Online Appendix to:

From Maize to Haze: Agricultural Shocks and the Growth of the Mexican Drug Sector

(Not Intended for Publication)

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A Supporting Information Appendix

This appendix provides supporting information for "From Maize to Haze: Agricultural Shocks and the Growth of the Mexican Drug Sector." In Section A.1, we describe our weather instruments and additional controls. In section A.2, we present results on household economic outcomes. In section A.3, we present a more extended discussion around a subset of results that are referenced in the main text. In Section A.4, we present a calibrated model of eradication. In Section A.5, we discuss the implications of evolving drug prices for our analysis.

A.1 Weather Instruments and Additional Controls

A.1.1 U.S. Weather Instruments

Our weather instruments are a series of indices that capture weather conditions affecting counties in the United States "Corn Belt." We identify these counties using data from the National Agricultural Statistics Service (NASS) of the United States Department of Agriculture. Specifically, we use the 2002 Census of Agriculture to get county-level data on the number of acres harvested in corn.[1] The Census provides acreage data for 2,284 counties. All of our weather indices represent weighted averages across weather conditions for these counties, with the acreage in each county used as weights.

We use hourly weather station data from the Meteorological Development Laboratory (MDL) of the National Oceanic and Atmospheric Administration. Specifically, we use the database *TDL U.S. and Canada Surface Hourly Observations, daily from December 1976 to present*, obtained from the Research Data Archive of the Computational and Information Systems Laboratory (NOAA, `http://rda.ucar.edu`). The data provide hourly readings from over 2,500 weather stations. We determine the latitude and longitude coordinates of each of the 2,284 counties using the Google Geocoding API V3, which allows us to calculate the distance between a county and each weather station in the MDL data. We match each county to the nearest weather station to obtain county-specific weather observations.

[1]There are three waves of the Census of Agriculture that contain the data we require during our sample period: 1997, 2002, and 2007. We used the 2002 Census since it lies in the middle of our sample period.

Temperature is known to have significant and non-linear effects on corn growth, with corn yields rising in temperature at low and moderate levels, and then falling sharply with excessive heat (Schlenker and Roberts 2009). We therefore measure the average daytime temperature in July, as there is some evidence that heat sensitivity may be particularly high in that month, which is the typical corn flowering period (See the Appendix in Schlenker and Roberts).[2] The variable $USTEMP_t$ is the average of the average day-time temperature across our 2,284 counties, weighted by harvested acres.[3] We use both $USTEMP_t$ and its square $USTEMPSQ_t$ to form instruments (which include interactions of these annual weather variables with cross sectional municipal maize suitability).

Earlier in the growing season, corn crops are also sensitive to frosts that may delay planting or damage young plants. Planting typically starts in early spring, as "Most farmers in the Corn Belt do not begin planting corn until the first or second week of April." (Hirtzer 2012). Frosts early in April have been cited as damaging to early corn in Illinois (ACES College News, 2012). For each county, we construct the fraction of observed hours during which the nearest station experienced freezing temperatures (less than 32 degrees Fahrenheit) during the first two weeks of April. The variable $USFRZ_t$ averages this index of freezing hours across counties. We use $USFRZ_t$ and its square, $USFRZSQ_t$ to form instruments. The quadratic specification allows us to pick up the effects of deep freezes that could be particularly detrimental.

Finally, we also include a measure related to the dew point during the flowering month of July. The dew point is related to the availability of moisture in the air. Lower dew points are (ceteris paribus) associated with a higher vapor pressure deficit, which has a negative impact on crop yields (Roberts et al. 2013 and Lobell et al. 2014). For each county, we construct the average day-time dew point associated with the closest station in July, and then average this across counties to get our instrument $USDEW_t$.

A.1.2 Additional Controls

In certain Appendix specifications, we present estimates where we control for time trends interacted with five cross-sectional enforcement and economic characteristics, in lieu of municipio-specific trends.

[2]We use station observations between 6:00 A.M. - 10:00 P.M. for this purpose

[3]For each county and each daytime hour in July, we get a temperature reading. We then average the hourly temperature for all non-missing observations in the month to get a single temperature variable in July for a particular station. Each corn county is then matched to the closest station.

In these specifications, we include trend controls interacted with distance to the nearest point on the U.S.-Mexico border, and with an indicator for whether the municipio has a major highway, both of which are likely to affect the extent of trade in the municipio. This is especially important since NAFTA may have influenced the volume of trade in legal and illegal goods (Andreas 1996). We also control for trends based on distance to the nearest security station distance (already described in the main text). We additionally utilize data from the 1990 Mexican Census to control for trends based on start-of-sample economic characteristics. These include the fraction of employed males employed involved in agriculture as a proxy for rurality, and the average agricultural income in each municipio in 1990. We refer to these controls as our economic and enforcement trends. Panel B of Table A.9 presents the descriptive statistics of the additional cross-sectional characteristics in these control sets.

A.2 Maize Prices and Household Economic Outcomes

As emphasized in our mechanisms section, we should expect to observe that maize price fluctuations induce households in more maize suitable areas to experience larger declines in their legal income opportunities. To explore the relationship between the maize price and economic outcomes of rural workers, we construct a sample that pools observations from the various waves of the Encuesta Nacional de Ingresos y Gastos en los Hogares (ENIGH). The ENIGH is a nationally representative survey of Mexican households which focuses on gathering detailed information about household income and expenditures. We combine the 10 biennial waves from 1992 to 2010 with a 2005 wave. Table A.9 presents summary statistics of the main variables used in our analysis of the ENIGH data.

We use the ENIGH data to explore impacts on a range of labor market outcomes, including measures of rural wages computed on the basis of reported income. While the ideal data would distinguish data on income generated from legal and illegal production, we are only able to observe total reported income, which may reflect income generated from the cultivation of drug crops. Thus, our estimates should be interpreted as reflecting the impacts of the maize price on households after they have made decisions about labor supply, occupation and crop adjustments, including the decision to grow drugs.

For all of our variables of interest, we estimate the individual-level equivalent of Equation 2 (in the main text) excluding municipio-specific trends. We do this because we have fewer years of time series variation (11 as opposed to 21 in the main specification), and we do not observe data on individuals from each municipio in every year. In fact, 27% of the 869 municipios appear in the sample for 1 year only, and 57% appear for 3 or fewer years. This limits the municipio-specific time series variation that can be used to identify our main difference-in-differences coefficient. Instead of municipio-specific trends, we add in the five economic and enforcement trends described in Section 1 of the Appendix. In addition to this control set, we also include individual-specific controls for age, education, and a full set of dummy variables for survey month. All regressions weight observations using the sampling weights provided by the ENIGH. In Table A.10 we first examine whether fluctuations in maize prices alter the labor supply behavior of rural individuals. Here we restrict our sample to men between the ages of 18 and 65 who reported working last month and live in locations with populations less than 2,500 (INEGI's smallest size classification).[4] The dependent variable in Column 1 is a dummy for working 40 or more hours in the past week, which we take to be full time work. We find no evidence that changes in the maize price induce differential effects on the propensity for men to work full-time.

Next, we observe whether changes in the maize price affect labor market outcomes for those that work. It is possible that a reduction in the price of maize can reduce a household's incentives to produce a surplus for the market, and increase the propensity to engage in subsistence work that does not generate monetary income. For example, if the price is sufficiently low, households will not find it optimal to incur fixed costs of market participation, and may instead only produce for household consumption and informal exchange. Indeed, de Janvry et al. (1995) and Yunez-Naude and Serrano-Cote (2010) argue that such an increase in subsistence activity has occurred in Mexico in the wake of NAFTA. We can measure subsistence behavior in our sample in two ways. First, the ENIGH survey asks workers to identify their job classification (e.g. paid employee, self-employee etc.). One worker type indicates an unpaid worker in a family farm or business, and this classification represents our first measure of subsistence employment. Second, we can directly measure whether individuals report earning zero income, regardless of their worker type. Columns 2-5 present results on the effect of maize prices on these subsistence measures among full-time workers. In Columns 2-3, we find negative and statistically significant coefficients on both measures. However, we know

[4]We focus on these places within our municipios because we should only expect a direct labor market response to maize price fluctuations in less populated locations that depend on agricultural production. If changes in the maize price alter drug production in a municipio, it will be the result of changes to the incentives of this class of workers rather than those in larger urban areas with the municipio.

that unpaid labor is a phenomenon associated with relatively young workers, so in Columns 4-5, we repeat these regressions restricting the sample to workers aged 30 or younger. As expected, in this young sample, we find even larger, statistically significant coefficients on both subsistence measures. The estimated coefficient of -0.033 in the unpaid worker specification suggests that in the response to the 59 percent maize price decline between 1990 and 2005, the fraction of unpaid family workers increased by 12 more percentage points in the more maize suitable municipio. Since about 8.5% of young workers in the entire sample are unpaid workers, this differential effect is sizable.

We next examine the impact of a change in the maize price on log hourly wages, which are computed from survey items on income and hours worked. We restrict our sample to those working 20 or more hours per week. We first examine the impact on all such rural workers, not only those identified as maize workers in the ENIGH. We do this for at least two reasons. First, many farming households grow a variety of crops, making it difficult to identify them with any one particular output. Indeed, in the 1990 Census, over 40 percent of agricultural workers were not classified as cultivating any one particular crop. Ethnographic studies suggest that even those farmers associated with non-maize crops devote a non-trivial fraction of their land to maize cultivation (Eakin 2006, pp. 54-82). As such, only considering individuals identified as maize workers will understate the fraction of farmers whose income stream is sensitive to changes in maize prices. Second, households may endogenously change the mix of crops they plant, or may move out of agriculture in response to changing crop prices. We consider the impact of a change in the maize price on all workers to avoid bias stemming from compositional changes.

Column 6 indicates that the wage elasticity with respect to the maize price is significantly higher in those municipios that are more suited to growing maize. To interpret the magnitude of the coefficient estimate, we again compare the implications for the difference in wages between workers in a high and low maize municipios. The estimated coefficient of 0.058 suggests the wage elasticity with respect to the maize price is higher by 0.24 in the more maize suitable municipio. This implies that as the maize price declined by 59 percent between 1990 and 2005, average wages of rural workers in the more maize suitable municipio fell by an additional 21 percentage points.

In Column 7, we restrict the sample further to only include agricultural workers. The point estimate from this specification is similar to the estimate in Column 6, but reducing the sample size increases the standard error and this estimate is insignificant at the 0.10 level. In Column 8, we restrict the sample to only include workers identified as maize and bean workers. In this specification we estimate a large and significant coefficient of 0.176. This suggests that in response to the 59 percent decline in the maize price between 1990 and 2005, the average wages of maize and bean workers fell by about 64 more percentage points in the high maize municipio. Finally, in Column 9, we restrict the sample to workers who identify themselves as cultivating specific crops which are not maize.[5] We do not find differential effects for these workers, consistent with the argument that our difference-in-difference strategy isolates a change in income opportunities that is specifically related to maize workers.

Taken together, the results in Table A.10 provide evidence that changes in the maize price over our sample period generated substantial differences in the labor market outcomes of municipios with varying levels of maize suitability. A fall in the maize price not only increased the propensity for subsistence work, but also substantially reduced the wages of those who do work non-trivial hours.

A.3 Discussion of Additional Results

A.3.1 Border Effect and Processed Marijuana Seizures

The results in Panel A of Table 4 indicate a positive and significant effect of the maize price on seizures of processed marijuana in high maize municipios relative to low maize municipios. However, this appears to be driven by phenomena near the U.S. border, since we find no statistically significant effect when we drop municipios within 100 miles of the U.S.-Mexico border.

We posit that this is consistent with our overall account linking the maize price to differential drug production in highly maize suitable municipios. Seizures of processed marijuana are more likely to take place along the border, where packaged drug output enters the final stage of trafficking into the United States. However, areas along the border tend to have low values of our maize suitability index $MAIZE_i$. Drug trafficking routes connect rural growing areas on the interior of the country with the desert municipios along the border. When the price of maize falls, this stimulates greater drug production in high-maize municipios relative to low-maize municipios. However, as this output is

[5] Specifically, we include any cultivator who identifies a crop-specific occupation code which is not related to maize. This definition includes cultivators of cereals (e.g. rice and sorghum), cotton, henequen, fruits and vegetables, coffee, cacao, tobacco, and flowers.

processed and trafficked, it moves through the low-maize suitable municipios along the border where it may be seized. A fall in the price of maize should thus be expected to generate relatively more seizures of processed marijuana in the low-maize border municipios relative to high-maize municipios. This would generate a positive relationship between $MAIZE_i \times PRICE_t$ and processed marijuana seizures when the border municipios are included in the sample.

Trafficking routes converge at crossing points along the border, but also extend beyond their vicinity in a less concentrated manner. If our account holds, we should expect to observe that the positive estimates on processed seizures diminish as we gradually eliminate municipios that are close to the border. To test for this, we estimate effects on processed marijuana seizures in the full sample; in the sample dropping the 31 municipios that are directly contiguous with the U.S.-Mexico border; and in the sample dropping 107 municipios that are within 100 miles of the border. (100 miles is still fairly close to the border in that the largest the largest distance between a municipio centroid and the U.S. border among the contiguous border municipios is 72 miles. Furthermore, the mean distance of municipios within border states are 122 miles).

In Appendix Table A.5, Panel A shows that the positive coefficient for processed marijuana seizures holds when we estimate impacts using the entire sample. This is true for all five additional specifications that appear in the paper: controlling for local enforcement; controlling for legal crop suitability; controlling for drug crop suitability; controlling for Diconsa; dropping Sinaloa. In Panel B, dropping the municipios contiguous with the border causes a substantial reduction in the magnitudes of the estimated coefficients across all specifications. In Panel C, when we drop the municipios with 100 miles of the border, we find no evidence of a significant relationship between $MAIZE_i \times PRICE_t$ and processed marijuana seizures in any of the five specifications.

A.3.2 Addressing Threats to Identification: Endogenous Enforcement

Our estimates could be biased if falling maize prices cause changes in the quantity of resources that are available for eradication. However, the most likely scenario is that as the price falls, maize dependent municipios would see greater strain placed on local budgets, decreasing resources used in support of federal eradication. We would therefore expect endogenous budgetary resources to attenuate estimated impacts of maize prices. Our specifications, which do not control for budgetary resources, likely represent a lower bound on the true effects.

Although we are not able to observe local enforcement budgets, or allocations devoted specifically to eradication, we are able to observe aggregate military expenditures at the national level, which include resources for drug eradication. In addition, we can measure the total number of personnel in the armed forces, which is relevant for the drug war because soldiers both partake in anti-cartel campaigns and conduct manual eradication of illicit crops. Finally, we can track the amount of military aid provided to Mexico by the United States. Much of this assistance has been provided for counternarcotics purposes, including equipment that has facilitated eradication missions (GAO 1998). Figure A.1 plots the time series of these three variables reflecting national enforcement efforts, alongside the predicted maize price. The figure shows no systematic relationships between these variables and our price variation for most of the sample period. The exception is the period after 2005. In that year, the price of maize pivots upward as a result of the World Food Crisis. Government military expenditures and armed personnel also pivot upward as a results of the Calderón administration's anti-drug military campaigns. This denoted a marked shift in the Mexican drug war strategy—the administration prioritized attacking cartels in urban areas, which may have lowered resources available for eradication in rural areas, including more maize suitable municipios. This suggests that it may be important to account for the coincidence of these two trends. We do so by controlling for maize suitability interacted with these three time series in Panel A of Appendix Table A.13.[6] In Panel B of this table, we additionally incorporate our local enforcement controls. In both specifications, we estimate larger coefficients on both eradication outcomes relative to baseline effects (in Table 2). The coefficients also retain their statistical significance for all outcomes, with the exception of raw marijuana seizures. This likely reflects loss of precision from additional collinear controls, since this coefficient also increases in magnitude relative to baseline estimates (in Table 4). Overall, these results suggest that enforcement dynamics do not lead us to over-estimate the impact of maize price shocks on drug production.

[6] We are not able to estimate impacts on drug war killings with these additional time-varying controls since we have limited time series variation with just four years of data, over 2007-2010.

A.3.3 Addressing Threats to Identification: Inter-temporal linkages and Alternate Trend Controls

Our interpretation of the results will also be threatened if the process of eradication alters the incentives to produce drugs in the future — either by destroying household resources, or by changing expectations about the future risks of drug production. This concern would be greatest for perennial plants like coca (used to manufacture cocaine). In contrast, marijuana and poppy are annual crops that need to be replanted each year. For these crops, eradication in a particular year does not reduce a household's ability to grow drugs in the future. Generally, it is reasonable to presume that the risk of eradication is understood by growers. However, we can also assess the nature of serial correlation in the eradication process by incorporating lags of the dependent variables. These are of course, endogenous controls. As such, we take these specifications to be suggestive, and most informative for gauging the type of serial correlation that arises.

In Table A.16, we examine the consequences of adding the lag of the dependent variable to our specifications for marijuana and poppy eradication. Columns 1-2 add lagged municipio-level marijuana and poppy eradication, respectively, to our two baseline specifications for these outcomes. In both cases, the lagged dependent variable is estimated to have a positive, statistically significant relationship with contemporaneous eradication. The difference-in-differences coefficient on $MAIZE_i \times PRICE_t$ is negative and statistically significant for marijuana eradication, but this coefficient becomes attenuated and insignificant for the poppy outcome. To explore this further, we consider specifications that take into account the policy shift initiated by the Calderón administration in 2006. If Calderón's policy shift initiated a systematic reduction in eradication, then this could disrupt the auto-regressive relationship between past and present eradication. In Columns 3-4, we re-estimate our specifications with lags, but also add in an indicator variable for the post-2005 period interacted with maize suitability to control for possible systematic differences in eradication after this period. In these specifications, the main difference-in-differences coefficient is negative and significant for both drug crops.

An alternate approach to understanding the consequences of the 2005 shift is to drop the years after 2005. In Columns 5-6 of Table A.16, we estimate our baseline specifications (without lags) for the sake of comparison. For both outcomes, we estimate negative, statistically significant coefficients on $MAIZE_i \times PRICE_t$ that are somewhat larger than our baseline estimates. In Columns 7-8, we add the lag of the dependent variable while dropping the post-2005 years. In these specifications, adding the lagged dependent variable does little to change the difference-in-differences estimates. We interpret the collection of results in Table A.16 as indicating that the attenuation in the coefficient for poppy with the inclusion of a lag is driven by events at the end of our sample which may be due to the policy change occurring at that time. Overall, the results suggest that there appears to be quite a bit of persistence in eradication.[7]

In Appendix Table A.17, we also account for concerns that other changes (such as enforcement policy) induced differential trends in eradication through various alternate strategies. Each of these specifications includes alternative types of trend controls in lieu of municipio-specific trends in the baseline specification. First, we account for non-linear trends. Since maize prices fell prior to 2005 and rose thereafter, our results could be spurious if some other factor caused drug production to trend upward differentially in more maize-suitable before 2005, and then caused it to trend downward differentially in these areas after 2005. It is difficult to imagine a factor that would cause such a specific reversal in underlying trends. (For example, military resources devoted to enforcement were rising after 2005, but they were not decreasing beforehand—see Appendix Figure A.1). Adding additional terms for non-linear trends by maize suitability is almost surely an over-control, as these terms will soak up two of the most important sources of price variation in our sample – the fall prior to 2005 and the rise thereafter. Nonetheless, in Panel A of Table A.17, we add three such trend controls: an annual trend interacted with maize suitability, an indicator for the five years after 2005 interacted with maize suitability, and an annual trend interacted with both maize suitability and an indicator for the five years after 2005. The coefficient estimates remain statistically significant for all outcomes, with the exception of raw marijuana seizures, although this change arises from inflated standard errors, as the point estimate remains economically substantial.

[7]This discussion also raises the question of why farmers continue to grow drug crops when they face risk associated with drug crop cultivation, as reflected in eradication and other factors. Qualitative accounts from the Yucatan peninsula suggest that drug lords take some steps to minimize these risks. For example, they provide seed and fertilizer and a guaranteed market for the harvested crop (Steinberg 2004, p. 170). In addition, many rural workers are hired to work as laborers on farms operated by cartels (Humphrey 2003 and Ríos 2008). Working as paid laborers shields farmers from some of the risk of eradication and crop loss. Furthermore, legal crops also expose cultivators to a substantial amount of risk. For example, anecdotal evidence suggests that while peaches and avocados represent alternatives for poppy growers in Guerrero, poor roads increase the probability that harvested crops will spoil before reaching market (Chandler 2015). In contrast, drug crops are often transported by drug cartels.

In Panel B, we eliminate the post-2005 period from the sample. This is an alternate way of examining whether the 2005 military policy change, and differing trends in maize suitable municipios after 2005 influence the estimated effects. However, we observe significant impacts of the maize price interaction on all of our main outcomes. The size of the cartel effect is smaller than the baseline estimate. But this is not surprising as the most dramatic increase in cartel in-fighting occurred over the last part of our full sample period, which is omitted from this specification. This again casts doubt on the idea that trend changes after 2005 drive our estimates.

In Panel C, we address the concern that enforcement policies may vary from year to year across different regions of Mexico. Though we are not able to observe these policies directly, we divide Mexico into five geographic regions and include region by year effects as controls. This specification also constitutes a fairly stringent check, as it produces estimates identified solely off of differential within-region outcomes. We continue to find strong effects on all main outcomes under this approach.

Finally, in Appendix Table A.18, we undertake one additional robustness check that relates to the source of time variation used in our analysis. Since our estimation strategy uses both annual-level variation in prices and municipal-level variation in maize suitability, we check our main results across five specifications by clustering two-way on municipality and year. Almost all coefficients retain their statistical significance within any given specification. Effects on marijuana eradication, any cartel, and multiple cartels remain significant consistently across all specifications. No outcome is systematically insignificant across all specifications. For example, poppy eradication remains significant in two specifications and marijuana seizures remains significant in four specifications. Overall, these results suggests that this alternate clustering strategy does not change our results in a fundamental manner.

A.3.4 Addressing Threats to Identification: Trends by Legal and Illegal Crop Suitabilities

If maize suitability is correlated with suitability for other crops whose prices covary with the maize price, this could confound our interpretation. For example, if barley suitability is positively correlated with maize suitability, and the price of barley rises (falls) with the price of maize, this would bias our estimated effects upwards (downwards). To address this, we gather FAO suitability measures for 15 other crops besides maize, which rank among the top 30 most important agricultural commodities in Mexico in terms of production value.[8] We utilize two strategies to control for these crops. In our preferred approach, we use a principal components analysis to identify the first, second and third principal components of the crop suitability data for all crops except beans and sorghum, since they are highly correlated with maize suitability.[9] , [10] The first three components together account for over 80% of the joint variation in these suitabilities. In Table A.19, we add separate interactions between the three components and a full set of year dummies to flexibly control for their influence on drug crop production. The estimated effects in this specification are similar to baseline values, suggesting that overall, changing returns to legal crop suitabilities do not confound our estimates.

Next, we consider a set of 15 specifications in which we take our baseline and add just one crop suitability interacted with year dummies. We plot the resulting coefficients on $MAIZE \times PRICE$ in Panel A of Figure A.2. We have ordered the crops so that each subsequent crop is more highly correlated with maize suitability. The x-axis labels the added crop and the associated correlation coefficient. For both marijuana eradication and poppy eradication, the coefficients remain remarkably stable until we add in sorghum suitability, which has the highest correlation coefficient with maize suitability (of 0.67). With the addition of the sorghum interactions, the estimated coefficients for both marijuana and poppy become attenuated.

In Panel B, we consider a set of specifications in which we add the crop suitability by year dummy interactions cumulatively. For example, the third specification in Panel B includes a separate set of year interactions for pasture, rice, and soybean suitabilities. For marijuana eradication, the effects remain statistically significant and stable in size across the board, even when interactions with all 15 crop suitabilities are added in. Even with poppy eradication, the effects remain stable up to the addition 10 crops, but attenuate and become insignificant when the last five crops that most highly correlated with maize suitability are added into the control set.

Another natural concern emerges if municipios with high maize suitability are also well suited

[8] These crops are wheat, barley, carrots, pasture grass, sorghum, rice, alfalfa, banana, cotton, oats, onions, potatoes, soybeans, tomatoes, and beans.

[9] Retention of the first three principal components of the suitability data is consistent with the Kaiser rule, which suggests that one should retain all components with associated eigenvalues above 1. In our application only the first three principal components meet this criterion.

[10] The correlation between maize suitability and bean suitability is .6. The next most correlated crop is alfalfa, with a correlation coefficient of .39.

to growing drug crops. Suppose this is true and the drug trade has expanded over time for reasons unrelated to price changes. Since maize prices are falling for most of our sample period, we might then expect to find the same difference-in-differences results even in the absence of income changes. To account for this, we re-estimate our baseline specifications but now include as controls interactions between annual dummies and the average value of the dependent variable over the period 1990-1993. These results are shown in Table A.20. When examining cartel outcomes, we include the interaction of year dummies with both average marijuana and poppy eradication from 1990-1993. For all outcomes, the new point estimates are quite similar to the baseline values.

A.4 A Calbibrated Model of Eradication

Here we develop and calibrate a simple economic model of eradication to explore the econometric consequences of using eradication as a proxy for drug production. Let $j = 1, 2, ..., J$ index municipios, with $MAIZE_j$ measuring the maize suitability of municipio j. The variable D_{jt} represents the quantity of a drug crop cultivated in municipio j in time period t. The variable $PRICE_t$ represents the log of the maize price at time period t. We assume that $PRICE_t$ is potentially associated with drug production, and could have a different relationship with drug production in those places that are more highly suited to maize. The true data generating process for *drug cultivation* (before eradication) is thus given by:

$$\log(D_{jt}) = \alpha_{0j} + \alpha_m MAIZE_j + \alpha_p PRICE_t + \alpha_{mp} MAIZE_j x PRICE_t + \alpha_{trend} t + \epsilon_{jt} \quad (1)$$

Note that the intercept α_{0j} is allowed to vary by municipio, and that $\alpha_{trend} t$ represents a common linear trend. The ϵ_{jt} disturbances are i.i.d. across time and municipios, and are drawn from a normal distribution with mean 0 and a common variance σ_ϵ^2. If we could directly observe drug output, we could estimate the differential impact of the maize price on drug production through the difference-in-differences approach that we employ in the main empirical analysis of this paper. That could be accomplished by estimating the following regression equation (we add a one to drug output to make this comparable to the empirical specification that we will estimate with the eradication data which contain a substantial number of zeros):

$$\log(D_{jt}+1) = \mu_j + \nu_t + \beta MAIZE_j xPRICE_t + \epsilon_{jt} \tag{2}$$

Here μ_j represents a vector of municipio fixed effects, and ν_t represents a vector of time period effects. Now, suppose that we cannot observe D_{jt} but rather can only observe the quantity of drugs that the government chooses to eradicate in each municipio-year, E_{jt}. The econometric consequences of replacing D_{jt} with E_{jt} will in general depend on how the government decides to target eradication resources. To explore this further, we develop a simple model of eradication.

Suppose that the government enters period t with a budget of B_t for eradication. It must decide how to allocate these resources across each of the J municipios. Let S_{jt} represent the expenditure of eradication resources in municipio j at time t. Also assume that a fixed cost of FC must be paid in order to eradicate at all in a specific municipio. Then the government's budget constraint in period t becomes:

$$B_t = \sum_j \left(S_{jt} + FC\mathbf{1}_{\{S_{jt}>0\}}\right) \tag{3}$$

A given level of expenditure maps into a specific quantity of drugs eradicated through the following production function:

$$E_{jt}(S_{jt}) = \left(1 - \frac{1}{1+S_{jt}}\right) D_{jt} \tag{4}$$

This specification implies three reasonable relationships for an eradication production function. First, resources must be allocated to a municipio for us to observe any eradication there ($E_{jt}(0) = 0$). Second, the marginal productivity of resources is positive but diminishing: $E'_{jt}(S_{jt}) > 0$ and $E''_{jt}(S_{jt}) < 0$. Third, the greater is the volume of drug cultivation in a municipio, the greater is the marginal productivity of resource expenditure. Holding expenditure fixed at $\overline{S}$, $E'_{jt}(\overline{S})$ is positively related to D_{jt}.

The government's utility function is decreasing in the quantity of drugs successfully produced (and not eradicated) in each location, so that overall period utility is given by:

$$U_t(E, D) = \sum_j -(D_{jt} - E_{jt})^\gamma \tag{5}$$

Note that the parameter $\gamma > 0$ determines the curvature of the utility function with respect to drugs successfully produced in each municipio.

Given this environment, we assume that the government chooses an optimal allocation of eradication expenditures, $\{S_{jt}\}_{j=1}^J$ so as to maximize period utility:

$$\max_{\{S_{jt}\}_{j=1}^J} \quad \sum_j -(D_{jt} - E_{jt})^\gamma \tag{6}$$
$$s.t.\ B_t = \sum_j \left(S_{jt} + FC\mathbf{1}_{\{S_{jt}>0\}}\right)$$

The solution to this optimization problem will generate a series of eradication outcomes $\{E^*_{jt}\}_{j=1}^J$. Suppose that we can only observe $\{E^*_{jt}\}_{j=1}^J$ each period rather than $\{D_{jt}\}_{j=1}^J$, and we then estimate the following specification to learn about drug production:

$$\log(E^*_{jt} + 1) = \mu_j + \nu_t + \theta MAIZE_j xPRICE_t + e_{jt} \tag{7}$$

Will the estimator for θ exhibit bias relative to β, and if so what is the direction and magnitude of the bias? We can learn a bit more about this by calibrating the model to the data and exploring the consequences of using eradication data instead of direct cultivation data in the world of the model. Calibrated values of the key model parameters are obtained by matching summary statistics from simulated data with those observed in the sample. Specifically, we simulate 100 panel data sets from the data generating process described above for the period 1990-2010. For each random sample, we simulate drug outcomes and endogenous government eradication in a stylized economy with 8 municipios that vary in maize suitability, $MAIZE_j$, and in the baseline level of drug production, α_{0j}. The municipios are assigned maize suitabilities that reflect the distribution of $MAIZE_j$ in our empirical sample. Specifically, the distribution of $MAIZE_j$ in the observed data (with mean 6.64 and standard deviation 1.59) can be approximated as a discrete probability distribution with four equally likely mass points: $MAIZE_j \in \{4.62\,, 6.12\,, 7.16\,, 8.66\}$. Each of these levels represents an average value in the four regions of the continuous $MAIZE_j$ distribution that are separated by its quartiles. For each level of $MAIZE_j$, we simulate two separate municipios: one with $\alpha_{0j} = \alpha_0$, and one with $\alpha_{0j} = (\alpha_0 + \alpha_{0H})$, where α_0 and α_{0H} are parameters to be calibrated. This allows for some heterogeneity in the distribution of baseline drug production holding $MAIZE_j$ constant.

We take the maize price series $PRICE_t$ directly from our data and hold this fixed across all simulations. We also generate a time series for the eradication budget by assuming that it is proportional to the growth of real military expenditures in Mexico. Specifically, if $MilExp_t$ represents real military expenditures, then we model the budget in our simulations as follows:

$$B_t = B_0 \left(\frac{MilExp_t}{MilExp_{1990}} \right) \phi_t \tag{8}$$

Here B_0 is a baseline scale for the budget (to be calibrated), and ϕ_t is a factor that takes the value 1 for years 1990-2005 and the value $\phi_{Calderon}$ for the years 2006-2010. That is, we allow for the possibility that a different fraction of military resources was allocated to rural eradication efforts during the Calderon administration. This allows for the model to flexibly accommodate the substantial shift in counter-narcotics policy enacted under his administration.

For each year in each simulation run, we generate simulated data as follows. First, given $PRICE_t$, we simulate drug output for each municipio according to the production process in Equation 1. Next, given a vector of drug outputs D_{jt} and the current eradication budget B_t, we numerically solve the government's optimal eradication decision based on the decision problem outlined above. This generates a vector of simulated eradication outcomes. Doing this for every year for all 100 runs gives us a combined simulated data set of $16,800$ observations.

Given our modeling assumptions, there are 11 parameters to be calibrated. We have seven undetermined drug production parameters: α_0, α_{0H}, α_m, α_p, α_{mp}, α_{trend}, and σ_ϵ. We also must calibrate four parameters related to government preferences and the eradication budget constraint: γ, B_0, $\phi_{Calderon}$, and FC. Note that we are restricting $\phi_{Calderon}$ and FC to be positive numbers. We calibrate these 11 parameters so that our simulated data matches 17 features of our observed data. Appendix Table A.14 summarizes these features of the data. First, we try to match average levels of log marijuana eradication (plus one) in three time periods: 1990-1995, 1996-2005, and 2006-2010. Next, in each of these time periods, we try to match the average difference in log eradication between municipios in the second, third, and fourth quartiles of the $MAIZE_j$ distribution and those in the first quartile after first eliminating the effects of our standard controls.[11] Since there are three such differences in three time periods, this adds nine more features of the data to match. We also try to match the standard deviation of residual log marijuana eradication for each of the four $MAIZE_j$ quartiles.[12] Finally, we try to match our baseline difference-in-differences estimate for the effect of $MAIZE_j xPRICE_t$ on marijuana eradication (-0.033). We construct estimates of these features of the data in each of our 100 simulation runs, and then try to match the averages across these runs to the values observed in the data. Specifically, we find our calibrated parameters by trying to minimize the sum of squared differences between the data and simulation averages. For example, in each of the simulated samples, we generate a diff-in-diff estimate of the effect of $MAIZE_j xPRICE_t$ by estimating Equation 7 with the simulated data from that run. The $\widehat{\theta}$ estimates from each run represent simulated sample analogues of our diff-in-diff estimate which we average and compare to our target of -0.033.

Table A.15 presents our calibrated parameter values, and Columns 1-2 of Table A.14 show how the calibrated model performs in terms of matching the empirical statistics. Given that the model is over-identified (we have more statistics to match than free parameters), and that the model is very stylized, it is noteworthy that it replicates the features of the empirical data quite well. The model matches average eradication levels and captures the evolution of differential eradication across MAIZE quartiles over time. The model tends to under-predict the positive relationship between MAIZE and the standard deviation of log eradication, but this is understandable given the assumed homogeneity in the variance of the production shocks, σ^2_ϵ.

The calibrated model is useful because it allows us to explore the consequences of using endogenous

[11]To get the empirical counterpart of these averages, we first run a regression explaining log eradication as function of all of the covariates in our baseline specification except for $MAIZE_j xPRICE_t$. Next, we take the residuals from this regression and run a secondary regression with fixed effects for the three time periods, and interactions between these time period effects and indicators for the different $MAIZE_j$ quartiles. The coefficients from these secondary regressions indicate differences in eradication across the $MAIZE_j$ quartiles in each of the time periods. We work with the residuals to eliminate the effects of time-varying confounds that are controlled for in our regressions but which we abstract away from in the calibrated model

[12]As with the differences by $MAIZE_j$ quartile, the empirical standard deviations are based on residuals from an initial regression.

eradication data instead of underlying drug cultivation data. To do this, we again simulate 100 samples from our model with the calibrated parameter values and now, for each sample, we estimate Equation 2 and get an average value of the estimated diff-in-diff coefficient (β) using the actual cultivation data. As shown in Table A.14, this average is -0.041, compared to the -0.027 average estimate using eradication data. These expected values are reasonably similar in magnitude, and suggest that if anything, endogenous enforcement may generate attenuated difference-in-difference estimates when using eradication as a proxy for drug production.

A.5 The Implications of Evolving Drug Prices

So far, we have ignored the role of drug prices in determining illicit crop production. Since we are concerned with the effects of exogenous changes in the maize price, it is not necessary to incorporate drug prices into our empirical specifications to obtain consistent estimates of the main parameter of interest. Furthermore, several challenges would prevent us from credibly studying the relationship between drug prices and production. First, data limitations severely limit such analysis. While we are able to obtain time-series data on the wholesale retail prices of marijuana and heroin, we are unable to obtain data on the farm-gate prices faced by rural producers. Since there may be a wedge between the farm-gate price and the retail (street) price, and since this wedge could be evolving over time, the use of inappropriate price data could generate biased estimates. Second, the price of drugs is an inherently endogenous variable which is determined, in equilibrium, by the supply of drugs. Directly including the price of drugs in a supply equation would generate bias in the estimated effect of the maize price, since the maize price is a determinant of the drug price.

The exclusion of drug prices from our empirical specifications could be problematic if the maize price happens to be correlated with *exogenous* determinants of the demand for drugs. For example, if the price of maize is trending downward at the same time as the demand for drugs is exogenously shifting upwards, our estimates for the effect of the maize price could be biased downwards (larger in magnitude). Our existing specifications implicitly account for this by including time effects. Furthermore, since exogenous changes in the demand for drugs should affect the incentives to produce drugs in all municipios, it is not clear how such factors would induce a differential change in drug production in the maize suitability areas. Yet, this is the only scenario in which our difference-in-differences estimates would be biased by exogenous changes in drug demand.

Figure A.3 plots the evolution of the log maize price along with the log wholesale prices of marijuana and heroin. The marijuana data reflect annual estimates (averaged over quarters) of the price per bulk above 100 grams in 2007 dollars. (Fries et al. 2008). The heroin price series comes from the UN Office on Drugs and Crime and reflects estimates of the wholesale price (UNODC World Drug Report 2011). It is important to note that these are wholesale retail prices that do not necessarily reflect the farm-gate prices received by farmers. It is clear from Figure A.3 that the prices of both marijuana and heroin generally followed a downward trend throughout the 1990s before leveling off in the early 2000s. The maize price is highly positively correlated with both drug prices over this period. This is consistent with the proposition that lower maize prices in the 1990s increased the supply of marijuana and opium poppies, depressing output prices in both markets.

The magnitude of the fall in marijuana and heroin prices over the period 1990-2005 raises an additional question regarding our theoretical account. We explain our main empirical results as stemming from an increase in drug production in response to the falling maize price. However, Figure A.3 demonstrates that log drug prices declined at approximately the same rate as the log maize price over much of the sample period, leaving relative prices largely unchanged. Our account is thus inconsistent with simple models in which the relative price of the drug crop is all that matters for drug supply. However, in the presence of non-trivial income effects, proportional changes in all prices can still induce a change in drug production. We demonstrate this possibility here in a simple illustrative model. Consider a highly stylized environment in which each rural household is endowed with a single unit of land, $L = 1$, that must be split between the production of maize and the production of drug crops. Let s_d refer to the share of land allocated to drugs, and let p_m and p_d be the observed, non-stochastic prices for maize and the drug crop, respectively. We assume that the household's land is equally productive at producing maize and the drug crop. Thus, a household choosing s_d will generate income (and thus consumption) of $s_d p_d + (1 - s_d)p_m$ Households are endowed with CRRA utility functions over consumption bundles, but also have non-monetary preferences against illegal activities. In particular, households incur some non-monetary disutility of θ_i when they produce positive quantities of drugs. We assume that there is some distribution of this term in the population: $\theta_i \sim F$. The household's decision problem is thus the following:

$$\max_{s_d} \quad V(s_d, p_m, p_d) = \left[\frac{(s_d p_d + (1 - s_d) p_m)^{1+\eta}}{1+\eta} - \theta_i 1(s_d > 0) \right] \tag{9}$$
$$s.t. \quad 0 \leq s_d \leq 1$$

Where $\eta \leq 0$. If the household decides to produce drugs, the choice for s_d must satisfy the following first order condition for an interior optimum:

$$\frac{\partial V}{\partial s_d} = (s_d p_d + (1 - s_d) p_m)^{\eta} (p_d - p_m) = 0 \tag{10}$$

However, as long as $p_d > p_m$, the household can always increase utility by shifting land from maize production to drug production. Thus, if a household chooses to produce drugs, it will specialize in the production of drugs. The household's decision problem thus reduces to a choice about whether to specialize in the production of drugs or maize given the idiosyncratic utility term θ_i. The household specializes in the production of drugs if the following is true:

$$\frac{p_d^{1+\eta}}{1+\eta} - \theta_i - \frac{p_m^{1+\eta}}{1+\eta} > 0 \tag{11}$$

This means that there will be a threshold value θ^* that will represent the highest value of θ_i consistent with drug production:

$$\theta^* = \frac{p_d^{1+\eta}}{1+\eta} - \frac{p_m^{1+\eta}}{1+\eta} \tag{12}$$

Ceteris paribus, an increase in the price of maize will reduce this threshold, reducing the number of households that find it optimal to produce drugs:

$$\frac{\partial \theta^*}{\partial p_m} = -p_m^{\eta} < 0 \tag{13}$$

Now, however, suppose that both the price of drugs and the price of maize move together, rising or falling in the same proportion. In particular, suppose that $p_d = \alpha p_m$, so that the relative price of drugs is fixed at α. Substituting this relationship back into the expression for θ^*, we have:

$$\theta^*|_{pd=\alpha p_m} = \frac{(\alpha p_m)^{1+\eta}}{1+\eta} - \frac{p_m^{1+\eta}}{1+\eta} = \frac{p_m^{1+\eta}}{1+\eta}\left[\alpha^{1+\eta} - 1\right] \tag{14}$$

Now suppose that the price of maize changes, *holding the relative price of drugs constant.* This results in the following change in the threshold:

$$\frac{\partial\theta^*}{\partial p_m}|_{pd=\alpha p_m} = p_m^{\eta}\left[\alpha^{1+\eta} - 1\right] \tag{15}$$

Here we see that the absolute level of the maize price matters for drug production, even if the relative price of drugs remains constant. In particular, assuming that $\alpha > 1$ (the drug price exceeds the price of maize), the above derivative will be negative as long as $\eta < -1$. Conventional estimates of η satisfy this criterion. Indeed, in a survey of the literature on life-cycle models of consumption, Attanasio and Weber (2010) cite estimates of η that fall in the range $[-3, -1.25]$. With sufficient curvature in the utility function, proportional decreases in both the price of maize and the price of drugs will induce an increase in the aggregate production of drugs. This occurs because a reduction in all prices reduces the monetary returns to farming of any kind, effectively making the family poorer and increasing the marginal value of income. With a higher marginal value of income, households will be more willing to accept the non-monetary costs of drug production in exchange for the relatively larger monetary payoff, even if the payoff of both crops is lower.

How much of the fall in drug prices over this time period can be attributed to the fall in the maize price? We can use our price series to obtain a back of the envelope estimate. Consider the following system for the aggregate demand for drug j at time t, Q_{jt}^D, and the quantity of drug j supplied by municipio i at time period t:

$$\log(Q_{jt}^D) = \alpha_{0j} + \alpha_{1j}X_{jt}^D + \alpha_{2j}\log(p_t^d) + \epsilon_{jt}^d \tag{16}$$

$$\log(Q_{ijt}^S) = \beta_{0ij} + \beta_{1j}X_{ijt}^S + \beta_{2j}Z_{jt}^S + \beta_{3j}\log(p_{jt}^d) + \beta_{4j}\log(p_t^m) + \epsilon_{ijt}^s \tag{17}$$

Here Equation 17 represents a municipio-level supply equation like those estimated in Columns 3-4 of Table A.4. In order to facilitate a general equilibrium analysis, we will abandon the difference-in-differences set-up so that we can explicitly model the relationship between prices and aggregate output. Note that p^d_{jt} refers to the price of drug j, p^m_t refers to the price of maize, X^D_t refers to a vector of demand shifters, X^S_{ijt} refers to a vector of municipio-specific supply shifters, and Z^S_{jt} refers to a vector of supply shifters affecting all municipios. Summing output over all of the municipios in a given year, we have the following expression for the log of aggregate output:

$$\begin{aligned}
\log(Q^S_{jt}) &= \log\left(\sum_i \exp\left(\beta_{0ij} + \beta_{1j}X^S_{ijt} + \beta_{2j}Z^S_{jt} + \beta_{3j}\log(p^d_{jt}) + \beta_{4j}\log(p^m_t) + \epsilon^s_{ijt}\right)\right) \\
&= \log\left(\exp(\beta_{2j}Z^S_{jt} + \beta_{3j}\log(p^d_{jt}) + \beta_{4j}\log(p^m_t))\sum_i \exp\left(\beta_{0ij} + \beta_{1j}X^S_{ijt} + \epsilon^s_{ijt}\right)\right) \\
&= \beta_{2j}Z^S_{jt} + \beta_{3j}\log(p^d_{jt}) + \beta_{4j}\log(p^m_t) + \log\left(\sum_i \exp\left(\beta_{0ij} + \beta_{1j}X^S_{ijt} + \epsilon^s_{ijt}\right)\right) \qquad (18)
\end{aligned}$$

In equilibrium, we have $\log(Q^D_{jt}) = \log(Q^S_{jt})$, which allows us to express the drug price $\log(p^d_{jt})$ as a function of the other variables:

$$\log(p^d_{jt}) = \frac{1}{\beta_{3j} - \alpha_{2j}}\left[\alpha_{0j} + \alpha_{1j}X^D_{jt} - \beta_{2j}Z^S_{jt} - \beta_{4j}\log(p^m_t) - \log\left(\sum_i \exp\left(\beta_{0ij} + \beta_{1j}X^S_{ijt} + \epsilon^s_{ijt}\right)\right) + \epsilon^d_t\right] \qquad (19)$$

The portion of the change in $\log(p^d_{jt})$ over a given time period that is due to a change in the maize price is given by $\frac{-\beta_{4j}}{\beta_{3j}-\alpha_{2j}}\Delta\log(p^m_t)$. The term $\frac{-\beta_{4j}}{\beta_{3j}-\alpha_{2j}}$ can be obtained as the coefficient on the maize price in a regression explaining the price of drug j. We first obtain estimates of the municipio-level supply equation (Equation 17). For the purposes of this exercise, we use the IV, time-series specification featured in Columns 3-4 of Table A.4, but we also add in additional controls. Specifically, Z^S_{jt} includes a time trend, and the log of the real exchange rate. On the other hand, X^S_{ijt} includes the interaction between our maize suitability measure $MAIZE_i$ and the real exchange rate, along with the full set of controls for weather, economic, and enforcement controls enumerated in the Empirical Strategy section, excluding annual fixed effects. Note also that we include linear trends interacted with the soil quality measure instead of interactions with annual dummies. Columns 1-2 of Table A.21 present the estimates of the effect of the maize price on log marijuana and poppy eradication (our measures of production) using this approach. These estimates are quite close to the time-series estimates from Table A.4. Using the coefficient estimates from these regressions, we construct an estimate of the municipio-specific component of aggregate output in each year:

$$\widetilde{Q_{jt}} = \log\left(\sum_i \exp\left(\widehat{\beta_{0ij}} + \widehat{\beta}_1 X^S_{ijt}\right)\right) \approx \log\left(\sum_i \exp\left(\beta_{0ij} + \beta_{1j} X^S_{ijt} + \epsilon^s_{ijt}\right)\right) \tag{20}$$

We are now in a position to estimate the parameters of Equation 19, by regressing the log drug price on the log maize price, the supply shifters Z^S_{jt}, and the approximation of $\widetilde{Q_{jt}}$. Note that this is an annual-level regression. The drug demand shifters X^D_{jt} are unobserved and are thus excluded from this regression. Columns 3-4 of Table A.21 present the estimated coefficient on the log maize price in these drug price regressions. For both marijuana and heroin we find substantial positive coefficients on the maize price. The estimates suggest that a one percent increase in the maize price is associated with a 0.52 percent increase in the price of marijuana and a 0.87 percent increase in the price of heroin. Over the period 1990-2005, the marijuana price fell by 0.81 log points, the heroin price fell by 1.47 log points, and the maize price fell by 0.88 log points. Calculating $\frac{-\beta_{4j}}{\beta_{3j}-\alpha_{2j}} \frac{\Delta p^m_t}{\Delta p^d_{jt}}$ for each drug, we estimate that the fall in the maize price can explain 57% of the fall in the marijuana price, and 52% of the fall in the heroin price over this period.

Our back of the envelope exercise suggests that over half of the fall in marijuana and heroin prices over 1990-2005 can be explained by the maize price. The remainder is explained by the evolution of other supply variables and the unobserved demand shifters. This raises the possibility that our main estimates could be biased, since the price of maize was falling over a stretch of time when important shifts in demand were underway. However, the most plausible scenario is that our estimates are biased upwards towards zero (attenuated), since drug prices and the incentives to grow drugs were falling while the price of maize was falling. In the presence of stable demand, we would likely estimate larger effects of the maize price on drug production.

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Table A.1: Characteristics of Rural Workers (1990 Census)

	All Workers		*Agricultural Workers*		*Maize Workers*	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Age	35.22	12.56	36.93	13.44	37.15	13.4
Education	5.13	4.16	3.41	3.12	2.94	2.85
Full Time	0.75	0.43	0.73	0.44	0.75	0.43
Agricultural Worker	0.48	0.5	-	-	-	-
Maize Worker	0.14	0.35	0.29	0.45	-	-
Class of Worker:						
Own Account	0.35	0.48	0.48	0.5	0.62	0.49
Unpaid	0.04	0.2	0.07	0.26	0.1	0.29
Employer	0.02	0.13	0.01	0.1	<0.01	0.06
Paid Employee	0.56	0.5	0.38	0.49	0.23	0.42
Zero Income	0.14	0.35	0.27	0.44	0.37	0.48
Monthly Inc. (if >0)	4,517.66	21,115.26	3,153.84	19,855.35	2,519.22	20,230.78
Total Observations	748,486		361,511		105,643	

Notes: Full Time indicates an individual working at least 40 hours per week. For each subsample, we list total observations, which is the largest number of observations in the subsample used to calculate a particular sample mean. However, for some variables, we use fewer observations because of missing data. For All Workers, we have 748,486 total observations, but fewer for education (735,441) and monthly income conditional on positive income (716,819). Similarly, for Agricultural Workers, we have 361,511 total workers but fewer for education (357,371) and monthly income (343,317). For Maize Workers, we have 105,643 total observations, but fewer for education (104,812) and monthly income (100,890).

Table A.2: Time Series Relationship of Maize Price and Instruments

VARIABLES	(1) Log national maze price	(2) Log national maze price	(3) Log national maze price
FRA	-0.200	-0.222	-0.288
	(0.210)	(0.212)	(0.209)
ARG	-0.514***	-0.501***	-0.343***
	(0.035)	(0.037)	(0.104)
CHN	-0.008	0.006	-0.030
	(0.009)	(0.011)	(0.019)
FREEZE	-2.200*	-2.735**	-2.212*
	(1.087)	(1.180)	(1.115)
FREEZE SQ	9.554**	11.220***	8.929**
	(3.260)	(3.396)	(3.556)
DEW POINT	-0.116***	-0.114***	-0.103***
	(0.025)	(0.026)	(0.019)
TEMP	-1.965***	-2.133***	-1.845***
	(0.480)	(0.520)	(0.471)
TEMP SQ	0.014***	0.015***	0.013***
	(0.003)	(0.003)	(0.003)
Real exchange rate		0.353*	-0.084
		(0.195)	(0.299)
Year trend			-0.017
			(0.011)
F-statistic on Excluded Instruments:	47.15	47.68	63.57
Observations	21	21	21
R-squared	0.936	0.943	0.957

Notes: Robust standard errors are shown in parentheses. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.3: Alternate Controls

VARIABLES	(1) Log marijuana eradication	(2) Log poppy eradication	(3) Log marijuana eradication	(4) Log poppy eradication	(5) Log marijuana eradication	(6) Log poppy eradication	(7) Log marijuana eradication	(8) Log poppy eradication
MAIZE x PRICE	-0.023***	-0.015***	-0.033***	-0.014***	-0.034***	-0.014***	-0.032***	-0.012**
	(0.006)	(0.004)	(0.007)	(0.005)	(0.007)	(0.005)	(0.007)	(0.005)
Alternate controls	Enforcement, Economic and Maize Trends		Removing MAIZE x Real Exchange Rate		Adding Square Terms in Rainfall / Temperature		Temp. / Rainfall All Months	
Observations	46,872	46,872	48,216	48,216	48,216	48,216	48,216	48,216
Municipios	2,232	2,232	2,296	2,296	2,296	2,296	2,296	2,296

Notes: Variables not shown in all regressions are: municipio and year fixed effects, log population, land quality interacted with year effects, and temperature in the months of April-July, as well as rainfall in the months of June-July, in Mexican municipios. Columns 3-4 additionally add in square terms of these rainfall and temperature variables. Columns 5-6 add in rainfall and temperature for each month of the year. All columns include municipio-specific linear trends except 1-2, which instead include trends by: average agricultural income in 1990, the fraction of agricultural workers, major highway presence, distance to the U.S. border, and distance to the nearest security station. All columns include the interaction of maize suitability with the (log) U.S. Mexico real exchange rate except columns 7-8. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.4: Maize Price and Illicit Crops

	(1)	(2)	(3)	(4)
VARIABLES	Log marijuana eradication	Log poppy eradication	Log marijuana eradication	Log poppy eradication
PRICE	-0.135***	-0.052***	-0.144***	-0.056***
	(0.012)	(0.008)	(0.012)	(0.008)
Estimation method	OLS	OLS	IV-2SLS	IV-2SLS
Observations	48,279	48,279	48,279	48,279
Municipios	2,299	2,299	2,299	2,299

Notes: Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown include municipio fixed effects, log population and a linear time trend and the log U.S. Mexico real exchange rate. Log marijuana and poppy eradication are measured as log of area eradicated per 10,000 hectares plus 1. In columns 3 and 4, the log national maize price is instrumented with lagged weather conditions in the U.S. (dewpoint, temperature, temperature squared, freeze hours, and freeze hours squared), along with the log export volumes of China, France, and Argentina. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.5: Processed Marijuana Seizures

	(1)	(2)	(3)	(4)	(5)
Specification:	*Controlling for Local Enforcement*	*Controlling for Legal Crop Suitability*	*Controlling for Drug Crop Suitability*	*Controlling for Diconsa*	*Dropping Sinaloa*
			Panel A: Full Sample		
MAIZE x PRICE	0.078***	0.073***	0.091***	0.074**	0.094***
	(0.028)	(0.025)	(0.027)	(0.029)	(0.027)
Municipio trends?	Y	Y	Y	Y	Y
Observations	39,027	48,216	48,216	47,439	47,901
Municipios	2,292	2,296	2,296	2,259	2,281
			Panel B: Dropping Municipios Contiguous with the U.S. Border		
MAIZE x PRICE	0.037	0.041*	0.046*	0.031	0.048*
	(0.026)	(0.024)	(0.025)	(0.026)	(0.025)
Municipio trends?	Y	Y	Y	Y	Y
Observations	38,408	47,565	47,565	46,956	47,250
Municipios	2,261	2,265	2,265	2,236	2,250
			Panel C: Dropping Municipios Near the Border		
MAIZE x PRICE	-0.001	0.015	0.009	-0.005	0.011
	(0.025)	(0.024)	(0.023)	(0.024)	(0.023)
Municipio trends?	Y	Y	Y	Y	Y
Observations	36,888	45,969	45,969	45,591	45,654
Municipios	2,185	2,189	2,189	2,171	2,174

Notes : Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown and included in all regressions are: municipio and year fixed effects, municipio-specific linear trends, log population, the interaction of maize suitability with the (log) U.S. Mexico real exchange rate, and weather and land quality controls. Processed marijuana seizures are measured as the log of kilograms seized plus 1. In column 1, all regressions include the mayor's political party and (log) detainees plus 1. In column 2, regressions include controls for the first three principal components of 13 legal crop suitabilities, interacted with year effects. In column 3, regressions include the interaction of year effects with average dependent variable over 1990–1993. Column 4 includes the average number of Diconsa stores between 1994 and 1996 interacted with year effects, and in column 5 the state of Sinaloa is excluded from all regressions. The interaction of maize suitability and the log national maize price is instrumented with the interaction of maize suitability and lagged weather conditions in the U.S. (dewpoint, temperature, temperature squared, freeze hours, and freeze hours squared), along with the log export volumes of China, France, and Argentina. Municipios "Contiguous with the U.S. Border" are those located exactly on the border. "Near the Border" includes municipios within 100 miles of the U.S.-Mexico border. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.6: Seizures of Heroin and Other Drugs

	(1)	(2)	(3)	(4)	(5)
Specification:	*Controlling for Local Enforcement*	*Controlling for Legal Crop Suitability*	*Controlling for Drug Crop Suitability*	*Controlling for Diconsa*	*Dropping Sinaloa*
			Panel A: Heroin Seizures		
MAIZE x PRICE	0.001	0.001	0.001	0.002	0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Municipio trends?	Y	Y	Y	Y	Y
Observations	39,027	48,216	48,216	47,439	47,901
Municipios	2,292	2,296	2,296	2,259	2,281
			Panel B: Other Seizures		
MAIZE x PRICE	0.007	0.005	0.005	0.005	0.003
	(0.008)	(0.007)	(0.007)	(0.008)	(0.007)
Municipio trends?	Y	Y	Y	Y	Y
Observations	39,027	48,216	48,216	47,439	47,901
Municipios	2,292	2,296	2,296	2,259	2,281

Notes: Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown and included in all regressions are: municipio and year fixed effects, log population, the interaction of maize suitability with the (log) U.S. Mexico real exchange rate, and weather and land quality controls. "Other Seizures" includes cocaine and meth. All seizures are measured as the log of kilograms seized plus 1. In column 1, all regressions include the mayor's political party, (log) detainees plus 1, and interactions between year dummies and the (log) distance to the nearest security station. In column 2, regressions include controls for the first three principal components of 13 legal crop suitabilities, interacted with year effects. In column 3, regressions include the interaction of year effects with average dependent variable over 1990–1993. Column 4 includes the average number of Diconsa stores between 1994 and 1996 interacted with year effects, and in column 5 the state of Sinaloa is excluded from all regressions. The interaction of maize suitability and the log national maize price is instrumented with the interaction of maize suitability and lagged weather conditions in the U.S. (dewpoint, temperature, temperature squared, freeze hours, and freeze hours squared), along with the log export volumes of China, France, and Argentina. All regressions include municipio-specific linear trends. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.7: Dropping Municipios Near the U.S. Border - Other Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Log marijuana eradication	Log poppy eradication	Any cartel	Multiple cartels	First cartel presence	Log total drug-related killings	Log drug-related executions	Log killings from confronta-tions	Log killings from cartel attacks
MAIZE x PRICE	-0.034***	-0.014**	-0.019***	-0.010**	-0.012***	-0.249***	-0.235***	-0.004	-0.030**
	(0.007)	(0.005)	(0.006)	(0.004)	(0.004)	(0.079)	(0.075)	(0.035)	(0.012)
Municipio trends?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	45,969	45,969	43,780	43,780	41,473	8,756	8,756	8,756	8,756
Municipos	2,189	2,189	2,189	2,189	2,187	2,189	2,189	2,189	2,189

Notes. In all regressions, the sample excludes municipios within 100 miles of the U.S.-Mexico border. Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown and included in all regressions are: municipio and year fixed effects, municipio-specific linear trends, log population, and weather and land quality controls. Any cartel, Multiple cartels, and First cartel presence are dichotomous indicators of whether a municipio has any cartel, multiple cartels, or a cartel operating for the first time, respectively, in any given year. Log total drug-related killings, drug-related executions, killings from confrontations, and killings from cartel attacks are measured as log count per 10,000 people plus 1. In columns 1–5, the interaction of maize suitability and the log national maize price is instrumented with the interaction of maize suitability and lagged weather conditions in the U.S. (dewpoint, temperature, temperature squared, freeze hours, and freeze hours squared), along with the the log export volumes of China, France, and Argentina. These regressions also include the interaction of maize suitability with the (log) U.S. Mexico real exchange rate. In columns 6-9, the interaction of maize suitability and log national maize price is instrumented by the interaction of maize suitability and a generated price instrument (predicted on the basis of the lagged weather conditions in the U.S. and the log export volumes of China, France and Argentina). ** is significant at the 5% level, and * is significant at the 10% level.

Table A.8: Heterogenous Effects on Drug Seizures

	(1) Log raw marijuana seizures	(2) Log opium gum seizures	(3) Log raw marijuana seizures	(4) Log opium gum seizures
Sample Split:	*Below Median*		*Above Median*	
	Panel A: Legal Crop Concentration			
MAIZE x PRICE	-0.010	-0.004	-0.051**	-0.001
	(0.023)	(0.004)	(0.022)	(0.003)
Municipio trends?	Y	Y	Y	Y
Observations	23,604	23,604	23,604	23,604
Municipios	1,124	1,124	1,124	1,124
	Panel B: Marijuana Suitability			
MAIZE x PRICE	-0.011	-0.001	-0.044	-0.007
	(0.011)	(0.001)	(0.038)	(0.006)
Municipio trends?	Y	Y	Y	Y
Observations	31,689	31,689	16,527	16,527
Municipios	1,509	1,509	787	787
	Panel C: Poppy Suitability			
MAIZE x PRICE	0.001	-0.000	-0.124*	-0.014
	(0.013)	(0.001)	(0.071)	(0.012)
Municipio trends?	Y	Y	Y	Y
Observations	39,921	39,921	8,295	8,295
Municipios	1,901	1,901	395	395
	Panel D: Ruggedness			
MAIZE x PRICE	-0.010	-0.004	-0.051**	-0.001
	(0.023)	(0.004)	(0.022)	(0.003)
Municipio trends?	Y	Y	Y	Y
Observations	24,108	24,108	24,108	24,108
Municipios	1,148	1,148	1,148	1,148
	Panel E: Distance to Police Station			
MAIZE x PRICE	0.007	-0.006	-0.047**	-0.002
	(0.022)	(0.005)	(0.022)	(0.003)
Municipio trends?	Y	Y	Y	Y
Observations	24,108	24,108	24,108	24,108
Municipios	1,148	1,148	1,148	1,148

Notes: Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown and included in all regressions are: municipio and year fixed effects, municipio-specific linear trends, log population, the interaction of maize suitability with the (log) U.S. Mexico real exchange rate, and weather and land quality controls. All drug seizures are measured as the log of kilograms seized plus 1. Panels A, B, C, D, and E split the sample into below and above median levels of the Herfindahl Index of other crop concentration, suitability for growing marijuana, suitability for growing opium poppy, terrain ruggedness, and distance to the nearest security station, respectively. The interaction of maize suitability and the log national maize price is instrumented with the interaction of maize suitability and lagged weather conditions in the U.S. (dewpoint, temperature, temperature squared, freeze hours, and freeze hours squared), along with the log export volumes of China, France, and Argentina. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Tab A.9: Descriptive Statistics of Additional Variables

Panel A: Additional Municipio-Level Cross-Sectional Variables

	Obs.	Mean	Std. Dev.
Log distance to U.S. border	2,296	6.03	0.64
Highway indicator	2,296	0.55	0.50
Average agricultural income (1990)	2,232	12.06	0.72
Fraction of agricultural workers	2,294	0.68	0.33

Panel B: Individual-Level Variables (ENIGH)

	Obs.	Mean	Std. Dev.
Age	48,555	37.41	13.2
Education	48,555	5.26	3.79
Agricultural Worker	48,555	0.60	0.49
Maize Worker	48,555	0.25	0.43
Reference Month:			
June	48,555	0.00	0.01
July	48,555	0.10	0.30
August	48,555	0.29	0.46
September	48,555	0.33	0.47
October	48,555	0.25	0.43
November	48,555	0.02	0.13
Missing	48,555	0.00	0.06
Hours Worked	48,555	50.10	17.01
Unpaid	45,855	0.04	0.19
Zero Income	45,855	0.06	0.25
Hourly Wage (2005 Pesos)	41,719	15.42	32.30

Notes: Individual-level variables are from the ENIGH surveys. See data section for definitions of variables. The baseline sample includes all men aged 18-65 who worked last month, and for whom we observe non-missing values of our regressors. The samples for the Unpaid and Zero Income variables have been restricted to those with non-missing income values. The real hourly wage statistics are calculated for the group of individuals who worked at least 20 hours per week with a strictly positive hourly wage.

Table A.10: Maize Price, Maize Suitability, and Labor Market Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Full time	Unpaid	No income	Unpaid	No income	Log wage	Log wage	Log wage	Log wage
MAIZE x PRICE	0.010	-0.012*	-0.020**	-0.033**	-0.038**	0.058**	0.064	0.176**	0.008
	(0.009)	(0.007)	(0.009)	(0.014)	(0.015)	(0.028)	(0.039)	(0.076)	(0.072)
Worker type	All workers	Full time workers	Full time workers	Full time workers	Full time workers	All workers, ≥ 20 hours	Agricultural workers, ≥ 20 hours	Maize & bean cultivators, ≥ 20 hours	Non-maize & bean cultivators, ≥ 20 hours
Age group	18-65	18-65	18-65	18-30	18-30	18-65	18-65	18-65	18-65
Observations	48,554	37,160	37,160	12,944	12,944	41,717	23,058	9,040	4,558
Municipios	869	868	868	817	817	868	828	644	424

Notes : Robust standard errors clustered at the municipio level are shown in parentheses. Regressors included in all specifications: municipio fixed effects, year fixed effects, a complete set of age dummies, education, a complete set of dummies for reference month, log population, weather and land quality controls, the interaction of maize suitability with the (log) U.S. Mexico real exchange rate, and trends by: average agricultural income in 1990, the fraction of agricultural workers, major highway presence, distance to the U.S. border, and distance to the nearest security station. The interaction of maize suitability and the log national maize price is instrumented with the interaction of maize suitability and lagged weather conditions in the U.S. (dewpoint, temperature, temperature squared, freeze hours, and freeze hours squared), along with the the log export volumes of China, France, and Argentina. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.11: Cartel Presence Controlling for Eradication

	(1)	(2)	(3)
VARIABLES	Any cartel	Multiple cartels	First cartel presence
MAIZE x PRICE	-0.028***	-0.019***	-0.016***
	(0.006)	(0.004)	(0.004)
Municipio-Specific Trends?	Y	Y	Y
Observations	45,920	45,920	43,155
Municipios	2,296	2,296	2,293

Notes: Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown and included in all regressions are: municipio and year fixed effects, log marijuana and poppy eradication, log population, the interaction of maize suitability with the (log) U.S. Mexico real exchange rate, and weather and land quality controls. Any cartel, Multiple cartels, and First cartel presence are dichotomous indicators of whether a municipio has any cartel, multiple cartels, or a cartel operating for the first time, respectively, in any given year. The interaction of maize suitability and the log national maize price is instrumented with the interaction of maize suitability and lagged weather conditions in the U.S. (dewpoint, temperature, temperature squared, freeze hours, and freeze hours squared), along with the log export volumes of China, France, and Argentina. All regressions include municipio-specific linear trends. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.12: Drug-Related Killings — Robustness Checks

VARIABLES	(1) Log total drug-related killings	(2) Log drug-related executions	(3) Log killings from confrontations	(4) Log killings from cartel attacks
	Panel A: Accounting for Local Enforcement			
MAIZE x PRICE	-0.371***	-0.345***	-0.085	-0.022
	(0.092)	(0.083)	(0.054)	(0.018)
Municipio trends?	Y	Y	Y	Y
Observations	7,494	7,494	7,494	7,494
Municipios	1,874	1,874	1,874	1,874
	Panel B: Controlling for Legal Crop Suitabilities			
MAIZE x PRICE	-0.374***	-0.338***	-0.094*	-0.025
	(0.093)	(0.084)	(0.054)	(0.018)
Municipio trends?	Y	Y	Y	Y
Observations	9184	9184	9184	9184
Municipios	2296	2296	2296	2296
	Panel C: Accounting for Drug Crop Suitability			
MAIZE x PRICE	-0.318***	-0.289***	-0.084*	-0.021
	(0.086)	(0.077)	(0.049)	(0.016)
Municipio trends?	Y	Y	Y	Y
Observations	9,184	9,184	9,184	9,184
Municipios	2,296	2,296	2,296	2,296
	Panel D: Controlling for Diconsa Stores			
MAIZE x PRICE	-0.331***	-0.318***	-0.057	-0.018
	(0.091)	(0.081)	(0.052)	(0.016)
Municipio trends?	Y	Y	Y	Y
Observations	9,036	9,036	9,036	9,036
Municipios	2,259	2,259	2,259	2,259
	Panel E: Excluding the State of Sinaloa			
MAIZE x PRICE	-0.371***	-0.339***	-0.095*	-0.023
	(0.086)	(0.078)	(0.049)	(0.016)
Municipio trends?	Y	Y	Y	Y
Observations	9,124	9,124	9,124	9,124
Municipios	2,281	2,281	2,281	2,281

Notes: Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown and included in all regressions are: municipio and year fixed effects, log population, and weather and land quality controls. Log total drug-related killings, drug-related executions, killings from confrontations, and killings from cartel attacks are measured as log count per 10,000 people plus 1. In Panel A, all regressions include the mayor's political party, (log) detainees plus 1, and interactions between year dummies and the (log) distance to the nearest security station. In Panel B, regressions include controls for the first 3 principal components of 13 legal crop suitabilities interacted with year effects. In Panel C, regressions include the interaction of year effects with average marijuana and poppy eradication over 1990–1993. Panel D includes the average number of Diconsa stores between 1994 and 1996 interacted with year effects, and in Panel E the state of Sinaloa is excluded from all regressions. The interaction of maize suitability and log national maize price is instrumented by the interaction of maize suitability and a generated price instrument (predicted on the basis of the lagged weather conditions in the U.S. and the log export volumes of China, France and Argentina). All regressions include municipio-specific linear trends. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.13: Accounting for Additional Enforcement Measures

VARIABLES	(1) Log marijuana eradication	(2) Log poppy eradication	(3) Log raw marijuana seizures	(4) Log opium gum seizures	(5) Any cartel	(6) Multiple cartels	(7) First cartel presence
	Panel A: Accounting for National Enforcement						
MAIZE x PRICE	-0.080***	-0.053***	-0.023	-0.009*	-0.034***	-0.018***	-0.012**
	(0.014)	(0.011)	(0.035)	(0.005)	(0.007)	(0.006)	(0.005)
Municipio trends?	Y	Y	Y	Y	Y	Y	Y
Observations	48,216	48,216	48,216	48,216	45,920	45,920	43,155
Municipios	2,296	2,296	2,296	2,296	2,296	2,296	2,293
	Panel B: Accounting for Local and National Enforcement						
MAIZE x PRICE	-0.107***	-0.063***	-0.038	-0.009	-0.036***	-0.020***	-0.012**
	(0.015)	(0.011)	(0.037)	(0.006)	(0.008)	(0.006)	(0.006)
Municipio trends?	Y	Y	Y	Y	Y	Y	Y
Observations	39,027	39,027	39,027	39,027	39,027	39,027	36,282
Municipios	2,292	2,292	2,292	2,292	2,292	2,292	2,289

Notes: Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown and included in all regressions are: municipio and year fixed effects, log population, the interaction of maize suitability with the (log) U.S. Mexico real exchange rate, and weather and land quality controls. Log marijuana and poppy eradication are measured as log of area eradicated per 10,000 hectares plus 1. All drug seizures are measured as (log) kilograms seized plus 1. Any cartel, Multiple cartels, and First cartel presence are dichotomous indicators of whether a municipio has any cartel, multiple cartels, or a cartel operating for the first time, respectively, in any given year. In Panel A, all regressions include interactions of maize suitability with: the log of military expenditures, the log of armed forces personnel, and the log of U.S. military aid. In Panel B, all regressions include the set of controls from Panel A plus the mayor's political party, (log) detainees plus 1,and interactions between year dummies and the (log) distance to the nearest security station. The interaction of maize suitability and the log national maize price is instrumented with the interaction of maize suitability and lagged weather conditions in the U.S. (dewpoint, temperature, temperature squared, freeze hours, and freeze hours squared), along with the the log export volumes of China, France, and Argentina. All regressions include municipio-specific linear trends. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.14: Features of the Data Matched in Calibration

	(1) Data	(2) Calibratio n
Average log Eradication:		
1990-1995	0.120	0.122
1996-2005	0.188	0.188
2006-2010	0.143	0.143
Differences in avg. log Eradication by MAIZE Quartile, 1990-1995:		
Q2-Q1	-0.012	-0.014
Q3-Q1	-0.019	-0.021
Q4-Q1	-0.035	-0.025
Difference in avg. log Eradication by MAIZE Quartile, 1996-2005:		
Q2-Q1	0.012	0.015
Q3-Q1	0.019	0.019
Q4-Q1	0.032	0.047
Difference in avg. log Eradication by MAIZE Quartile, 2006-2010:		
Q2-Q1	-0.008	-0.024
Q3-Q1	-0.015	-0.005
Q4-Q1	-0.023	0.009
Standard Deviation of log Eradication by MAIZE Quartile:		
Q1	0.256	0.315
Q2	0.330	0.326
Q3	0.337	0.325
Q4	0.393	0.349
Diff-in-diff effect of MAIZExPRICE on log Eradication	-0.033	-0.027
Diff-in-diff effect of MAIZExPRICE on log Output	-	-0.041

Note: All statistics from the observed data refer to marijuana eradication. The differences by MAIZE quartile and the standard deviations are calculated from residuals. To compute these statistics in the data we first regress log Eradication on our basic set of controls (but excluding MAIZExPRICE), and then work with the residuals from that regression.

Table A.15: Calibrated Parameters

Drug Production:		
α_0	(baseline intercept)	-0.02
α_{0H}	(intercept component)	0.11
α_{trend}	(coeff on time trend)	-0.001
α_m	(coeff on MAIZE)	0.12
α_{mp}	(coeff on MAIZExPRICE)	-0.11
α_p	(coeff on maize price)	-0.16
σ_ϵ	(std. dev. of shocks)	0.78
Gov. Preferences:		
γ	(curvature parameter)	4.41
Eradication Budget:		
B_0	(1990 budget)	1.66
$\phi_{Calderon}$	(Calderon effect)	0.53
FC	(fixed cost)	0.37

Table A.16: Accounting for Lag Eradication and the 2006 Policy Change

VARIABLES	(1) Log marijuana eradication	(2) Log poppy eradication	(3) Log marijuana eradication	(4) Log poppy eradication	(5) Log marijuana eradication	(6) Log poppy eradication	(7) Log marijuana eradication	(8) Log poppy eradication
MAIZE x PRICE	-0.021***	-0.004	-0.067***	-0.031***	-0.096***	-0.083***	-0.106***	-0.075***
	(0.006)	(0.004)	(0.011)	(0.008)	(0.020)	(0.017)	(0.020)	(0.014)
Lag Marijuana Eradication	0.174***	-	0.174***	-	-	-	0.121***	-
	(0.016)	-	(0.016)	-	-	-	(0.018)	-
Lag Poppy Eradication	-	0.271***	-	0.272***	-	-	-	0.252***
	-	(0.027)	-	(0.027)	-	-	-	(0.030)
Sample Period	1990-2010	1990-2010	1990-2010	1990-2010	1990-2005	1990-2005	1990-2005	1990-2005
MAIZE X Post 2005 Control?			Y	Y				
Municipio Trend?	Y	Y	Y	Y	Y	Y	Y	Y
Observations	45,920	45,920	45,920	45,920	36,736	36,736	34,440	34,440
Municipios	2,296	2,296	2,296	2,296	2,296	2,296	2,296	2,296

Notes: Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown and included in all regressions are: municipio and year fixed effects, municipio-specific trends, log population, the interaction of maize suitability with the (log) U.S. Mexico real exchange rate, and weather and land quality controls. Log marijuana and poppy eradication are measured as log of area eradicated per 10,000 hectares plus 1. Columns 1, 3 and 7 control for annual lag values of marijuana eradication and columns 2, 4 and 8 control for annual lag values of poppy eradication. Columns 3-4 control for maize suitability interacted with an indicator for the post-2005 period. The interaction of maize suitability and the log national maize price is instrumented with the interaction of maize suitability and lagged weather conditions in the U.S. (dewpoint, temperature, temperature squared, freeze hours, and freeze hours squared), along with the log export volumes of China, France, and Argentina. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.17: Alternate Trend Controls

VARIABLES	(1) Log marijuana eradication	(2) Log poppy eradication	(3) Log raw marijuana seizures	(4) Log opium gum seizures	(5) Any cartel
			Panel A: Non-linear Trends		
MAIZE x PRICE	-0.103***	-0.076***	-0.056	-0.011*	-0.017***
	(0.013)	(0.022)	(0.055)	(0.007)	(0.007)
Observations	46,872	46,872	46,872	46,872	44,640
Municipios	2,232	2,232	2,232	2,232	2,232
Controls	Y	Y	Y	Y	Y
			Panel B: Excluding Post-2005 Period		
MAIZE x PRICE	-0.017***	-0.011**	-0.045***	-0.005***	-0.007***
	(0.006)	(0.004)	(0.011)	(0.001)	(0.002)
Observations	35,712	35,712	35,712	35,712	33,480
Municipios	2,232	2,232	2,232	2,232	2,232
Controls	Y	Y	Y	Y	Y
			Panel C: Region by Year effects		
MAIZE x PRICE	-0.029***	-0.015***	-0.063***	-0.005***	-0.008***
	(0.006)	(0.005)	(0.013)	(0.001)	(0.003)
Observations	46,872	46,872	46,872	46,872	44,640
Municipios	2,232	2,232	2,232	2,232	2,232
Controls	Y	Y	Y	Y	Y

Notes: Robust standard errors clustered at the municipal level are shown in parentheses. Controls not shown and included in all regressions are: municipio and year fixed effects, log population, the interaction of maize suitability with the (log) U.S. Mexico real exchange rate, weather and land quality controls, and trends by: average agricultural income in 1990, the fraction of agricultural workers, major highway presence, distance to the U.S. border, and distance to the nearest security station. Log marijuana and poppy eradication are measured as log of area eradicated per 10,000 hectares plus 1. All seizures are measured as the log of kilograms seized plus 1. Any cartel is a dichotomous indicator of whether a municipio has any cartel operating in any given year. Panel A includes non-linear trends with a trend break at 2005, Panel B excludes the years 2006-2010, and Panel C includes region by year effects. The interaction of maize suitability and the log national maize price is instrumented with the interaction of maize suitability and lagged weather conditions in the U.S. (dewpoint, temperature, temperature squared, freeze hours, and freeze hours squared), along with the log export volumes of China, France, and Argentina. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.18: Two-Way Clustering

VARIABLES	(1) Log marijuana eradication	(2) Log poppy eradication	(3) Log raw marijuana seizures	(4) Log opium gum seizures	(5) Any cartel	(6) Multiple cartels	(7) First cartel presence	(8) Log total drug-related killings	(9) Log drug-related executions
	Panel A: Baseline Specification								
MAIZE x PRICE	-0.033**	-0.013	-0.028*	-0.003	-0.028***	-0.019***	-0.016***	-0.334***	-0.308***
	(0.015)	(0.013)	(0.015)	(0.002)	(0.007)	(0.005)	(0.006)	(0.094)	(0.078)
Municipio trends?	Y	Y	Y	Y	Y	Y	Y		
Observations	48,216	48,216	48,216	48,216	45,920	45,920	43,155	9,184	9,184
Municipios	2,296	2,296	2,296	2,296	2,296	2,296	2,293	2,296	2,296
	Panel B: Controlling for National and Local Enforcement								
MAIZE x PRICE	-0.107***	-0.063***	-0.038	-0.009	-0.036***	-0.020***	-0.012	-	-
	(0.025)	(0.024)	(0.026)	(0.006)	(0.009)	(0.007)	(0.008)	-	-
Municipio trends?	Y	Y	Y	Y	Y	Y	Y		
Observations	39,027	39,027	39,027	39,027	39,027	39,027	36,282		
Municipios	2,292	2,292	2,292	2,292	2,292	2,292	2,289		
	Panel C : Control for Legal Crop Suitability								
MAIZE x PRICE	-0.028**	-0.011	-0.027*	-0.004	-0.022***	-0.014***	-0.015**	-0.374***	-0.338***
	(0.014)	(0.012)	(0.017)	(0.002)	(0.006)	(0.005)	(0.006)	(0.094)	(0.075)
Municipio trends?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	48,216	48,216	48,216	48,216	45,920	45,920	43,155	9,184	9,184
Municipios	2,296	2,296	2,296	2,296	2,296	2,296	2,293	2,296	2,296
	Panel D: Control for Drug Crop Suitability								
MAIZE x PRICE	-0.027**	-0.014*	-0.037***	-0.004*	-0.031***	-0.021***	-0.017***	-0.318***	-0.289***
	(0.010)	(0.008)	(0.013)	(0.002)	(0.006)	(0.005)	(0.006)	(0.102)	(0.084)
Municipio trends?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	48,216	48,216	48,216	48,216	45,920	45,920	43,155	9,184	9,184
Municipios	2,296	2,296	2,296	2,296	2,296	2,296	2,293	2,296	2,296
	Panel E: Control for Diconsa								
MAIZE x PRICE	-0.036**	-0.015	-0.028*	-0.003	-0.024***	-0.015***	-0.013**	-0.331***	-0.318***
	(0.015)	(0.013)	(0.016)	(0.002)	(0.006)	(0.004)	(0.006)	(0.087)	(0.075)
Municipio trends?	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	47,439	47,439	47,439	47,439	45,180	45,180	42,574	9,036	9,036
Municipios	2,259	2,259	2,259	2,259	2,259	2,259	2,256	2,259	2,259

Notes: Robust standard errors using two-way clustering (municipio and year) are shown in parentheses. Variables not shown and included in all regressions are: municipio and year fixed effects, municipio-specific linear trends, log population, and weather and land quality controls. Columns 1–7 include the interaction of maize suitability with the (log) U.S. Mexico real exchange rate. In Panel B, all regressions include the mayor's political party and (log) detainees plus 1, and interactions of maize suitability with: the log of military expenditures, the log of armed forces personnel, and the log of U.S. military aid. Note that we cannot estimate this specification for the drug war killings results because adding additional time-varying regressors interacted with maize suitability is infeasible given the short time dimension of the killings sample. In Panel C, regressions include controls for legal crop suitabilities. In Panel D, regressions include the interaction of year effects with average dependent variable over 1990–1993. Panel E includes the average number of Diconsa stores between 1994 and 1996 interacted with year effects. In columns 1–7, the interaction of maize suitability and log national maize price is instrumented by the interaction of maize suitability and a generated price instrument (predicted on the basis of the lagged weather conditions in the U.S. and log export volume of China, France and Argentina). In columns 8 and 9, The interaction of maize suitability and log national maize price is instrumented by the interaction of maize suitability and a generated price instrument (predicted on the basis of the lagged weather conditions in the U.S. and the log export volumes of China, France and Argentina). *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.19: Accounting for Legal Crop Suitabilities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Log marijuana eradication	Log poppy eradication	Log raw marijuana seizures	Log opium gum seizures	Any cartel	Multiple cartels	First cartel presence
MAIZE x PRICE	-0.028***	-0.011**	-0.027*	-0.004	-0.022***	-0.014***	-0.015***
	(0.007)	(0.005)	(0.016)	(0.002)	(0.006)	(0.004)	(0.004)
Principal Component Controls?	Y	Y	Y	Y	Y	Y	Y
Municipio Trends?	Y	Y	Y	Y	Y	Y	Y
Observations	48,216	48,216	48,216	48,216	45,920	45,920	43,155
Municipios	2,296	2,296	2,296	2,296	2,296	2,296	2,293

Notes: Robust standard errors clustered at the municipal level are shown in parentheses. The principal component controls include the first, second and third principal components of 13 other legal crop suitabilities, interacted with year effects. Additional variables not shown and included in all regressions are: municipio and year fixed effects, municipio-specific linear trends, log population, temperature and rainfall conditions in Mexican municipios, land quality interacted with year effects, and the interaction of maize suitability with the (log) U.S. Mexico real exchange. Log marijuana and poppy eradication are measured as log of area eradicated per 10,000 hectares plus 1. All drug seizures are measured as log of kilograms seized plus 1.Any cartel, First cartel presence, and Multiple cartels are dichotomous indicators of whether a municipio has any cartel, a cartel operating for the first time, or multiple cartels, respectively, in any given year. The interaction of maize suitability and the log national maize price is instrumented with the interaction of maize suitability and lagged weather conditions in the U.S. (dewpoint, temperature, temperature squared, freeze hours, and freeze hours squared), along with the log export volumes of China, France, and Argentina. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.20: Accounting for Drug Crop Suitability

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Log marijuana eradication	Log poppy eradication	Log raw marijuana seizures	Log opium gum seizures	Any cartel	Multiple cartels	First cartel presence
MAIZE x PRICE	-0.027***	-0.014***	-0.037**	-0.004*	-0.031***	-0.021***	-0.017***
	(0.006)	(0.005)	(0.015)	(0.002)	(0.006)	(0.004)	(0.004)
Municipio trends?	Y	Y	Y	Y	Y	Y	Y
Observations	48,216	48,216	48,216	48,216	45,920	45,920	43,155
Municipios	2,296	2,296	2,296	2,296	2,296	2,296	2,293

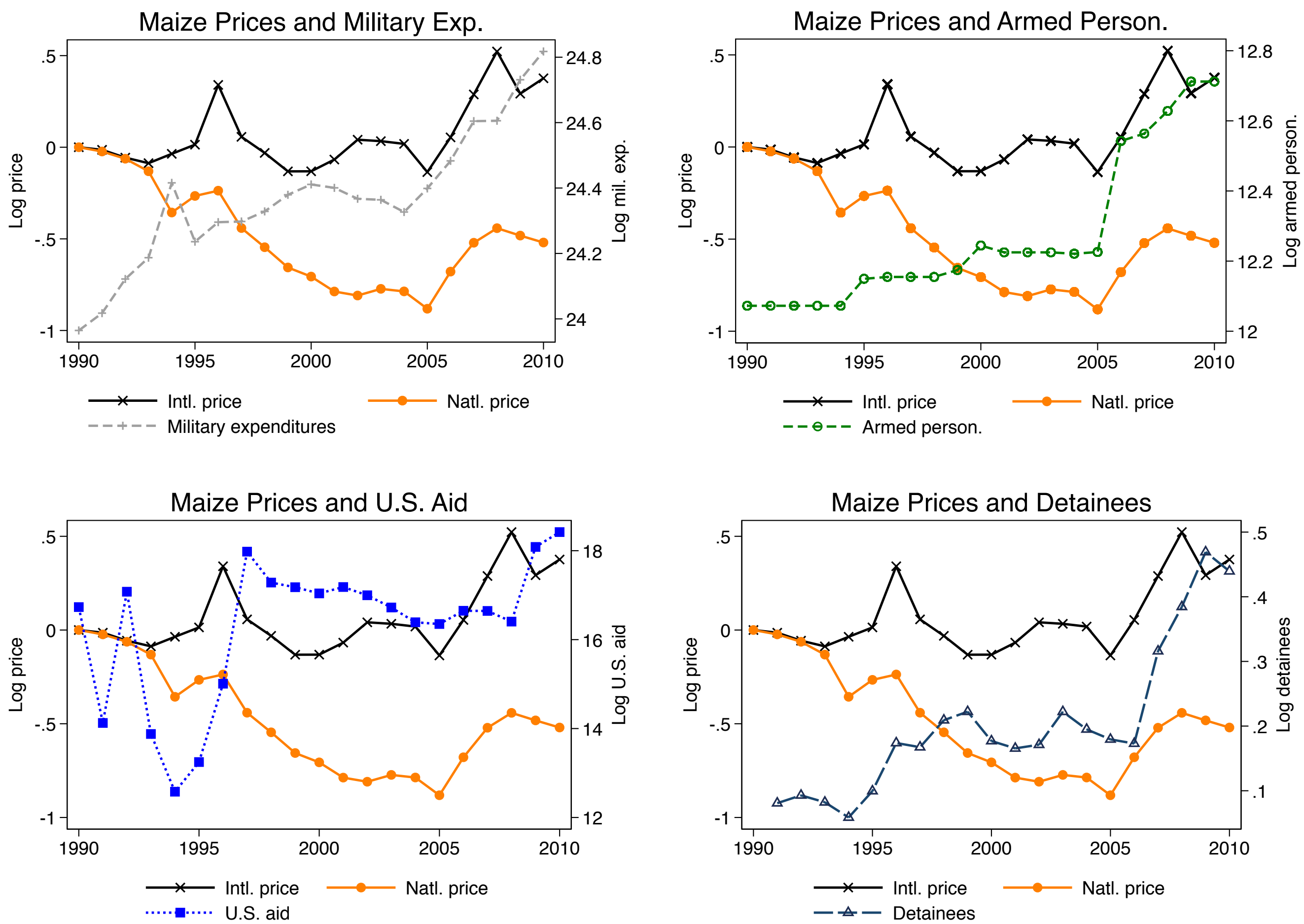
Notes: Robust standard errors clustered at the municipal level are shown in parentheses. Variables not shown and included in all regressions are: municipio and year fixed effects, log population, the interaction of maize suitability with the (log) U.S. Mexico real exchange rate, and weather and land quality controls. Log marijuana and poppy eradication are measured as log of area eradicated per 10,000 hectares plus 1. All drug seizures are measured as log of kilograms seized plus 1. Any cartel, Multiple cartels, and First cartel presence are dichotomous indicators of whether a municipio has any cartel, multiple cartels, or a cartel operating for the first time, respectively, in any given year. In columns 1–4, regressions include the interaction of year effects with average dependent variable over 1990–1993. In columns 5–7, regressions include the interaction of year effects with both average marijuana and poppy eradication over 1990–1993. The interaction of maize suitability and the log national maize price is instrumented with the interaction of maize suitability and lagged weather conditions in the U.S. (dewpoint, temperature, temperature squared, freeze hours, and freeze hours squared), along with the log export volumes of China, France, and Argentina. All regressions include municipio-specific linear trends. *** is significant at the 1% level, ** is significant at the 5% level, and * is significant at the 10% level.

Table A.21: Drug Prices and the Maize Price

	(1)	(2)	(3)	(4)
VARIABLES	Log marijuana eradication	Log poppy eradication	Log marijuana price	Log heroin price
Log maize price	-0.150***	-0.057***	0.522*	0.870***
	(0.012)	(0.008)	(0.261)	(0.170)
Observations	46,872	46,872	18	20

Notes: Log maize price reflects annual measures of the Mexican maize price from 1990-2010. Log marijuana and poppy eradication are measured as log of area eradicated per 10,000 hectares plus 1. The marijuana prices reflect annual estimates (averaged over quarters) of the price per bulk above 100 grams in 2007 dollars from 1990-2007. The heroin price represents estimates of the wholesale price from 1990-2009. See the Online Appendix for additional details.

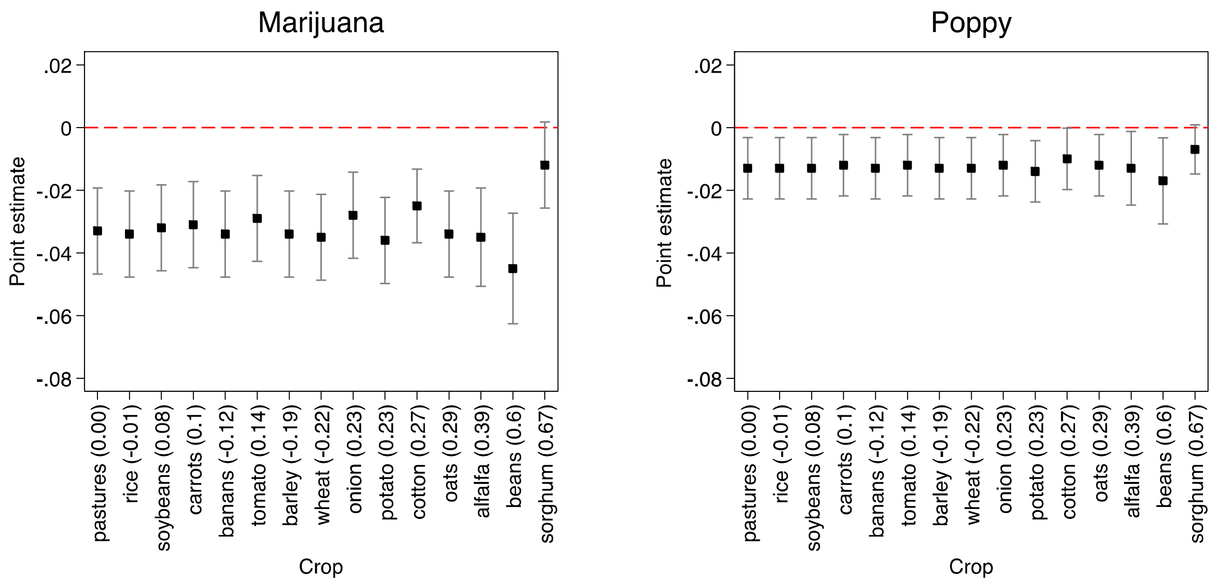
Figure A.1 Maize Prices and Enforcement Measures



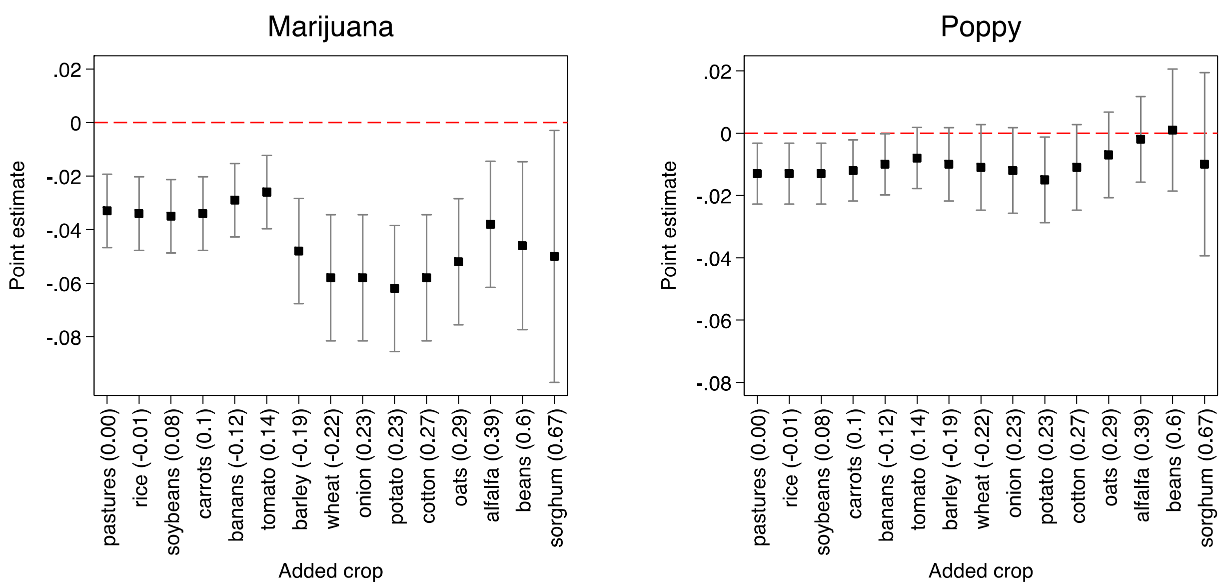
Notes: This figure plots the national maize price, international maize price and four measures of national enforcement: (log) Mexican government military expenditures; (log) total armed personnel in the Mexican military; (log) U.S. military aid to Mexico; and (log) average number of drug war detainees among Mexican municipios.

Figure A.2 Accounting for Legal Crop Suitabilities Individually

Panel A: Adding Crops One at a Time

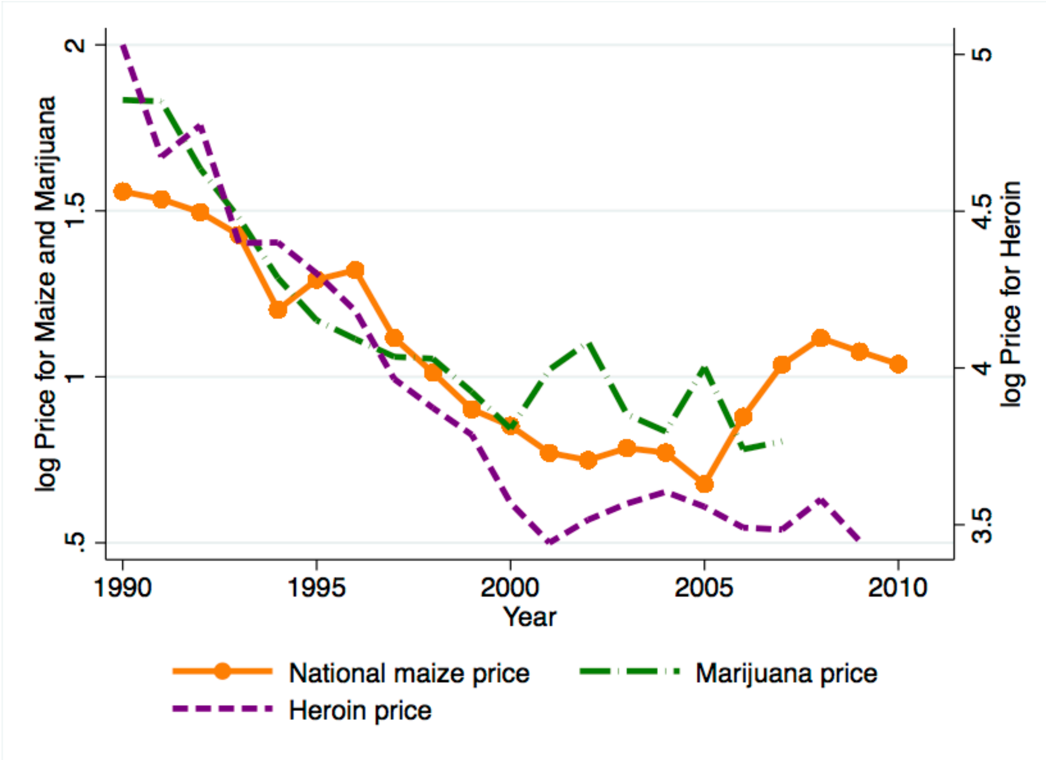


Panel B: Adding Crops Cumulatively



Notes: This figure presents coefficient estimates and 95% confidence intervals on MAIZE x PRICE in regressions of marijuana and poppy eradication, controlling for other legal crop suitabilities interacted with year effects. The x-axis indicates the added crop suitability, and shows the correlation between this crop suitability and maize suitability in parentheses. In Panel A, we add in interactions with each crop suitability one at a time. In Panel B, we add interactions with the crop suitabilities cumulatively.

Figure A.3 Maize and Drug Prices



Notes: This figure shows the Mexican maize price over the 1990-2010 period (based on data from the Servicio de Información Agroalimentaria y Pesquera (SIAP), in the Mexican Ministry of Agriculture), the wholesale price for heroin in the U.S. over 1990—2009 (based on data from the UNODC World Drug Reports), and the price of marijuana per bulk above 100 grams in the U.S. (based on data from the Office of National Drug Control Policy).