**	0.033**	0.033**	0.033**
	(0.0122)	(0.0122)	(0.0131)	(0.0092)	(0.0129)	(0.0130)	(0.0131)	(0.0133)	(0.0128)	(0.0129)	(0.0130)	(0.0132)
Seizures in Colombia × High PAN support	0.164**	0.164**	0.164	0.164*	0.164*	0.164*	0.164*	0.164*	0.164**	0.164*	0.164*	0.164*
	(0.0770)	(0.0777)	(0.0991)	(0.0948)	(0.0846)	(0.0863)	(0.0894)	(0.0918)	(0.0833)	(0.0850)	(0.0882)	(0.0906)
Seizures in Colombia × Proximity to the U.S. × High PAN support	0.019**	0.019**	0.019	0.019	0.019*	0.019*	0.019*	0.019	0.019*	0.019*	0.019*	0.019*
	(0.0098)	(0.0098)	(0.0126)	(0.0121)	(0.0107)	(0.0110)	(0.0114)	(0.0118)	(0.0105)	(0.0108)	(0.0112)	(0.0117)
Observations	97,902	97,902	97,902	97,902	97,902	97,902	97,902	97,902	97,902	97,902	97,902	97,902
Number of clusters	2,456	2,335	160	32								
Spatial correlation within:					50km	100km	200km	500km	50km	100km	200km	500km

Note.- The table presents estimates of the interaction between cocaine seizures in Colombia (measured at the monthly level in logs), proximity to U.S. entry points (measured in 100km), cartel presence, and PAN support on violence in Mexico. The dependent variable is the homicide rate. All estimates include a full set of municipality and time fixed effects, as well as a differential time trend by distance from U.S. entry points, by the number of cartels and by PAN support. Each panel indicates the type of standard errors estimated. Coefficients with *** are significant at the 1% level, ** only at the 5% level, and * only at the 10% level.