The Cost of Dissidence: International Commodity Prices and Political Unrest in Latin America

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"As long as oil prices remain high, Chavez seems likely to continue in power. But when they fall, Venezuela faces a reckoning."

Michael Reid
Forgotten Continent (2007)

Abstract: Latin America is a region characterized by a turbulent political history and a marked dependence on commodity exports. Constructing a new panel dataset covering most of the 20th century, I examine how international prices for Latin America's principal exports influenced political unrest. I document a significant association between prices and subsequent political unrest. The results suggest that political dissidents behave rationally, choosing from a menu of protest activities. Specifically, higher export prices are associated with a lower likelihood of violent protest and a higher probability of peaceful demonstration, consistent with higher opportunity cost discouraging dissidents from undertaking riskier protest activities. This pattern is especially true for the price of commodities which produce diffuse rents which are less easily extracted by the state.

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1. Introduction

Why is it that some groups of people chose to show their discontent through more peaceful forms of protests such as anti-government demonstrations and strikes while other groups of people show their discontent in more violent manners like rioting or creating government crises?[1] An argument could be made to suggest that disgruntled groups or political dissidents behave in a rational manner and choose the type of demonstration from a menu of protest activities based on opportunity costs. That is, they are less likely to choose a violent activity if there is a high opportunity cost to getting thrown in jail while on the other hand, choose more violent activities if there is nothing to lose – that is, if there is a low opportunity cost.

In a region highly dependent on commodity exports and commodity prices being as volatile as they are, opportunity costs for many people in Latin America can be influenced by increases and decreases in commodity prices. Today, many Latin American countries export large amounts of primary products and are therefore vulnerable to movements in international commodity prices. Recent work has found that for many countries in the region, revenues from commodities have been growing in importance since the 1990s (Sinnott, 2009). Many countries have experienced internal political instability and unrest in various forms. Given the historical and current importance of commodities for Latin American countries, it is worth examining to what extent the political stability of the region is affected by the fluctuations in commodity prices.

Compiling new commodity price indexes from various sources based on primary commodity exports, I test whether commodity prices have an effect on the political stability of 18 Latin American countries between 1919 and 2000. Employing a probit model, I find that changes in a country's total commodity price index have a significant effect on subsequent political unrest. The results when disaggregating each country's commodity price index into point source commodities (i.e. capital intensive, appropriable, or easily taxed commodities such as natural resources and plantation crops) and diffuse commodities (i.e. small holder owned, difficult to tax commodities such as small farm production and livestock) are similar and robust

[1] Strikes, anti-government demonstrations, riots, and government crises refer to the definitions given by Banks (2011) which can be found in Table 1 of this paper.

to the use of a zero-inflated negative binomial count model.[2] The results suggest that political dissidents behave rationally, choosing from a menu of protest activities. Specifically, higher export prices are associated with a lower likelihood of violent protest and a higher probability of peaceful demonstration, consistent with higher opportunity cost discouraging dissidents from undertaking riskier protest activities. This pattern is especially true for the price of commodities which produce diffuse rents which are less easily extracted by the state. Further disaggregation of the point source commodities into its mineral and agricultural components reveal that the negative point source effect is driven primarily by increases in mineral prices and the positive point source effect is driven primarily by increases in agricultural prices.

While there is limited work on political unrest, there has been a great deal of work on the relationship between natural resources and the onset/duration of civil wars.[3] The literature on oil exports and civil war has found that oil exports increase the likelihood of conflict, especially separatist conflict since secession can be economically advantageous to those in an oil producing region of a country (Collier and Hoeffler, 2004; 2006). Other resources such as "lootable" resources – commodities like gemstones and drugs which are easily extracted by unsophisticated means – have been found to prolong the duration of conflict but are not the cause of conflict. The availability of lootable resources allows for factions to easily acquire and sell these resources to fund their campaign. In contrast, the literature has found that agricultural commodities are uncorrelated with civil wars and that primary commodities are "not robustly associated" with civil wars (Fearon, 2004; Fearon and Latitin, 2003).[4] However, more recent work has found a significant relationship between primary commodity prices and the onset of civil war. In a sample of 124 countries, Besley and Persson (2008) find that higher world prices of both imports and exports increase the likelihood of civil wars. Brückner and Ciccone (2010) focus on 39 Sub-Saharan African countries and find that civil wars are more likely to begin following downturns in the world prices of a country's main commodity exports.

[2]Point source refers to natural resources "extracted from a narrow geographic or economic base, such as oil and minerals" as well as plantation crops and diffuse refers to natural resources "relying primarily on livestock and agricultural produce from small family farms" (Isham, Woolcok, Pritchett, and Busby, 2005). Appendix 1 lists the countries and years in my sample

[3] See for example, Besley and Persson (2008), Buhaug and Gates (2002), Collier and Hoeffler (2002; 2004; 2006) Fearon (2004), and Lujala et al. (2005).

[4] Primary commodities are a more general category which includes agricultural goods, oil, and other non-fuel minerals.

Commodities also affect regime change or changes between autocracy and democracy. Haber and Menaldo (2011) find that natural resource booms had more of an effect in keeping countries democratic, or moving them towards democracy than keeping them autocratic or moving them towards autocracy. In contrast, Ross (2001; 2009) finds that oil and mineral wealth have strong anti-democratic effects, that oil wealth prolongs authoritarian rule, and that the effect of prolonging authoritarian rule has become stronger over time. However, he goes on to show that oil-rich countries in Latin America are an exception to this trend (Ross, 2010). Instead, among Latin American countries, oil production is linked to increased governmental conflict (i.e. conflict over control of the existing state), which is a different type of instability. The results from Haber and Menaldo (2010) suggest that Latin America may be a unique case when talking about the resource curse. They find that natural resources do not have a significant effect on either democracies or autocracies in Latin America – making natural resources in the region neither a curse nor a blessing. If this is the case, looking at what other types of effects commodities, including natural resources, have on Latin American countries is an important topic.

The rest of the paper is organized as follows. Section 2 discusses why a Latin American regional focus is appropriate. Section 3 describes the measurement of political unrest, commodities, the construction of commodity price indexes, and the control variables. Section 4 presents the estimation framework and the main results. Alternative indexes and an alternative estimation strategy are discussed and their results are presented in section 5 and section 6 concludes.

2. Political Instability and Conflict in Latin America

Existing literature connecting civil wars and commodity prices are either not region specific (e.g. Besley and Persson, 2008) or focus on Africa (e.g. Brückner and Ciccone, 2010). This is in part driven by the data, the majority of the countries with civil wars are in Africa and the Middle East and some regions like Latin America have only a few incidences of civil war.[5] Within Latin America, the dearth of civil war observations in the region implies that the bulk of the political instability or unrest takes a different form. Measuring unrest by events like anti-government demonstrations, government crises, riots, and strikes, Latin America is the region

[5] Depending on your definition of civil war, there may not be any civil war observations in the region during the twentieth century.

with the highest level of unrest during the better part of the 20th century. More specifically, for 18 Latin American countries between 1919 and 2000 there were more than 690 anti-government demonstrations, 380 crises that threatened to bring down the current regime, 700 riots, and 370 strikes.[6] In the same time period, the most politically unstable country, Argentina, had 77 anti-government demonstrations, 54 government crises, 85 riots, and 86 strikes. Even the most politically stable country, Costa Rica, still had 11 anti-government demonstrations, 3 government crises, 10 riots, and 6 strikes over the period.[7] Focusing on civil wars alone thus hides the region's true level of unrest.

Second, while some work has been done on the relationship between commodity prices and civil wars in Sub-Saharan Africa and both Sub-Saharan African and Latin America are primary commodity exporters, their historical backgrounds and cultures are quite different, making it difficult to generalize Africa's results to Latin America.[8] In addition, since most Latin American countries gained their independence before the turn of the twentieth century, there is a large amount of information on sovereign countries in the region, allowing for a longer time period of analysis. This is in contrast to many parts of Asia and Sub-Saharan Africa, which did not attain independence until later in the twentieth century.

In addition to focusing on civil wars and other regions of the world, the natural resource and instability literature primarily examines states producing oil and other lootable resources. While Latin America does have oil-producing states, the majority of the countries in the region do not export oil, and even though there is an abundance of commodity exports, very few are classifiable as lootable. Focusing on Latin America allows me to use the region's wide variety of primary commodity exports which have a lot of cross-country variation. On the agricultural side, the range of products is diverse, ranging from tropical fruits like bananas to temperate grains like wheat. On the non-agricultural side there are minerals ranging from iron ore to petroleum. This variability in commodity exports facilitates the study of the link between certain types of

[6] Refer to Table 1 for definitions of these variables.

[7] All instability numbers come for the Cross-National Time Series Data archive (Banks, 2011). Data from the Cross National Time Series Data Archive has been widely used in both economics and political science fields. See for example Barro (1991), Burkhart and Lewis-Beck (1994), Easterly and Levine (1997) and Levine and Zervos (1998).

[8] See for example, Collier and Hoeffler (2002) and Brückner and Ciccone (2010). Research focusing on specific commodities, such as diamonds, focuses mostly on African countries and a few other countries in the world (e.g. Lujala et al., 2005).

commodity exports and political stability and should be informative as to whether that influence is beneficial or detrimental to the countries in the region.

To study how political instability in Latin America is affected by commodity prices, I consider additional forms of instability beyond civil war as well as a broad set of commodities which include not only minerals but also agricultural commodities. Before analyzing the effects of commodity prices on unrest in Latin America, it is necessary to clearly define instability, identify the export commodities for each Latin American country for the period of study, and create the appropriate country specific commodity price indexes. These tasks are undertaken in the next section.

3. Data

The literature has not come to an agreement on how to measure political instability. However, there are two general approaches. The first is to use principle component analysis to create a single measure of political instability from a list of variables that are considered to be indicators of political instability or unrest – such as anti-government demonstrations, riots, and strikes.[9] The second approach is to use counts of the individual events directly in the analysis or to include a dummy variable indicating the occurrence of a specific event type.[10]

It is plausible that commodity prices may have different effects on each indicator of unrest. For example, an increase in commodity prices may increase the probability of anti-government demonstrations but decrease that of government crises. In this situation, a principle component instability measure may not be able to capture these event specific effects.[11] In order to try and capture these effects, I follow the second strategy by indicating the occurrence of political instability with a dummy variable. This allows for individual analysis of each indicator. Since there is no one variable in the literature that fully captures the idea of political instability, I use four different variables – anti-government demonstrations, government crises, riots, and strikes – all of which can be viewed as different manifestations of political unrest. These measures come from the Cross National Time Series Data Archive and their definitions are listed

[9] Refer to Alesina and Perotti (1996), Perotti (1996), Annett (2001), Fosu (2001), Campos and Nugent (2002), Schatzman (2005), and Blanco and Grier (2009) for examples.

[10] See for example, Cukierman et al. (1992), Alesina et al. (1996), and Blomberg (1996), Camignani (2003)

[11] Also, as I am constructing the commodity price indexes, it seems inappropriate to also have a constructed dependent variable as well.

in Table 1 (Banks, 2011). This dataset provides consistent definitions across time and countries with data back to 1919.

3.1 Commodities, Prices, and Indexes

There are twenty five primary export commodities that make up the majority of the commodity export share for Latin American countries during the 20th century. Table 2 lists these commodities. It is important to note that some of these commodities, such as rubber and nitrates, were prominent exports in the beginning of the century while others, such as soybeans and iron ore, are dominant in the latter part of the century. The commodity export data is used to build each country's commodity price indexes.

International primary commodity price data is available from various sources for the entirety of the twentieth century. Appendix 2 lists the data sources for the primary commodity prices used in the analysis.[12] Even though there is data for all commodities under study, including all twenty five commodity prices would create problems in the specification due to their high level of collinearity.[13] Instead, price indexes based on the each country's commodities and their international prices must be constructed.

Most price indexes are created by weighting each commodity price in the index by its world export value share for a given base year. Price indexes that focus on a certain region or subset of the world weight the prices by the value share of the region's export of each commodity in the index for a given base year. For example, Grilli and Yang (1988) create a commodity price index based on the developing countries' value share of exports and use 1977-79 average as their base year.

In order to construct a price index in this manner, value shares of the twenty five exports for the eighteen countries that make up the sample would be necessary. Unfortunately, this data is not available. Moreover there is no one year between 1919 and 2000 where all twenty five commodities under consideration are exported. This makes choosing a base year that gives a

[12] Most of the price data comes from the Grilli and Yang commodity data series (Grilli and Yang, 1988). They, and the update of their data by Pfaffenzeller et al. (2007), index all prices to the 1977-1979 average for each series. For consistency and comparability, all price series that are not from the Grilli and Yang series are also index to the 1977-1979 average.

[13] When including all twenty five commodity prices as well as the other control variables, the condition index is many orders of magnitudes larger than the conditional index when using the price indexes. For a discussion of condition indexes see Belsley et al. (1980).

good set of representative weights difficult. Therefore, a different weighting scheme needs to be used in order to construct the price indexes.

Intuitively, a relevant country or region specific commodity price index is a function of both prices and relative exports weights. Because this is a study of how primary commodity export prices affect political stability throughout the century, allowing weights to perfectly update every year would make interpretation of commodity price changes difficult because observed changes could simply occur due to changes in the relative weights instead of changes in prices. Therefore, we need a constant weighting scheme so that the price index captures price changes only. In Latin America there are some commodities that are dominant for longer periods of time, such as sugar for Brazil and beef for Argentina whereas others, such as nitrates for Chile, are exported for a relatively short period of time in the 20th century. To address this, when creating a price index for each country, the weights can be calculated by accounting for the number of years that the commodity is produced and exported in that particular country for the time period of the analysis. Given this, sugar in Brazil should get a higher weight than iron ore, which only became a dominant export late in the twentieth century. I create a weighting scheme for the price indexes based on the idea of country importance measured by the fraction of all years that each commodity is produced within each country (i.e. commodities produced in more years get a higher weight). The commodity weights, ω_{ic}, are therefore calculated as:

$$\omega_{ic} = \frac{\sum_t d_{itc}}{\sum_t \sum_c d_{itc}} \tag{1}$$

where d_{itc} is a dummy equal to one if commodity c is produced in country i during year t and zero otherwise. This weight is unique to each commodity and the sum of all the weights, ω_c, for each country is equal to one.

Using this weighting scheme, each country specific price index is calculated in the following way:

$$Commodity\ Price\ Index_{it} = \sum_{c=1}^{n} \omega_{ic} P_{ct} \tag{2}$$

where ω_{ic} is the weight given to each commodity c in country i that makes up the price index and P_{ct} is the international commodity price for commodity c at time t. The price indexes created for each country are thus based on international prices for the country's principal commodities exports.

Although the use of constant country specific weights will create some imprecision in the commodity price index, it is not clear a priori that this would induce any particular price bias in one direction and should instead act as noise attenuating the strength of any observed connection between commodity prices. The advantage to this approach is that variation over time in the constructed commodity price index is solely due to change in commodity prices and not attributed to fluctuations in commodity export weights. Table 3a reports the summary statistics for the various commodity price indexes constructed. The first, Total Price Index (Total PI), is constructed using all of each country's export commodities. This is the most aggregate index in this study. To see the effect of changes in prices of specific subgroups of commodities, I also create the Diffuse Price Index (Diffuse PI) and Point Source Price Index (Pt. Source PI). Table 2 lists the commodities in each group. Finally, I further disaggregate the Point Source Price Index into its mineral and agricultural components to create the Point Source-Mineral Price Index (Mineral PI) and the Point Source-Agriculture Price Index (Agricultural PI).

3.2 Additional Covariates

I include five control variables in the estimation: regime type, growth of real GDP per capita, inflation, population, and a neighborhood effect.[14] All control variables, as well as the commodity indexes, are lagged one year to mitigate any concerns about reverse causality.[15] Table 3b lists the summary statistics for all variables.

The first control variable, regime type, is a dummy for democracy. Following Besley and Persson (2008), it is equal to one when the polity2 score for country *i* at time *t* is greater than

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[14] While the results presented here are with all the right-hand side variables lagged one period, the results are still significant when they are lagged two and three periods. These results are available upon request.

[15] Endogeneity of commodity prices could be a problem in the analysis if these countries are price setters. In such a case, instability in the country could lead to higher world prices of the commodities produced in the country as the world market adjusts to the decline in supply. However, I am studying commodities that are produced not only in Latin America, but also in other regions of the world. As such, most of these countries are price takers (there may be an exception in the case of Chile with nitrates and copper prices. However, the results presented below are robust the exclusion of these two commodities). Lagging the dependent variables by one year mitigates the endogeneity problem because it is hard to argue that political instability in a country this year has an effect on commodity prices, population, and GDP last year.

zero and zero otherwise. [16] Based on this definition, less than half of the country years in the sample qualify as democratic. Various works have studied the effect of regime type on political instability. Some of the findings suggest that democracies experience less instability (Ellingsen 2000; Parsa 2003; Besley and Persson 2008), lower levels of violence (Rummel 1995), and fewer civil wars (Besley and Persson, 2008). In Latin America, Schatzman (2005) finds that between 1980 and 1993, more democratic regimes appear to experience more rebellions (violent) but less collective protests (non-violent). Based on Schatzman's work, one would expect that the effect of democracy on instability may differ across instability measures.

The second control variable is growth rate of real GDP per capita. The literature on instability has shown that economic performance has a major influence on political instability. There are two channels through which this effect works. The first is that the opportunity cost of rising up or rebelling is lower when incomes are low or falling (Collier and Hoeffler, 2004; Dube and Vargas, 2010). The second is that deprivation tends to increase when there are hard economic times, fueling the image of government incompetence (Gurr, 1970; Posner, 1997; Nafziger and Auvinen, 2002). Supporting this idea, Alesina et al. (1996) find that lower GDP growth is associated with a higher probability of unconstitutional political change and Besley and Persson (2008) find that poorer countries are more likely to be involved in conflict than richer ones. Both of these channels suggest that negative growth increases the likelihood of instability.

I also control for inflation. Since I am testing for the effect that commodity prices have on political stability through an increase (or reduction) in income that comes from changes in international prices (i.e. the production side), I need to control for domestic prices (i.e. the consumption side). It is very likely that increases in domestic prices of agricultural and energy products (the majority of the commodities in the study) results in instability as citizens become unhappy with the increasing prices. Existing research documents an association. Cukierman et al. (1992) find that seignorage and political instability are positively correlated. Paldam (1987) finds evidence that in Latin America, military regimes, which he considers to be relatively more unstable than democratic regimes, are correlated with higher levels of inflation. Moreover, few Latin American regimes have survived an episode of hyperinflation and regime change can be a

[16] The polity2 variable ranges from -10 to 10 and is the difference between the democracy and autocracy variables in the Polity IV database (Marshall and Jaggers, 2009). Higher values of the polity2 variable means more democratic. The results are robust to a more stringent (higher polity 2) definition of democracy.

form of instability. In order to disentangle the two effects – the consumption vs. the production effects – the rate of inflation is included to capture the consumption side.[17]

Collier and Hoeffler (2004) find that the risk of conflict is proportional to population size. They suggest that with larger populations, both grievances (ethnic or religious hatred, political repression and/or exclusion and economic inequality) and the opportunity to rebel increase. Population size is included in the analysis to control for any potential effect that sheer numbers may have on the probability of instability.[18]

The last control variable is a neighborhood dummy intended to capture a contagion or demonstration effect. This variable takes a value of one if there is at least one instability event in a contiguous country and zero otherwise. This dummy is constructed to match the particular instability event under consideration and information for contiguous countries that are not part of the sample were used to construct this variable (e.g. Haiti). Table 3b also reports the summary statistics for all the neighborhood dummies. Between 45 and 61 percent of the country years contain unstable neighbors. Note that only one neighborhood dummy is used in each regression presented below.

4. Model and Results

4.1 Model

The instability measures are all dichotomous, which means that a simple OLS framework is inappropriate because the predicted values may lie outside the zero-one range.[19] Instead I use a probit model with the following form:

$$Instability_{i,t} = \beta_1 TotalPI_{i,t-1} + \gamma' Controls_{i,t-1} + \alpha_i + \varepsilon_{it} \tag{3}$$

Where $Instability_{i,t}$ is a dummy variable equal to one when there is an instability event in country i at time t and zero otherwise.[20] The first right hand side variable is the aggregate commodity

[17] When inflation is not included in the analysis, the commodity price results are stronger and have slightly higher statistical significance. However, qualitatively the results are the same.
[18] Using population growth instead of population does not significantly change the results.
[19] The results using OLS are very similar to the marginal effects reported in Table 4. The OLS results are available upon request.
[20] I tested for autocorrelation using the Wooldridge test for serial correlation in panel-data models and the results using both the dummy instability measures and the count instability measures show that we fail to reject the null of no serial correlation. In all cases in this study, the test fails to reject the null of no serial correlation.

price index, Total PI, that is unique to each country and year. $Controls_{i,t-1}$ is a vector containing the control variables previously discussed and α_i are country fixed effects.

4.2 Results

Table 4 shows the marginal effects for the probit results from equation (3). Each column has a different type of political instability as the dependent variable and the neighborhood dummy captures instability of the same type as the dependent variable. The results show that changes in Total PI have a positive effect on anti-government demonstrations and strikes and a negative effect on government crises and riots. Holding everything else constant the estimates suggest that a one standard deviation increase in the Total PI increases the probability of anti-government demonstrations by 7.1% and strikes by 6.1% and decreases the probability of government crises by 4.5% and riots by 5.9%. If we were to plot these four measures of instability based on threat of violence and risk of government retribution, as seen in Figure 1, the results can be generalized as showing that an increase in commodity prices increases the likelihood of peaceable demonstrations and decreases the probability of violent protest. However, keep in mind that there are a wide range of commodities in the Total PI and prices for different commodities do not always move in tandem. These results show the general effect that a country's average weighted commodity prices have on these measures of political instability. So while we can say that commodity prices have an effect on political instability, we cannot say whether a specific subgroup of commodities is driving these results. This issue is explored in detail in the next section.

It is interesting to examine the control variables as well. First, there appears to be a strong spillover effect. All of the neighborhood coefficients are positive, suggesting that the probability of political instability in a particular country increases when a neighbor experienced the same type of political instability. The democracy variable is also positive across the board meaning that these five types of political instability are more likely under democracies. It is not unusual to think about certain types of political instability being more likely under democracies and others under autocracies. Lastly, GDP growth is negative suggesting that increases in GDP growth decrease the probability of instability. This last result is in line with the findings in the literature.

The results so far show that commodity prices affect political instability. But as the commodity price index used contains many different types of commodities, it is difficult to discern whether specific types of commodities are more likely to affect political instability than others.

5. Alternative Indexes and Estimation Framework

5.1 Point Source and Diffuse Indexes

Disaggregating the Total Commodity PI requires we split the commodities into subgroups. Some of the literature that examines how commodity prices affect political stability relies on the idea of a rentier state. A rentier state is one that regularly receives external economic rents (Yates, 1996).[21] A good example is an oil producing state which exports the majority (if not all) of its oil. These states regularly receive large amounts of money from external actors. However, as Ross (2001) points out, other minerals also create rents which are captured directly by the state (through export taxes, corporate taxes, and state-owned enterprises). Isham et al. (2005) also make the argument that states are able to easily extract rents not just from all forms of natural resources (i.e. oil and minerals) but also from other resources that have a narrow geographic base such as plantation crops (e.g. through marketing boards and direct procurement by government). They call resources that provide rents for the government "point source resources" and resources whose rents are more difficult to capture, such as small farm production and livestock, "diffuse resources" (Isham et al. 2005).

The results in this section use commodity price indexes built around the definition of point source commodities versus diffuse commodities. Table 2 lists the commodities in each category. To investigate what effect point source and diffuse commodity prices have on political instability, I estimate equation (3) using Pt. Source PI and Diffuse PI instead of Total PI. The marginal effect results for the index coefficients are listed in Table 5a. Just as before, the dependent variable in each column is a different type of political instability.

The results show that an increase in the Pt. Source PI increases the probability of anti-government demonstrations and strikes and decrease the probability of government crises and riots. Holding everything else constant, a one standard deviation increase in the Pt. Source PI increases the probability of anti-government demonstrations by 6.6% and strikes by 5.3% and decreases the probability of government crises and riots by 3.5% and 5.4%, respectively. An

[21]Hazem Beblawi (1987) refined this definition to one where a state receives rents from foreign actors and where only a few domestic actors are involved in the generation of this rent and "the majority being only involved in the distribution or utilization of it"

increase in the Diffuse PI increases the probability of anti-government demonstrations and strikes but decreases the probability of government crises and riots. A one standard deviation increase in the Diffuse PI increases the probability of ant-government demonstrations and strikes by 6.3% and decreases the probability of government crises and riots by 5.5% and 4.9%, respectively.[22]

The results here still show that increases in export commodity prices increase the likelihood of peaceful protest activities – anti-government demonstrations and strikes – while decreasing the likelihood of violent protest activities – government crises and riots. This is consistent with the idea that higher opportunity costs discourage dissidents from undertaking riskier protest activities.

5.2 Mineral vs. Agricultural Point Source Commodities

The commodities that make up the Pt. Source PI include agricultural as well as mineral commodities. However, the existing literature consistently finds that changes in mineral prices (e.g. petroleum) are highly correlated with instability (Buhaug and Gates, 2002; Collier and Hoeffler 2002, 2004, 2006; Fearon 2004; Lujala et al. 2005) and only a few studies have found a correlation between instability and agricultural prices (Besley and Person, 2008; Brückner and Ciccone, 2010). In order to see if the Point Source results are driven by the minerals or the agricultural commodities in the index, I split the point source commodities into minerals and agricultural commodities. Table 2 lists which of the point source commodities are minerals and which are agricultural. I estimate equation (3) with Mineral PI, Agricultural PI and Diffuse PI instead of the Total PI. The index coefficient results are listed in Table 5b. From the results, it appears that the mineral prices are the driving force behind the negative point source results while the agricultural prices are driving the positive point source results. Once again, the results here support the idea of increasing export commodity prices decreasing the likelihood of violent protest activities and increasing the likelihood of non-violent ones.

5.3 Count Model

So far, the various instability measures are dummy variables that take a value of one when there is at least one instability event in a given country year and zero otherwise. However, the Banks data gives the total number of each type of event for each country year (Banks, 2011).

[22] The lower bound is the assassination estimate and the upper bound is the estimate for purges.

There are estimation techniques that allow for the use of count data as a dependent variable.[23] The appropriate model for the instability data is a Zero-Inflation Negative Binomial. A discussion of the various count data models as well as evidence supporting the choice of this model over others is presented in Appendix 3. This model has two components – a binary component and a count component. The binary section uses a logistic distribution and within this framework, "success" is a prediction of being a zero count and "failure" a non-zero count. The count/Negative Binomial part models the non-negative integer outcomes which includes zeros.[24]

Table 6 shows the zero-inflated negative binomial results using the Pt. Source PI and Diffuse PI. Panel A shows the marginal effects for the negative binomial component (the count part of the model) and Panel B shows the results for the Logit component (the binary part of the model). The negative binomial results using the count data model are similar to the probit results. From Panel A we can see that an increase in the Pt. Source PI increases the probability of anti-government demonstrations and decreases the probability of government crises and riots while an increase in the Diffuse PI increase the probability of anti-government demonstrations and strikes.

Focusing on the results presented in Panel B, recall that success in the binary part of the model is having a zero count of instability (i.e. no anti-government demonstrations, no assassinations, etc.). The results show that an increase in the Pt. Source PI increases the probability of having a positive number of anti-government demonstrations while an increase in the Diffuse PI decreases the probability of having a positive number government crises and riots.

Overall, the results from the count model are similar to the results in Table 5a. The similarity in the results suggests that the effects of commodity prices are relatively robust regardless of the estimation framework used. Moreover, the results still show that increases in export commodity prices increase the likelihood of peaceable demonstrations while decrease the likelihood of violent protests consistent with higher opportunity costs discouraging dissidents to undertake protest activities that have a higher probability of government retribution.

6. Conclusion

Latin America is still experiencing varying levels and types of political instability and at the same time many countries have not reduced their dependence on primary commodity exports.

[23] Appendix 4 lists the summary statistics for the instability measures in count data form.
[24] A truncated distribution would need to be used if the zeros were not included.

There is a possibility that the region's reliance on revenue from commodity exports could be an influential factor in the region's political stability. This paper studies how commodity prices affect the probability of political instability in Latin America. Using four different types of political instability, I test whether commodity prices have an effect on the various types of instability.

The results show that commodity prices influence the probability of political instability. However, the direction and magnitude of the effect depends on the measure of political instability. Based on the result from a probit model, I find that increases in a country's total commodity price index, increases the probability of anti-government demonstrations and strikes but decreases the probability of government crises and riots. However, this index is too aggregate to see if specific types of commodities are more prone to instability than others. The results when disaggregating each country's commodity price index into point source commodities and diffuse commodities are similar to the results when using the total commodity price index. Further disaggregation of the point source commodities into its mineral and agricultural components reveal that the negative coefficients on the point source price index are driven primarily by increases in mineral prices while the positive coefficients are driven by increases in agricultural prices affecting. All the results show that increases in export commodity prices reduce the likelihood of violent protest activities and increase the likelihood of non-violent ones. This supports the idea that dissidents are rational and choose from a menu of protest activities based on their opportunity cost. If the prices of export commodities are increasing, they stand to lose more if they are incarcerated so they shift their protest activities to ones that are less likely to lead to government retribution (i.e. more peaceable activities).

The finding that commodity prices affect the political stability of the region is important in the formulation of policy. The most important take-away for policymakers is that not all commodities affect stability in the same way. Also, it may be in the interest of governments to figure out ways to ensure shifts away from violent protest activities by implementing price stabilizing policies or other types of incentive programs that increase the opportunity cost of participating in violent protests activities. Unfortunately, there is not one easy solution as commodity prices are difficult to control making it difficult to formulate a policy to generally preempt instability from this source.

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Table 1
Definitions of Instability Variables

Variables	Definitions
Anti-Government Demonstrations	"Any peaceful public gathering of at least 100 people for the primary purpose of displaying or voicing their opposition to government policies or authority, excluding demonstrations of a distinctly anti-foreign nature."
Government Crises	"Any rapidly developing situation that threatens to bring the downfall of the present regime – excluding situations of revolt aimed at such overthrow."
Riots	"Any violent demonstration or clash of more than 100 citizens involving the use of physical force."
Strikes	"Any strike of 1,000 or more industrial or service workers that involves more than one employer and that is aimed at national government policies or authority."

Source: Cross National Time Series Data (Banks, 2011)

Table 2
Commodity Price Indexes – Component Commodities

Component Commodities			**Price Index Name**
− Beef − Hides	− Maize/Corn − Soybeans	− Wheat − Wool	***Diffuse*** "those relying primarily on livestock and agricultural produce from small family farms"*
Minerals − Antimony − Copper − Gold − Iron Ore − Lead − Nitrate − Petroleum	 − Quebracho Extract − Rubber − Silver − Timber − Tin − Zinc	Agricultural − Bananas − Cocoa − Coffee − Cotton − Sugar − Tobacco	***Point Source*** "those extracted from a narrow geographic or economic base, such as oil, minerals, and plantation crops (such as sugar and bananas)"*

Note: The price indexes for each country are based only on the commodities that are produce in that country.
*Source: Isham et al. (2005)

Table 3a
Summary Statistics
For Commodity Price Indexes

Variable	Mean	Std. Dev.	Min	Max
Total Price Index	59.609	39.176	4.653	285.28
∗ Diffuse Price Index	11.572	26.039	0	146.445
∗ Point Source Price Index	48.379	39.719	0	285.28
− Mineral Price Index	17.717	25.684	0	163.14
− Agricultural Price Index	29.347	29.448	0	157.63

Table 3b
Summary Statistics
For Other Covariates and Instability Measures

Variable	Mean	Std. Dev.	Min	Max
Anti-Government Demonstrations	0.291	0.454	0	1
Government Crises	0.221	0.415	0	1
Riots	0.312	0.464	0	1
Strike	0.207	0.405	0	1
Neighborhood				
Anti-Govt. Demonstrations	0.543	0.498	0	1
Govt. Crises	0.484	0.5	0	1
Riots	0.612	0.488	0	1
Strikes	0.442	0.497	0	1
Democracy	0.477	0.5	0	1
Population	15072	25274	580	167988
Inflation	13.704	18.944	-42.321	99.313
GDP Growth	1.608	5.177	-22.285	28.346

Note: All variables have 1146 observations

Table 4
Marginal Effects From Probit Regression
Using the Aggregate Commodity Price Index

	Anti-Govt. Demonstrations	Govt. Crises	Riots	Strikes
Total PI	0.002***	-0.001***	-0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Neighborhood	0.089***	0.125***	0.169***	0.070**
	(0.031)	(0.027)	(0.029)	(0.028)
Democracy	0.098***	0.060**	0.094***	0.084***
	(0.032)	(0.028)	(0.033)	(0.026)
Inflation	-0.000	0.000	-0.000	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
Growth GDP	-0.005*	-0.005**	-0.000	-0.002
	(0.003)	(0.002)	(0.003)	(0.002)
Population	0.000**	-0.000	-0.000*	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
χ^2 (1)	1,146	1,146	1,146	1,146
Total PI	154.686***	135.077***	163.744***	193.022***

Note: N = 1146 for all regressions. Standard errors in parenthesis. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level.

Table 5a
Marginal Effects From Probit Regression
Using the Point Source and Diffuse Price Indexes

	Anti-Govt. Demonstrations	Govt. Crises	Riots	Strikes
Pt. Source PI	0.002***	-0.001**	-0.001***	0.001***
	(0.000)	(0.000)	(0.001)	(0.000)
Diffuse PI	0.002**	-0.002**	-0.002*	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
χ^2 (1)	155.448***	136.286***	163.379***	194.682***

Table 5b
Marginal Effects From Probit Regression
Using the Diffuse and Disaggregated Pt. Source Prices Index

	Anti-Govt. Demonstrations	Govt. Crises	Riots	Strikes
Pt. Source:				
Mineral PI	0.001	-0.002**	-0.002**	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)
Agricultural PI	0.002***	-0.000	-0.001	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Diffuse PI	0.002**	-0.002**	-0.002*	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
χ^2 (1)	155.786***	68.176***	137.978***	164.959***

Note: N = 1146 for all regressions. All controls discussed in Section 4.4 are included. Standard errors in parenthesis. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level.

Table 6
Zero Inflated Negative Binomial Marginal Effects
Using the Point Source and Diffuse Price Indexes

Panel A
Negative Binomial Component

N = 1146	Anti-Govt. Demonstrations	Govt. Crises	Riots	Strikes
Pt. Source PI	0.008***	-0.008***	-0.008***	0.003
	(0.002)	(0.002)	(0.002)	(0.002)
Diffuse PI	0.011***	0.001	-0.002	0.011***
	(0.003)	(0.004)	(0.003)	(0.003)

Panel B
Logit Component

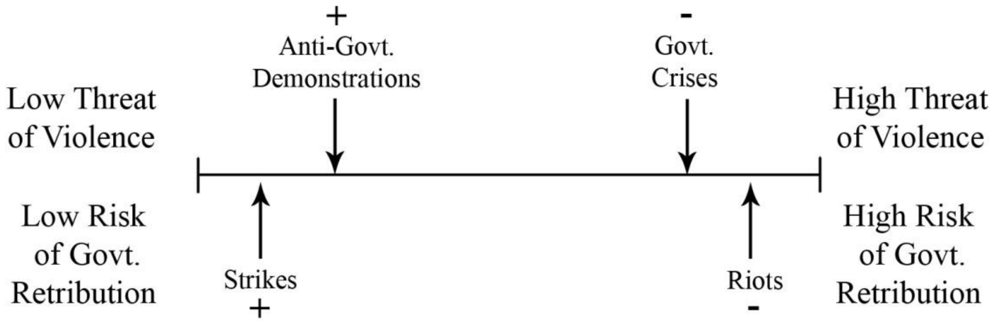
	No Anti-Govt. Demonstrations	No Govt. Crises	No Riots	Strikes
Pt. Source PI	-0.023**	0.019	0.001	-0.019
	(0.010)	(0.016)	(0.006)	(0.016)
Diffuse PI	0.005	0.054**	0.032***	0.007
	(0.010)	(0.024)	(0.009)	(0.014)
$\chi^{2\ a}$	95.48***	16.94***	124.05***	52.62***
Vuong Statistics [b]	3.58***	1.52*	4.00***	3.53***

Note: N = 1146 for all regressions. All controls discussed in Section 4.4 are included. Country fixed effects are not included. Cluster robust standard errors in parenthesis. *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level.

[a]Chi-Squared Statistic for the likelihood ratio test compares the Zero-Inflated Negative Binomial model with the Zero-Inflated Poisson Model. A significant statistic implies that there is overdispersion and the Zero-Inflated Negative Binomial is the appropriate technique.

[b]The Vuong test compares the Zero-Inflated Negative Binomial model with the Negative Binomial Model. A significant statistic implies the Zero-Inflated Negative Binomial is a better fit than the standard Negative Binomial.

Figure 1



Increases in export commodity prices are associated with a lower likelihood of violent protest activities and a higher probability of non-violent protest activities.

Appendix 1
Countries and Years

	Country	T	Years Included
1	Argentina	76	1919-1939, 1946-2000
2	Bolivia	54	1947-2000
3	Brazil	76	1919-1939, 1946-2000
4	Chile	76	1919-1939, 1946-2000
5	Colombia	76	1919-1939, 1946-2000
6	Costa Rica	57	1938-1939, 1946-2000
7	Dominican Republic	49	1952-2000
8	Ecuador	55	1946-2000
9	El Salvador	56	1939, 1946-2000
10	Guatemala	56	1939, 1946-2000
11	Honduras	57	1938-1939, 1946-2000
12	Mexico	76	1919-1939, 1946-2000
13	Nicaragua	56	1939, 1946-2000
14	Panama	55	1946-2000
15	Paraguay	55	1946-2000
16	Peru	76	1919-1939, 1946-2000
17	Uruguay	64	1931-1939, 1946-2000
18	Venezuela	76	1919-1939, 1946-2000

Appendix 2
Data Appendix

Commodity Price Data:

- Petroleum - Oxford Latin American Economic History Database
- Antimony, Gold, and Iron Ore – USGS
- Soybean and Natural Gas - CRB Encyclopedia
- Sodium Nitrate and Quebracho Extract - US Department of Commerce - Monthly Summary of Foreign Commerce of the United States (United States Geological Survey, 2011)
- All other commodity price data come from Grilli and Yang (1988) and the update by Pfaffenzeller et al. (2007). Full data was accessed at http://www.stephan-pfaffenzeller.com/cpi.html

Country Commodity Export Data:

- International Historical Statistics: The Americas 1750-2005 – (Mitchell, 2007)
- IMF-International Financial Yearbook – (International Monetary Fund, Various)

Economic Data:

- GDP and Population data comes from Angus Maddison's Statistics on World Population - (Maddison, 2010)
- Inflation data – Calculated from the country CPIs from Oxford Latin American Economic History Database (Latin American Economic Center, 2011)

Political Variables:

- Cross National Time Series Data Archive - (Banks, 2011)
- Polity IV Database – (Marshall and Jaggers, 2009)

Appendix 3
Count Model Discussion

Using a count variable as the dependent variable opens up a new set of possibilities in terms of the estimation framework. The various political instability measures used in this study are count variables with distributions that are all skewed right and contain a large proportion of zeros. Poisson, Negative Binomial, and their Zero-Inflated counterparts are some of the estimation techniques that try to deal with these characteristics.

The most widely used count models are Poisson and Negative Binomial. The Poisson distribution assumes that the mean and the variance are equal. Overdispersion in Poisson models occurs when the variance is greater than the mean. This violation of the distributional assumption may cause the estimates derived from a Poisson regression to be inefficient (Hilbe, 2007). The Negative Binomial model is an alternative approach that addresses the problem of overdispersion.

In addition to the problem of overdispersion, there is a problem with the large number of zeros in the data. Because the percentage of zeros in the data ranges from 68% (riots) to 82% (assassinations), it can easily be said that there is an excess of zeros. The distributional assumptions of both Poisson and Negative Binomial are violated when there are a large proportion of zeros in the data. Their zero-inflated counterparts – Zero-Inflated Poisson and Zero-Inflated Negative Binomial – can accommodate the large amount of zeros in the data. These models assume that the structural zeros come from a binary distribution (such as probit or logit) and the non-negative integer outcomes (including zeros) come from a count distribution (such as Poisson or Negative Binomial) (Hilbe, 2007).

To accommodate the overdispersion in the data and the large number of zeros, I use the Zero-Inflated Negative Binomial regression model.[25] This model has a binary section and a count section. A logistic distribution is used for the binary part of the model. Within this framework,

[25] I performed to tests on all regressions to see if this was the correct modeling framework. The first is the chi-squared statistic for the likelihood ratio test that compares Zero-Inflated Negative Binomial model with the Zero-Inflated Poisson model. The results support the use of Zero-Inflated Negative Binomial model over the Zero-Inflated Poisson model. The second statistic is for the Vuong test which compares the Zero-Inflated Negative Binomial with the Negative Binomial. The results from this test support the use of Zero-Inflated over simple Negative Binomial. The test statistics for both test are reported along with the results in Table 6. These two tests should provide some confidence that the correct estimation framework is being employed

"success" is a prediction of being a zero count and "failure" a non-zero count. The log-likelihood function of the logit part of the model is:

$$if\ (y == 0): \sum_{i=1}^{n} \left\{ \ln\left(\frac{1}{1+\exp(-x_i'\beta_1)}\right) + \frac{1}{1+\exp(x_i'\beta_1)} \left(\frac{1}{1+\alpha\exp(x_i'\beta)}\right)^{\frac{1}{\alpha}} \right\} \quad \text{(A.1)}$$

The count or Negative Binomial part models the non-negative integer outcomes which includes zeros. The log-likelihood function of the Negative Binomial part of the model is:

$$\begin{aligned} if\ (y > 0):\ \sum_{i=1}^{n} \Bigg\{ & \ln\left(\frac{1}{1+\exp\,(-x_i'\beta_1}\right) + \ln\Gamma\left(\frac{1}{\alpha} + y_i\right) - \ln\Gamma(y_i+1) \\ & - \ln\Gamma\left(\frac{1}{\alpha}\right) + \left(\frac{1}{\alpha}\right)\ln\left(\frac{1}{1+\alpha\exp(x_i'\beta)}\right) + y_i\ln\,[1 - \frac{1}{1+\alpha\exp(x_i'\beta)}\Bigg\} \end{aligned} \quad \text{(A.2)}$$

Using this estimation framework, the regression equations take the following general form:

$$\begin{aligned} Instability_{i,t} &= \beta_1 Pt.Source\ PI_{i,t-1} + \beta_2\ Diffuse\ PI_{i,t-1} + \alpha' Controls_{i,t-1} + \beta_0 \\ &\quad + v_{it} \end{aligned} \quad \text{(A.3)}$$

where Instability is one of the instability count variables listed in Table 2. The first two right hand side variables are the point source and diffuse commodity price indexes that are unique to each country and year. $Controls_{i,t-1}$ is a vector containing the control variables discussed in Section 4.4 .

Appendix 4
Summary Statistics of Instability Variables in Count Model

Variable	Total Events	Non-Zero Country Years	Mean	Std. Dev.	Min	Max
Anti-Govt. Demonstrations	687	333	0.599	1.291	0	15
Govt. Crises	357	253	0.312	0.712	0	7
Riots	689	358	0.601	1.280	0	15
Strikes	372	237	0.325	0.837	0	13

Note: All variables have 1146 observations