

Estimating How the Level and Volatility of Food Prices Shape Social Unrest in the Developing World, 1990-2011

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In the 20 years since the Food and Agriculture Organization (FAO) of the United Nations has been recording food prices, the food price index has never been as high as it was at the end of 2010/beginning of 2011 (FAO, 2011).

In 2000, the index averaged 90. In 2010, it averaged 185.

The food price index currently stands at 216, i.e., close to food price levels experienced during the food crisis of 2007-08.



















Food price volatility (i.e., unexpected departures from the food price level, holding the price level constant; the "noise" around the level) has also been on the rise (FAO, 2010).

Episodes of extreme price volatility are rare, but there is always a certain amount of uncertainty over future prices.

(Note: I use the terms "price volatility," "price uncertainty," and "price risk" interchangeably.)





(Source: FAO Economic and Social Perspectives Policy Brief #12.)



While we've understood the welfare impacts of rising food prices for a long time (Deaton, 1989), the impacts of food price volatility on welfare are not understood all that well.

In theory, producers should be price risk-averse (i.e., they dislike price volatility; Sandmo, 1970) and consumers price risk-loving (i.e., they like price volatility; Turnovsky et al., 1980).



But policy makers don't seem to know of this.

President Sarkozy: "If we don't do anything [about food price volatility], we run the risk of food riots in the poorest countries."

Brookings: "The crux of the food price challenge is about price volatility rather than high prices per se. It is the rapid and unpredictable changes in food prices that wreak havoc on markets, politics, and social stability."



Moreover, the unit of analysis in development policy is often the household, which can both produce and consume staples, and whose position *vis-à-vis* the market – net seller, autarkic, or net buyer – isn't always the same. Food prices thus have heterogeneous welfare impacts.

Finally, many people appear to conflate the twin issues of rising food prices and food price volatility. But food price volatility really measures both upward *and downward* changes over a given time period.



An example might be helpful.

Suppose the price of rice is \$5/kg today, but there is uncertainty as to what rice will cost next month, and I expect the price of rice to be anywhere between \$4 and \$6 but on average \$5/kg.

If my belief changes and I now expect the price of rice to be anywhere between \$3 and \$7 but on average \$5/kg, that is an increase in rice price *volatility*.



Suppose instead that the price of rice is \$5/kg today, but there is uncertainty as to what rice will cost next month, and I expect the price of rice to be anywhere between \$4 and \$6 but on average \$5/kg.

If my belief changes and I now expect the price of rice to be anywhere between \$4 and \$6 but on average \$5.50/kg, that is an increase in the rice price *level*. The goal of this paper is to investigate the different effects of each measure (level and volatility) on social unrest.



Indeed, knowing where to best spend each aid dollar – toward curbing rising food prices, food price volatility, or both – matters for policy.

This is especially important in this era of budget austerity...

... and of possible "foreign aid starting at zero."





Outline

- 1. Framing the Issue
- 2. Historical Evidence on Food Riots
- 3. Methodology
 - a) Data
 - b) Estimation Strategy
 - c) Identification Strategy
- 3. Key Findings
- 4. Policy Implications



Food riots have been frequent throughout history and are thought to have brought about the French Revolution (Rudé, 1964), the fall of the Confederacy (Smith, 2011), the Russian Revolution (Wade, 2005), and the fall of the British Raj in India (Arnold, 1979).

Rudé documents several instances of food riots in France and England between 1730 and 1848. He also notes how food riots usually occur after bad harvests and natural disasters.



In France, food riots were not political in nature until the Revolution.

Rather, rioters targeted farmers, merchants, and traders in order to decrease food prices ("taxation populaire").

In England, Rudé notes that two thirds of the 275 disturbances between 1733 and 1800 were food riots. Food riots tended to break out more often in the food-importing north and west of the country.



Walton and Seddon (1994) document study the "IMF riots" that took place between 1970 and the early 1990s.

There were 146 food riots across 39 countries in response to the IMF's austerity policies between 1976 and 1992.

Although the "classical" food riots studied by Rudé largely took place in the countryside, the modern food riots studied by Walton and Seddon took place almost exclusively in cities.



It is still too early to tell the story of the recent spate of food riots, but Schneider (2008) provides an overview of the riots that took place in 2008.

Likewise, Bush (2010) foretells the riots in North Africa and the Middle East.

Lastly, Arezki and Brückner (2011) also look at the impact of food prices on food riots, but they adopt a different identification strategy and ignore price volatility. More on this in a minute.



Methodology: Data

In order to study the impact of food prices – both rising food prices and food price volatility – on social unrest, one needs data on food prices and social unrest.

Data on food prices are readily available from the FAO, which has recorded its monthly food price index – disaggregated in five categories – since January 1990, in both real and nominal terms.



Methodology: Data

It is trickier to find data on social unrest.

The PRS Group publishes its International Country Risk Guide (ICRG) data, which measures a number of governancerelated indicators for each country at the annual level.

Although Arezki and Brückner (2011) use these data to study the relationship between food prices and food riots, annual data mask too much heterogeneity – prices can fluctuate a lot over 12 months.



Methodology: Data

I use LexisNexis to construct a monthly count of the number of news stories in the English media involving at least five occurrences of the terms "cereal," "commodity," "food," "grain," or "staple," and their plural forms, and at least five occurrences of the terms "demonstration," "mob," "protest," "riot," "strike," "unrest" or "violence" and their plural forms.

(Note: All empirical results are robust to a restricted dependent variable that only counts news stories involving at least five occurrences of the terms "food" and its plural, and at least five occurrences of the term "riot" and its plural.)



The major methodological issue is that finding a correlation between food prices and social unrest does not mean that there is a causal relationship flowing from food prices to social unrest.

The causal relationship could also flow the other way, from social unrest to food prices. Or the dependent variable could be measured with error – the media may be on the lookout for stories about food riots when food prices rise.

In other words, correlation does not imply causation.



One way to deal with this problem is to find a suitable instrumental variable (IV). That is, a variable that explains food prices, but which is unrelated to social unrest and only affects social unrest through food prices.

The most convincing IVs usually involve randomizing the variable of interest, but this is clearly not possible in this case.

I thus condition food prices on natural disasters (drought, extreme temperature, floods, insect infestations, storms, volcanic eruptions, and wildfires).



It is easy to test whether natural disasters affect food prices.

It is more difficult to argue that natural disasters only affect social unrest through food prices.

The full argument is in the paper, but in short: within a given month, natural disasters are unpredictable, and given the short time scale, they should only affect social unrest through food prices.



The identification strategy is helped by the geographical dispersion of the data – the data used here are worldwide.

What typically happens in the data is that a natural disaster occurs in country A, which has impacts on the price of food worldwide, which affects social unrest in countries B, C, ...

Thus, food prices are essentially the only channel through which natural disasters affect social unrest, since the two are highly unlikely to occur in the same country in the same month.



The natural disasters data come from the Center for Research on the Epidemiology of Disasters (CRED) EM-DAT data set, which records natural disasters worldwide. An event is classified as a disaster if

- 1. At least 100 people die;
- 2. At least 100 people require immediate assistance, are displaced, or evacuated;
- 3. Public officials declare a state of emergency; or
- 4. Public officials call for international assistance.



Methodology: Estimation Strategy

The equation to be estimated in this case is

$$\mathbf{y}_{t} = \alpha_{1} + \beta_{1f} f_{t} + \beta_{1\sigma} \sigma_{t} + \beta_{1y} \mathbf{y}_{t-1} + \beta_{1m} m_{t} + \beta_{1\tau} \tau_{t} + \varepsilon_{1t}$$

where

y_t denotes social unrest,

- f_{t} denotes the food price level,
- $\sigma_{\rm t}$ denotes three-month food price volatility,

 y_{t-1} denotes social unrest in t – 1,

- $m_{\rm t}$ is a vector of month dummies,
- $au_{
 m t}$ is a trend, and
- ε is the mean-zero error term.



Methodology: Estimation Strategy

Durbin-Watson tests show that the error term is not serially correlated.

Dickey-Fuller tests indicate that one can reject the presence of a unit root in the dependent variable and in the instrumental variable. This is not the case for the food price index, but Wang and Tomek (2007) show that food prices do not exhibit a unit root once structural breaks are accounted for.

For these reasons, the core equation is estimated in levels by ordinary least squares (OLS) and two-stage least squares (IV).

Variable	Mean	(Std. Dev.)	Observations
Dependent Variable			
Count of News Stories	69.29	(55.09)	253
Food Prices			
Food Price Index	112.68	(21.96)	253
Cereals Price Index	111.88	(30.44)	253
Food Price Three-Month Volatility	2.23	(2.25)	251
Food Price Six-Month Volatility	3.63	(3.70)	251
Cereals Price Three-Month Volatility	3.06	(3.23)	248
Cereals Price Six-Month Volatility	5.22	(5.08)	248
Natural Disasters			
Drought	1.15	(1.27)	253
Extreme Temperature	1.34	(2.34)	253
Floods	10.97	(6.06)	253
Insect Infestations	0.11	(0.57)	253
Storms	8.06	(4.74)	253
Volcanic Eruptions	0.47	(0.70)	253
Wildfires	0.99	(1.34)	253
Count of Natural Disasters	23.09	(9.45)	253

Table 1. Descriptive Statistics, January 1990 to January 2011

Note: All price figures are in real terms.



Figure 1. Food Price Index, Three-Month Food Price Volatility, and Political Unrest, January 1990 to January 2011.

		OLS	2	14			
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	
	Dependent V	Variab	le: Count of I	News Stories I	nvolvin	g Food Riots	
Food Price	0.656	***	(0.151)				
Food Price Three-Month Volatility	-2.064	*	(1.243)				
Cereals Price				0.614	***	(0.113)	
Cereals Price Three-Month Volatility	\prec		>	-2.889	***	(0.812)	
Count of News Stories in t - 1	0.303	***	(0.063)	0.282	***	(0.062)	
Trend	0.292	***	(0.046)	0.300	***	(0.045)	
Intercept	-56.901	***	(15.646)	-47.759	***	(12.238)	
Number of Observations		251			251		
Monthly Dummies		Yes			Yes		
p-value (Joint Significance)		0.00			0.00		
Durbin-Watson Statistic		2.00			1.96		
R-square	0	0.65			0.66		

Table 2a. OLS Estimation Results for the Determinants of Political Unrest, 1990-2011.

Note: The symbols ***, **, and * respectively denote statistical significance at the 1, 5, and 10 percent levels. With respect to the full sample of 253 observations, two observations are lost because food price three-month volatility is calculated using food prices in t, t - 1, and t - 2. The Durbin-Watson statistic is used to assess whether the error term is serially correlated.

		OLS		-			
Variable	Coefficient		(Std. Err.)	Coefficient	vo	(Std. Err.)	
	Dependent	Variab	le: Count of I	News Stories I	nvolvin	ig Food Riots	
Food Price	0.656	***	(0.151)	$\left(\right)$			
Food Price Three-Month Volatility	-2.064	*	(1.243)				
Cereals Price				0.614	***	(0.113)	
Cereals Price Three-Month Volatility				-2.889	***	(0.812)	
Count of News Stories in t - 1	0.303	***	(0.063)	0.282	***	(0.062)	
Trend	0.292	***	(0.046)	0.300	***	(0.045)	
Intercept	-56.901	***	(15.646)	-47.759	***	(12.238)	
Number of Observations		251			251		
Monthly Dummies		Yes			Yes		
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	(1) First Stage: Food Price			Seco	(2) ond Sta	ge:	Fi	e:	(4) Second Stage: Count of News Stories			
				Count o	Stories	Cer	eal Pri	ce				
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient	· · · ·	(Std. Err.)	Coefficient		(Std. Err.)
Food Price	(<u> </u>		1.305	*	(0.520)						
Food Price Three-Month Volatility	3.977	***	(0.444)	-4.965	*	(2.564)						
Cereals Price										0.905	***	(0.324)
Cereals Price Three-Month Volatility							4.234	***	(0.346)	-4.200	***	(1.595)
Count of News Stories in t - 1	0.119	***	(0.025)	0.222	**	(0.090)	0.163	***	(0.032)	0.231	***	(0.082)
Trend	0.116	***	(0.021)	0.249	***	(0.058)	0.147	***	(0.027)	0.278	***	(0.051)
Count of Natural Disasters	-0.638	***	(0.132)				-0.964	***	(0.166)			
Intercept	100.122	. *** .	(4.330)	-113.781	*	(46.381)	98.782	***	(5.462)	-71.122	***	(27.321)
Number of Observations			2	51					2	251		
Monthly Dummies			Y	es					1	Yes		
p-value (Joint Significance)			0.	00					0	00.		
F-statistic (Instrument)			23	.43					3.	3.52		
R-square			0.	63					C	.65		

Table 2b. IV Estimation Results for the Determinants of Political Unrest, 1990-2011.

Note: The symbols ***, **, and * respectively denote statistical significance at the 1, 5, and 10 percent levels. With respect to the full sample of 253 observations, two observations are lost because food price three-month volatility is calculated using food prices in t, t - 1, and t - 2. The *F*-statistic is used to assess whether the instrumental variable is weak (Stock and Yogo, 2002).

Table 2b. IV Estimation Results for the Determinants of Political Unrest, 1990-2011.

	(1) First Stage:			Sec	(2) ond Sta	ge:	Fin	e:	(4) Second Stage:				
Variable	Coefficient	ood Pric	(Std. Err.)	Count o	f News	Stories (Std. Err.)	Cer Coefficient	real Pri	ce (Std. Err.)	Count o	f News	Stories (Std. Err.)	
Food Price	-			1.305	*	(0.520)							
Food Price Three-Month Volatility	3.977	***	(0.444)	-4.965	*	(2.564)							
Cereals Price										0.905	***	(0.324)	
Cereals Price Three-Month Volatility				Į		5	4.234	***	(0.346)	-4.200	***	(1.595)	
Count of News Stories in t - 1	0.119	***	(0.025)	0.222	**	(0.090)	0.163	***	(0.032)	0.231	***	(0.082)	
Trend	0.116	***	(0.021)	0.249	***	(0.058)	0.147	***	(0.027)	0.278	***	(0.051)	
Count of Natural Disasters	-0.638	***	(0.132)				-0.964	***	(0.166)				
Intercept	100.122	***	(4.330)	-113.781	*	(46.381)	98.782	***	(5.462)	-71.122	***	(27.321)	
Number of Observations			25	51					2	251			
Monthly Dummies			Y	es					3	l'es			
p-value (Joint Significance)			0.	00			0.00						
F-statistic (Instrument)			23	43					3.	3.52			
R-square			0.	63					0	.65			

Note: The symbols ***, **, and * respectively denote statistical significance at the 1, 5, and 10 percent levels. With respect to the full sample of 253 observations, two observations are lost because food price three-month volatility is calculated using food prices in t, t - 1, and t - 2. The F-statistic is used to assess whether the instrumental variable is weak (Stock and Yogo, 2002).

Table 2b. IV Estimation Results for the Determinants of Political Unrest, 1990	-2011
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	(1) First Stage: Food Price			Sec	(2) ond Sta	σe:	Fir	(3) st Stag	e:	(4) Second Stage:			
				Count o	Stories	Cer	eal Pri	ice	Count of News Stories				
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient	it 11-10	(Std. Err.)	
Food Price				1.305	*	(0.520)	(>				
Food Price Three-Month Volatility	3.977	***	(0.444)	-4.965	*	(2.564)							
Cereals Price										0.905	***	(0.324)	
Cereals Price Three-Month Volatility							4.234	***	(0.346)	-4.200	***	(1.595)	
Count of News Stories in t - 1	0.119	***	(0.025)	0.222	**	(0.090)	0.163	***	(0.032)	0.231	***	(0.082)	
Trend	0.116	***	(0.021)	0.249	***	(0.058)	0.147	***	(0.027)	0.278	***	(0.051)	
Count of Natural Disasters	-0.638	***	(0.132)				-0.964	***	(0.166)				
Intercept	100.122	***	(4.330)	-113.781	*	(46.381)	98.782	***	(5.462)	-71.122	***	(27.321)	
Number of Observations			25	51					2	251			
Monthly Dummies			Y	es					3	7es			
p-value (Joint Significance)			0.	00					0	.00			
F-statistic (Instrument)			23	.43					33	3.52			
<i>R</i> -square			0.	63					0	.65			

Note: The symbols ***, **, and * respectively denote statistical significance at the 1, 5, and 10 percent levels. With respect to the full sample of 253 observations, two observations are lost because food price three-month volatility is calculated using food prices in t, t - 1, and t - 2. The *F*-statistic is used to assess whether the instrumental variable is weak (Stock and Yogo, 2002).
	Fi	(1) rst Stag	e:	Sec	(2) ond Sta	ige:	Fi	(3) rst Stag	e:	Sec	(4) ond Sta	ige:
	F	ood Prie	ce	Count o	f News	Stories	Cei	real Pri	ce	Count o	f News	Stories
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
Food Price				1.305	*	(0.520)				(
Food Price Three-Month Volatility	3.977	***	(0.444)	-4.965	*	(2.564)						
Cereals Price										0.905	***	(0.324)
Cereals Price Three-Month Volatility							4.234	***	(0.346)	-4.200	***	(1.595)
Count of News Stories in t - 1	0.119	***	(0.025)	0.222	**	(0.090)	0.163	***	(0.032)	0.231	***	(0.082)
Trend	0.116	***	(0.021)	0.249	***	(0.058)	0.147	***	(0.027)	0.278	***	(0.051)
Count of Natural Disasters	-0.638	***	(0.132)				-0.964	***	(0.166)			
Intercept	100.122	***	(4.330)	-113.781	*	(46.381)	98.782	***	(5.462)	-71.122	***	(27.321)
Number of Observations			2	51					2	251		
Monthly Dummies			Y	es					1	Yes		
p-value (Joint Significance)			0.	00					0	00.00		
F-statistic (Instrument)			23	.43					3.	3.52		
R-square			0.	63					0	0.65		

Table 2b. IV Estimation Results for the Determinants of Political Unrest, 1990-2011.

	-	IV	2		IV	
Variable	Coefficient		(Std. Err.)	Coefficient	-	(Std. Err.)
Dependent Varial	ole: Count of N	News S	tories Involvi	ng Food Riots		 3D 102
Food Price	1.283	**	(0.523)			
Food Price Three-Month Volatility	-5.012	**	(2.529)			
Cereals Price				0.890	***	(0.331)
Cereals Price Three-Month Volatility				-4.182	***	(1.602)
Count of News Stories in t - 1	0.201	**	(0.086)	0.214	***	(0.079)
Count of News Stories in t - 2	0.042		(0.076)	0.034		(0.074)
Count of News Stories in t - 3	0.038		(0.069)	0.036		(0.067)
Trend	0.221	***	(0.060)	0.254	***	(0.054)
Intercept	-111.777	**	(46.700)	-70.003	**	(27.893)
Number of Observations		250			250	
Monthly Dummies		Yes			Yes	
p-value (Joint Significance)		0.00			0.00	
F-statistic (Instrument)		23.43			33.18	
R-square		0.63			0.66	

Table 3. IV Estimation Results for Robustness Checks on the Determinants of Political Unrest Using Quarterly News, 1990-2011.

Note: The symbols ***, **, and * respectively denote statistical significance at the 1, 5, and 10 percent levels. With respect to the full sample of 250 observations, three observations are lost because of the use of the dependent variable in t - 1, t - 2, and t - 3 as regressors. The *F*-statistic is used to assess whether the instrumental variable is weak (Stock and Yogo, 2002).

		IV	~		IV	
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
Dependent Varia	ble: Count of N	vews S	tories Involvi	ng Food Riots		
Food Price	1.283	**	(0.523)	$\left(\right)$		
Food Price Three-Month Volatility	-5.012	**	(2.529)			
Cereals Price				0.890	***	(0.331)
Cereals Price Three-Month Volatility				-4.182	***	(1.602)
Count of News Stories in t - 1	0.201	**	(0.086)	0.214	***	(0.079)
Count of News Stories in t - 2	0.042		(0.076)	0.034		(0.074)
Count of News Stories in t - 3	0.038		(0.069)	0.036		(0.067)
Trend	0.221	***	(0.060)	0.254	***	(0.054)
Intercept	-111.777	**	(46.700)	-70.003	**	(27.893)
Number of Observations		250			250	
Monthly Dummies		Yes			Yes	
p-value (Joint Significance)		0.00			0.00	
F-statistic (Instrument)		23.43			33.18	
R-square		0.63			0.66	

Table 3. IV Estimation Results for Robustness Checks on the Determinants of Political Unrest Using Quarterly News, 1990-2011.

Note: The symbols ***, **, and * respectively denote statistical significance at the 1, 5, and 10 percent levels. With respect to the full sample of 250 observations, three observations are lost because of the use of the dependent variable in t - 1, t - 2, and t - 3 as regressors. The *F*-statistic is used to assess whether the instrumental variable is weak (Stock and Yogo, 2002).

Variable	Coefficient		(Std. Err.)	Coefficient	*	(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
				Dependent V	ariabl	e: Count of N	ews Stories In	ivolvin	g Food Riots			
Food Price	1.314	**	(0.512)				1.422	**	(0.651)			
Food Price Three-Month Volatility	-6.241	***	(2.254)				-5.221	*	(2.838)			
Cereals Price				0.881	***	(0.331)				0.827	**	(0.339)
Cereals Price Three-Month Volatility				<mark>-4</mark> .846	***	(1.358)				-3.960	**	(1.628)
Count of News Stories in t - 1	0.155	**	(0.081)	0.1752798	**	(0.072)	0.212	**	(0.099)	0.241	***	(0.083)
Trend	0.271	***	(0.062)	0.301	***	(0.056)	0.252	***	(0.057)	0.274	***	(0.050)
2008 Dummy	30.847	**	(15.907)	28.794		(17.842)						
2010-2011 Dummy							- <mark>13</mark> .913		(19.317)	12.648		(11.066)
Intercept	-112.232	**	(46.435)	-67.297	**	(28.634)	-125.066	**	(58.891)	-64.061	**	(28.718)
Number of Observations		251			251			251			251	
Monthly Dummies		Yes			Yes			Yes			Yes	
p-value (Joint Significance)		0.00			0.00			0.00			0.00	
F-statistic (Instrument)		24.90			36.12			16.89			30.14	
<i>R</i> -square		0.63			0.66	8		0.61		3	0.66	

Table 4. IV Estimation Results for Robustness Checks on the Determinants of Political Unrest Controlling for Food Crises, 1990-2011.

Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
				Dependent V	ariabl	e: Count of N	ews Stories In	volvin	g Food Riots			
Food Price	1.314	**	(0.512)				1.422	**	(0.651)			
Food Price Three-Month Volatility	-6.241	***	(2.254)				-5.221	*	(2.838)			
Cereals Price				0.881	***	(0.331)				0.827	**	(0.339)
Cereals Price Three-Month Volatility				<mark>-4</mark> .846	***	(1.358))			-3.960	**	(1.628)
Count of News Stories in t - 1	0.155	**	(0.081)	0.1752798	**	(0.072)	0.212	**	(0.099)	0.241	***	(0.083)
Trend	0.271	***	(0.062)	0.301	***	(0.056)	0.252	***	(0.057)	0.274	***	(0.050)
2008 Dummy	30.847	**	(15.907)	28.794		(17.842)	0.04.000					
2010-2011 Dummy							-13.913		(19.317)	12.648		(11.066)
Intercept	-112.232	**	(46.435)	-67.297	**	(28.634)	-125.066	**	(58.891)	-64.061	**	(28.718)
Number of Observations		251			251			251			251	
Monthly Dummies		Yes			Yes			Yes			Yes	
p-value (Joint Significance)		0.00			0.00			0.00			0.00	
F-statistic (Instrument)		24.90			36.12			16.89			30.14	
R-square	24	0.63		8	0.66			0.61		S.	0.66	

Table 4. IV Estimation Results for Robustness Checks on the Determinants of Political Unrest Controlling for Food Crises, 1990-2011.

		OLS			OLS			IV			IV	
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
				Dependent Va	ariable	Count of Ne	ews Stories In	volving	Food Riots			
Food Price	0.521	***	(0.127)				0.951	**	(0.385)			
Cereals Price				0.363	***	(0.090)				0.687	**	(0.279)
Count of News Stories in t - 1	0.317	***	(0.063)	0.316	***	(0.063)	0.258	***	(0.081)	0.253	***	(0.083)
Trend	0.285	***	(0.046)	0.292	***	(0.045)	0.237	***	(0.062)	0.246	***	(0.059)
Intercept	-46.598	***	(14.378)	-29.621	***	(11.373)	-86.449	**	(36.623)	-57.442	**	(25.465)
Number of Observations		252			252		9 - 9	252			252	
Monthly Dummies		Yes			Yes			Yes			Yes	
p-value (Joint Significance)		0.00			0.00			0.00			0.00	
F-statistic (Instrument)		12			-			30.36			29.05	
R-square		0.65		*	0.65			0.63	Ct - 1302001		0.63	

Table 5. OLS and IV Estimation Results for Robustness Checks on the Determinants of Political Unrest Omitting Price Volatility, 1990-2011.

Note: The symbols ***, **, and * respectively denote statistical significance at the 1, 5, and 10 percent levels. With respect to the full sample of 253 observations, one observations is lost because of the use of the dependent variable in t - 1 as a regressor. The *F*-statistic is used to assess whether the instrumental variable is weak (Stock and Yogo, 2002).

		OLS			OLS			IV			IV	
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
				Dependent Va	ariable	: Count of N	ews Stories In	volving	Food Riots	<u></u>		
Food Price	0.521	***	(0.127)				0.951	**	(0.385)			
Cereals Price				0.363	***	(0.090)				0.687	**	(0.279)
Count of News Stories in t - 1	0.317	***	(0.063)	0.316	***	(0.063)	0.258	***	(0.081) ≺	0.253	***	(0.083)
Trend	0.285	***	(0.046)	0.292	***	(0.045)	0.237	***	(0.062)	0.246	***	(0.059)
Intercept	-46.598	***	(14.378)	-29.621	***	(11.373)	-86.449	**	(36.623)	-57.442	**	(25.465)
Number of Observations		252			252			252			252	
Monthly Dummies		Yes			Yes			Yes			Yes	
p-value (Joint Significance)		0.00			0.00			0.00			0.00	
F-statistic (Instrument)		62			-			30.36			29,05	
R-square		0.65		*	0.65		4.15 State	0.63	0. 30304	the state of the	0.63	N.

Table 5. OLS and IV Estimation Results for Robustness Checks on the Determinants of Political Unrest Omitting Price Volatility, 1990-2011.

Note: The symbols ***, **, and * respectively denote statistical significance at the 1, 5, and 10 percent levels. With respect to the full sample of 253 observations, one observations is lost because of the use of the dependent variable in t - 1 as a regressor. The *F*-statistic is used to assess whether the instrumental variable is weak (Stock and Yogo, 2002).

-		OLS			OLS	
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
	Dependent V	Variabl	e: Count of N	ews Stories Inv	olving	Food Riots
Food Price Three-Month Volatility	0.867		(1.085)			
Cereals Price Three-Month Volatility				-0.117		(0.670)
Count of News Stories in $t - 1$ \prec	0.057	***	(0.063)	0.388	***	(0.063)
Trend	0.335	***	(0.047)	0.346	***	(0.046)
Intercept	0.5703381	63 B	(8.727)	1.621		(8.700)
Number of Observations		251	-		251	
Monthly Dummies		Yes			Yes	
p-value (Joint Significance)		0.00			0.00	
R-square		0.62			0.62	~ ~

Table 6. OLS Estimation Results for Robustness Checks on the Determinants of Political Unrest Omitting Price Levels, 1990-2011.

Note: The symbols ***, **, and * respectively denote statistical significance at the 1, 5, and 10 percent levels. With respect to the full sample of 253 observations, two observations are lost because food price three-month volatility is calculated using food prices in t, t - 1, and t - 2.

		OLS				
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
	Dependent V	/ariabl	e: Count of N	lews Stories In	volving	g Food Riots
Food Price Three-Month Volatility	0.867		(1.085)	$\left(\right)$		
Cereals Price Three-Month Volatility				-0.117		(0.670)
Count of News Stories in t - 1	0.057	***	(0.063)	0.388	***	(0.063)
Trend	0.335	***	(0.047)	0.346	***	(0.046)
Intercept	0.5703381	13 B	(8.727)	1.621	63 - 83	(8.700)
Number of Observations		251			251	
Monthly Dummies		Yes			Yes	
p-value (Joint Significance)		0.00			0.00	
R-square		0.62			0.62	

Table 6. OLS Estimation Results for Robustness Checks on the Determinants of Political Unrest Omitting Price Levels, 1990-2011.

Note: The symbols ***, **, and * respectively denote statistical significance at the 1, 5, and 10 percent levels. With respect to the full sample of 253 observations, two observations are lost because food price three-month volatility is calculated using food prices in t, t - 1, and t - 2.



Key Findings

This suggests that rising food prices cause food riots.

Consistent with this, Hsiang et al. (2011) recently found a correlation between El Niño Southern Oscillation cycles and conflict.

Food price volatility, however, is associated with *decreases* in social unrest. What does this mean?



Key Findings

First off, this cannot be argued to be causal, so it is worth asking whether there exists other evidence on that.

The price volatility finding is consistent with evidence at the micro level looking at the impact of commodity price volatility on rural households in Ethiopia (Bellemare et al., 2011).



Figure 1: Fractional polynomial regression of household WTP to eliminate price volatility among seven staple commodities on household income for households whose seasonal income does not exceed 10,000 birr.

(Source: Bellemare et al., 2011)



Key Findings

The intuition behind the volatility finding is as follows. Holding the price level constant, increases in volatility affect producers negatively – they must sink resources into production well ahead of realized prices (Baron, 1970; Sandmo, 1971), which leads to sub-optimal profit maximization decisions.

Consumers, however, can change their consumption bundle until the very last minute to enjoy relative price discounts when showing up at market. In technical terms, this is because of the quasiconvexity of the indirect utility function.



Key Findings

But food consumers vastly outnumber food producers – especially in cities, where proximity between individuals makes them more likely to organize into mobs – so it is perhaps no surprise that increases in food price volatility are associated with decreases in the level of social unrest.

The findings are robust to controlling for quarterly news; to controlling for food crises; to omitting food price volatility; to alternative definitions of the IV that progressively omit some types of natural disasters; etc.



The first policy implication is that if we want to avoid food riots, we should work toward curbing food price increases. This is something we can be relatively confident in.

In addition, it appears that the focus on food price volatility is misguided.

Indeed, according to my estimates, food price volatility actually appears to *reduce* the incidence of food riots.



On the basis of preliminary estimates, Chris Barrett and I published the following piece in July:



Published by the Council on Foreign Relations

July 12, 2011 SNAPSHOT

Why Food Price Volatility Doesn't Matter

Policymakers Should Focus on Bringing Costs Down

You can probably guess some of the reactions to our title.



Keeping food prices low and letting volatility do its thing has negative consequences for one group, however: food producers.

Typically, food producers have a lot more political clout than food consumers. This is especially true in industrialized countries, where producers are organized into lobbies and reside in political districts that may exert too much political power relative to their size.



It looks as though two things might be happening. First, policy makers could be really confused about the different impacts of rising food prices and food price volatility.



Price volatility makes both smallholder farmers and poor consumers increasingly vulnerable to poverty. Because food represents a large share of farmer income and the budget of poor consumers, large price changes have large effects on real incomes. Thus, even short episodes of high prices for consumers or low prices for farmers can cause productive assets – land and livestock, for example – to be sold at low prices, leading to potential poverty traps. In addition, smallholder farmers are less likely to invest in measures to raise productivity when price changes are unpredictable.

Source: FAO (2011), The State of Food Insecurity in the World.



Second, policy makers may simply be responding to their constituents and to lobbies. By emphasizing the "negative" impacts of food price volatility, they may be playing right into the hands of farm lobbies.

In light of the results in this paper, this topic – the political economy of food prices – deserves further investigation, similarly to Bates (1981).

Likewise, the anatomy of food riots deserves further investigation – the relevant costs and benefits that push people into taking to the streets.



Appendix

Table A1. OLS Estimation Results for the Reduced Form Relationship between Natural Disasters and Political Unrest, 1990-2011.

Variable	Coefficient	(Std. Err.)			
Dependent Variable: Count	of News Stories Involving Foo	od Riots			
Count of Natural Disasters	1.522 ***	(0.355)			
Intercept	34.142 ***	(8.857)			
Number of Observations	253				
p-value (Joint Significance)	0.01				
<i>R</i> -square	0.07				

10 percent levels.

	IV Inclu Extreme Floods, In an	roughts, erature, festations, ns	IV Incl Extreme Te and Ins	roughts, ture, Floods, estations	IV Incl Extrem at	(3) udes Di e Temp id Floo	roughts, perature, ds	(4) IV Includes Droughts and Floods				
Variable	Coefficient		(Std. Err.)	Coefficient	•	(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
				Dependent	Varial	ole: Count of l	News Stories I	nvolvir	g Food Riots	5		
Food Price	1.562	***	(0.582)	1.455	**	(0.598)	1.403	**	(0.604)	1.454	**	(0.605)
Food Price Three-Month Volatility	-6.115	**	(2.832)	-5.634	*	(2.891)	-5. <mark>40</mark> 4	*	(2.917)	-5.631	*	(2.922)
Count of News Stories in t - 1	0.190	*	(0.098)	0.203	**	(0.098)	0.210	**	(0.099)	0.203	**	(0.099)
Trend	0.232	***	(0.062)	0.239	***	(0.062)	0.242	***	(0.062)	0.239	***	(0.062)
Intercept	-136.334	***	(51.766)	-126.908	**	(53.121)	-122.395	**	(53.703)	-126.847	**	(53.762)
Number of Observations	**	251			251			251			251	
Monthly Dummies		Yes			Yes			Yes			Yes	
p-value (Joint Significance)		0.00			0.00			0.00			0.00	
F-statistic (Instrument)		19.71			17.98			17.31			17.47	
R-square	St.	0.60		2	0.61			0.61		24	0.61	

	IV Inclu Extreme Floods, In and	(1) Ides Dr Temp sect In d Storr	oughts, erature, festations, ns	IV Inch Extreme Te and Ins	(2) udes D mpera ect Infe	roughts, ture, Floods, estations	IV Incl Extrem at	(3) udes D e Temp nd Floo	roughts, oerature, ods	(4) IV Includes Droughts and Floods		
Variable	Coefficient		(Std. Err.)	Coefficient	•	(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
				Dependent	Varial	ble: Count of l	News Stories I	nvolvin	ng Food Riot	s		
Food Price	1.562	***	(0.582)	1.455	**	(0.598)	1.403	**	(0.604)	1.454	**	(0.605)
Food Price Three-Month Volatility	-6.115	**	(2.832)	-5.634	*	(2.891)	-5. <mark>40</mark> 4	*	(2.917)	-5.631	*	(2.922)
Count of News Stories in t - 1	0.190	*	(0.098)	0.203	**	(0.098)	0.210	**	(0.099)	0.203	**	(0.099)
Trend	0.232	***	(0.062)	0.239	***	(0.062)	0.242	***	(0.062)	0.239	***	(0.062)
Intercept	-136.334	***	(51.766)	-126.908	**	(53.121)	-122.395	**	(53.703)	-126.847	**	(53.762)
Number of Observations		251			251			251			251	
Monthly Dummies		Yes			Yes			Yes			Yes	
p-value (Joint Significance)		0.00			0.00			0.00			0.00	
F-statistic (Instrument)		19.71			17.98			17.31			17.47	
R-square	8	0.60		2	0.61			0.61		14	0.61	

	IV Inclu Extreme Floods, In an	(1) Ides Di Temp sect In d Stori	oughts, erature, festations, ns	IV Inch Extreme Te and Ins	roughts, ture, Floods, estations	IV Incl Extrem at	(3) udes D e Temp nd Floo	roughts, berature, bds	(4) IV Includes Droughts and Floods			
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
				Dependent	Varial	ole: Count of I	News Stories I	nvolvin	ng Food Riot	s		
Food Price	1.562	***	(0.582)	1.455	**	(0.598)	1.403	**	(0.604)	1.454	**	(0.605)
Food Price Three-Month Volatility	-6.115	**	(2.832)	-5.634	*	(2.891)	-5. <mark>40</mark> 4	*	(2.917)	-5.631	*	(2.922)
Count of News Stories in t - 1	0.190	*	(0.098)	0.203	**	(0.098)	0.210	**	(0.099)	0.203	**	(0.099)
Trend	0.232	***	(0.062)	0.239	***	(0.062)	0.242	***	(0.062)	0.239	***	(0.062)
Intercept	-136.334	***	(51.766)	-126.908	**	(53.121)	-122.395	**	(53.703)	-126.847	**	(53.762)
Number of Observations		251			251			251			251	
Monthly Dummies		Yes			Yes			Yes			Yes	
p-value (Joint Significance)		0.00			0.00			0.00			0.00	
F-statistic (Instrument)		19.71		17.98			17.31			17.47		
R-square		0.60		0.61			0.61			0.61		

	IV Inclu Extreme Floods, In and	(1) des Dr Temp sect In d Storr	roughts, erature, festations, ns	(2) IV Includes Droughts, Extreme Temperature, Floods, and Insect Infestations			IV Incl Extrem ar	(3) udes D e Temp id Floo	roughts, perature, ods		oughts s	
Variable	Coefficient		(Std. Err.)	Coefficient	(Std. Err.)		Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
				Dependent	Varial	ole: Count of	News Stories I	nvolvin	ng Food Riot	s		
Food Price	1.562	***	(0.582)	1.455	**	(0.598)	1.403	**	(0.604)	1.454	**	(0.605)
Food Price Three-Month Volatility	-6.115	**	(2.832)	-5.634	*	(2.891)	-5. <mark>40</mark> 4	*	(2.917)	-5.6	31 *	(2.922)
Count of News Stories in t - 1	0.190	*	(0.098)	0.203	**	(0.098)	0.210	**	(0.099)	0.20)3 **	(0.099)
Trend	0.232	***	(0.062)	0.239	***	(0.062)	0.242	***	(0.062)	0.23	39 ***	(0.062)
Intercept	-136.334	***	(51.766)	-126.908	**	(53.121)	-122.395	**	(53.703)	-126.84	17 **	(53.762)
Number of Observations		251			251			251			251	
Monthly Dummies		Yes			Yes			Yes			Yes	
p-value (Joint Significance)		0.00			0.00			0.00			0.00	
F-statistic (Instrument)		19.71			17.98			17.31			17.47	
R-square	8	0.60		0.61		0.61			0.61			

	IV Inclu Extreme Te Insect	(5) udes Dro mperatu Infesta id Storn	oughts, 1re, Floods, tions, 1s	IV Inclu Extreme Floods, and	(0) IV Includes Droughts, ≻ Extreme Temperature, Floods, and Insect Infestations				oughts, erature, ls	(8) IV Includes Droughts and Floods		
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
-				Dependent V	ariable	: Count of N	ews Stories In	volving	Food Riots			
Cereals Price	1.052	***	(0.349)	0.970	***	(0.357)	0.954	***	(0.369)	0.991	***	(0.373)
Cereals Price Three-Month Volatility	-4.865	***	(1.704)	-4.495	***	(1.736)	-4.420	**	(1.786)	-4.587	**	(1.803)
Count of News Stories in t - 1	0.206	**	(0.086)	0.220	**	(0.086)	0.223	**	(0.088)	0.217	**	(0.089)
Trend	0.267	***	(0.052)	0.274	***	(0.052)	0.275	***	(0.052)	0.272	***	(0.053)
Intercept	-82.968	***	(29.286)	-76.373	***	(29.899)	-75.047	**	(30.821)	-78.012	**	(31.133)
Number of Observations	52 St.	251			251			251			251	
Monthly Dummies		Yes			Yes			Yes			Yes	
p-value (Joint Significance)		0.00			0.00			0.00			0.00	
F-statistic (Instrument)		29.49			27.35			25.30			24.90	
<i>R</i> -square	3	0.64		8	0.65		0.65			0.65		

	IV Inclu Extreme Te Insect an	oughts, 1re, Floods, tions, 1s	IV Inclu Extreme Floods, and	oughts, erature, Infestations	IV Inclu Extreme an	(7) ides Dr Temp id Floor	oughts, erature, ds	(8) IV Includes Droughts and Floods				
Variable	Coefficient		(Std. Err.)	(Std. Coefficient Err.) Coe		Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	
-				Dependent V	ariable	: Count of N	ews Stories In	volving	Food Riots			
Cereals Price	1.052	***	(0.349)	0.970	***	(0.357)	0.954	***	(0.369)	0.991	***	(0.373)
Cereals Price Three-Month Volatility	-4.865	***	(1.704)	-4.495	***	(1.736)	-4.420	**	(1.786)	-4.587	**	(1.803)
Count of News Stories in t - 1	0.206	**	(0.086)	0.220	**	(0.086)	0.223	**	(0.088)	0.217	**	(0.089)
Trend	0.267	***	(0.052)	0.274	***	(0.052)	0.275	***	(0.052)	0.272	***	(0.053)
Intercept	-82.968	***	(29.286)	-76.373	***	(29.899)	-75.047	**	(30.821)	-78.012	**	(31.133)
Number of Observations	52 St.	251			251			251			251	
Monthly Dummies		Yes			Yes			Yes			Yes	
p-value (Joint Significance)		0.00			0.00			0.00			0.00	
F-statistic (Instrument)		29.49			27.35		25.30			24.90		
<i>R</i> -square	3	0.64		0.65		0.65			0.65			

Table A2. IV E	Estimation Results for Robustness Checks on the Detern	minants of Political Unrest Using Alternative Definitions of the
Instrumental V	Variable, 1990-2011 (Continued).	

	(5) IV Includes Droughts, Extreme Temperature, Floods, Insect Infestations, and Storms			IV Inclu Extreme Floods, and	oughts, erature, Infestations	IV Inclu Extreme an	(7) ides Di Temp id Floo	oughts, erature, ds	(8) IV Includes Droughts and Floods			
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient	<i></i>	(Std. Err.)
-				Dependent V	ariable	: Count of N	ews Stories In	volving	Food Riots			
Cereals Price	1.052	***	(0.349)	0.970	***	(0.357)	0.954	***	(0.369)	0.991	***	(0.373)
Cereals Price Three-Month Volatility	-4.865	***	(1.704)	-4.495	***	(1.736)	-4.420	**	(1.786)	-4.587	**	(1.803)
Count of News Stories in t - 1	0.206	**	(0.086)	0.220	**	(0.086)	0.223	**	(0.088)	0.217	**	(0.089)
Trend	0.267	***	(0.052)	0.274	***	(0.052)	0.275	***	(0.052)	0.272	***	(0.053)
Intercept	-82.968	***	(29.286)	-76.373	***	(29.899)	-75.047	**	(30.821)	-78.012	**	(31.133)
Number of Observations	••	251			251			251	**		251	
Monthly Dummies		Yes			Yes			Yes			Yes	
p-value (Joint Significance)		0.00			0.00			0.00			0.00	
F-statistic (Instrument)		29.49			27.35		25,30			24.90		
<i>R</i> -square	3	0.64		10	0.65	0.0		0.65		0.65		

Table A2. IV Estimation Results for Robustness Checks	on the Determinants of Political	Unrest Using Alternative Definitions of the
Instrumental Variable, 1990-2011 (Continued).		

	IV Incl Extreme Te Insect an	(5) udes Dro mperatu Infesta id Storn	oughts, 1re, Floods, tions, 1s	IV Inclu Extreme Floods, and	(6) ides Dr e Tempo Insect I	oughts, erature, infestations	IV Inclu Extreme an	(7) Ides Dr Temp Id Floo	oughts, erature, ds	(8) IV Includes Drought and Floods			
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)	Coefficient	90° -	(Std. Err.)	
				Dependent V	ariable	Count of N	ews Stories In	volving	Food Riots				
Cereals Price	1.052	***	(0.349)	0.970	***	(0.357)	0.954	***	(0.369)	0.991	***	(0.373)	
Cereals Price Three-Month Volatility	-4.865	***	(1.704)	-4.495	***	(1.736)	-4.420	**	(1.786)	-4.587	**	(1.803)	
Count of News Stories in t - 1	0.206	**	(0.086)	0.220	**	(0.086)	0.223	**	(0.088)	0.217	**	(0.089)	
Trend	0.267	***	(0.052)	0.274	***	(0.052)	0.275	***	(0.052)	0.272	***	(0.053)	
Intercept	-82.968	***	(29.286)	-76.373	***	(29.899)	-75.047	**	(30.821)	-78.012	**	(31.133)	3
Number of Observations		251			251			251			251		
Monthly Dummies		Yes			Yes			Yes			Yes		
p-value (Joint Significance)		0.00			0.00			0.00			0.00		
F-statistic (Instrument)		29.49			27.35			25.30			24.90		
<i>R</i> -square	ŝ	0.64		8	0.65	8	0.65			0.65			

	<u>.</u>	(1)			(2)	
Variable	Coefficient		(Std. EIT.)	Coefficient		(Std. Err.)
Dependent Varial	ole: Count of N	vews S	tories <mark>Involvi</mark>	ng Food Riots		- 50 - 102
Food Price	-0.658		(1.169)			
Food Price Three-Month Volatility	-2.986	**	(1.377)			
Cereals Price				-0.340		(0.685)
Cereals Price Three-Month Volatility				-2.556	*	(1.378)
Count of News Stories in t - 1	0.272	***	(0.065)	0.284	***	(0.064)
Trend	0.317	***	(0.048)	0.313	***	(0.046)
Food Price in t - 1	0.716		(1.162)			
Food Price in t - 2	0.629		(1.159)			
Food Price in t - 3	-0.167		(0.745)			
Food Price in $t + 1$	-0.723		(1.200)			
Food Price in $t + 2$	1.960	.*	(1.184)			
Food Price in $t + 3$	-1.102		(0.717)			
 Cereal Price in t - 1 			J	0.175		(0.676)
Cereal Price in t - 2				1.390	**	(0.683)
Cereal Price in t - 3				-0.866	*	(0.441)
Cereal Price in $t + 1$				-0.366		(0.677)
Cereal Price in $t + 2$				0.755		(0.673)
Cereal Price in $t + 3$				-0.330		(0.417)
Intercept	-63.516	***	(17.603)	-36.512	***	(12.812)
Number of Observations		247			247	
Monthly Dummies		Yes			Yes	
p-value (Joint Significance)		0.00			0.00	
<i>R</i> -square		0.65			0.66	

Table A3. OLS Estimation Results for a Test of Whether Political Unrest Granger-Causes Food Prices, 1990-2011.

Note: The symbols ***, **, and * respectively denote statistical significance at the 1, 5, and 10 percent levels. With respect to the full sample of 253 observations, six observations are lost because food price lags and lead are calculated using food prices in t - 3, to t + 3.

	× •	(1)	22		(2)	
Variable	Coefficient		(Std. Err.)	Coefficient		(Std. Err.)
Dependent Varial	ole: Count of N	vews S	tories <mark>Involvi</mark>	ng Food Riots		D
Food Price	-0.658		(1.169)			
Food Price Three-Month Volatility	-2.986	**	(1.377)			
Cereals Price				-0.340		(0.685)
Cereals Price Three-Month Volatility				-2.556	*	(1.378)
Count of News Stories in t - 1	0.272	***	(0.065)	0.284	***	(0.064)
Trend	0.317	***	(0.048)	0.313	***	(0.046)
Food Price in t - 1	0.716		(1.162)			
Food Price in t - 2	0.629		(1.159)			
Food Price in t - 3	-0.167		(0.745)			
Food Price in $t+1$	-0.723		(1.200)			
Food Price in $t+2$	1.960	.*	(1.184)			
Food Price in $t + 3$	-1.102		(0.717)			
Cereal Price in t - 1				0.175		(0.676)
Cereal Price in t - 2				1.390	**	(0.683)
Cereal Price in t - 3				-0.866	*	(0.441)
Cereal Price in $t + 1$				-0.366		(0.677)
Cereal Price in $t + 2$				0.755		(0.673)
Cereal Price in $t + 3$				-0.330		(0.417)
Intercept	-63.516	***	(17.603)	-36.512	***	(12.812)
Number of Observations	73	247	3	58	247	
Monthly Dummies		Yes			Yes	
p-value (Joint Significance)		0.00			0.00	
<i>R</i> -square		0.65			0.66	

Table A3. OLS Estimation Results for a Test of Whether Political Unrest Granger-Causes Food Prices, 1990-2011.

Note: The symbols ***, **, and * respectively denote statistical significance at the 1, 5, and 10 percent levels. With respect to the full sample of 253 observations, six observations are lost because food price lags and lead are calculated using food prices in t - 3, to t + 3.

			OLS					I	t	IV			
Variable	Coefficient	ie si	(Std. Err.)	Coefficient	85 - S	(Std. Err.)	Coefficie	nt	(Std. Err.)	Coefficient		(Std. Err.)	
				Dependent V	ariable	Count of N	News Stories	Involv	ing Food Riots	s 🕐 📕			
Food Price	0.579	***	(0.154)				0.7	8 **	(0.319)				
Food Price Three-Month Volatility	-0.557		(0.913)				-2.3	15	(1.763)				
Cereal Price				0.415	***	(0.133)				0.632	**	(0.297)	
Cereal Price Three-Month Volatility				-0.363		(0.711)	\prec			-2.128		(1.667)	
Count of News Stories in t - 1	0.313	***	(0.064)	0.311	***	(0.064)	0.2	54 **	* (0.081)	0.250	***	(0.086)	
Trend	0.285	***	(0.047)	0.290	***	(0.047)	0.2	51 **	* (0.055)	0.264	***	(0.054)	
Intercept	-50.798	***	(15.847)	-32.958	**	(13.209)	-62.9)6 **	(28.433)	46.929	**	(23.058)	
Number of Observations		248			248		0	24	8		248	2	
Monthly Dummies		Yes			Yes			Ye	s		Yes		
p-value (Joint Significance)		0.00			0.00			0.0	0		0.00		
F-statistic (Instrument)		34			-			30.1	14		29.27		
R-square	85 - W - ST - ST	0.64	());;)) [] (2) [] (2) [_]	*	0.64		2400 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	0.6	2		0.62		

Table A4. OLS and IV Estimation Results for Robustness Checks on the Determinants of Political Unrest Using Six-Month Price Volatility, 1990-2011.

		OLS			OLS				IV				
Variable	Coefficient	ke si	(Std. Err.)	Coefficient	8 N	(Std. Err.)	Coefficient	a ((Std. Err.)	Coefficient	87 - 55 	(Std. Err.)	
				Dependent Va	ariable	: Count of N	ews Stories In	volving	Food Riots	0			1.00
Food Price	0.579	***	(0.154)				0.738	**	(0.319)	$\left(\right)$			
Food Price Three-Month Volatility	-0.557		(0.913)				-2.325		(1.763)				
Cereal Price				0.415	***	(0.133)				0.632	**	(0.297)	
Cereal Price Three-Month Volatility				-0.363		(0.711)			-	-2.128		(1.667)	
Count of News Stories in t - 1	0.313	***	(0.064)	0.311	***	(0.064)	0.264	***	(0.081)	0.250	***	(0.086)	
Trend	0.285	***	(0.047)	0.290	***	(0.047)	0.261	***	(0.055)	0.264	***	(0.054)	
Intercept	-50.798	***	(15.847)	-32.958	**	(13.209)	-62.906	**	(28.433)	46.929	**	(23.058)	
Number of Observations		248			248			248		190 -	248	_	- 30
Monthly Dummies		Yes			Yes			Yes			Yes		
p-value (Joint Significance)		0.00			0.00			0.00			0.00		
F-statistic (Instrument)		14			2			30.14			29.27		
<i>R</i> -square		0.64	i 18-11-00-15	*	0.64			0.62	50 - 5007 - K		0.62		

Table A4. OLS and IV Estimation Results for Robustness Checks on the Determinants of Political Unrest Using Six-Month Price Volatility, 1990-2011.



What If There Is Measurement Error?

What if reporters seek out stories of food riots as prices rise? Then the dependent variable is

$$y'_t = y_t + \xi_t$$

where ξ_t denotes measurement error, so that the equation to be estimated becomes

$$\mathbf{y}_{t} = \boldsymbol{\alpha}_{1} + \boldsymbol{\beta}_{1f} f_{t} + \boldsymbol{\beta}_{1\sigma} \boldsymbol{\sigma}_{t} + \boldsymbol{\beta}_{1y} \mathbf{y}_{t-1} + \boldsymbol{\beta}_{1m} \boldsymbol{m}_{t} + \boldsymbol{\beta}_{1\tau} \boldsymbol{\tau}_{t} + \boldsymbol{\varpi}_{1t}$$

where $\omega_t = \varepsilon_t - \xi_t$.



What If There Is Measurement Error?

If reporters start looking for stories of food riots when food prices increase, then ω_t is correlated with f_t , i.e., a statistical endogeneity problem caused by measurement error.

But then, the instrumental variable should also eliminate this problem. Reporters are presumably not aware – or weren't until very recently, when Hsiang et al. (2011) was published – of the natural disasters—social unrest nexus.