Food prices and the multiplier effect of export policy

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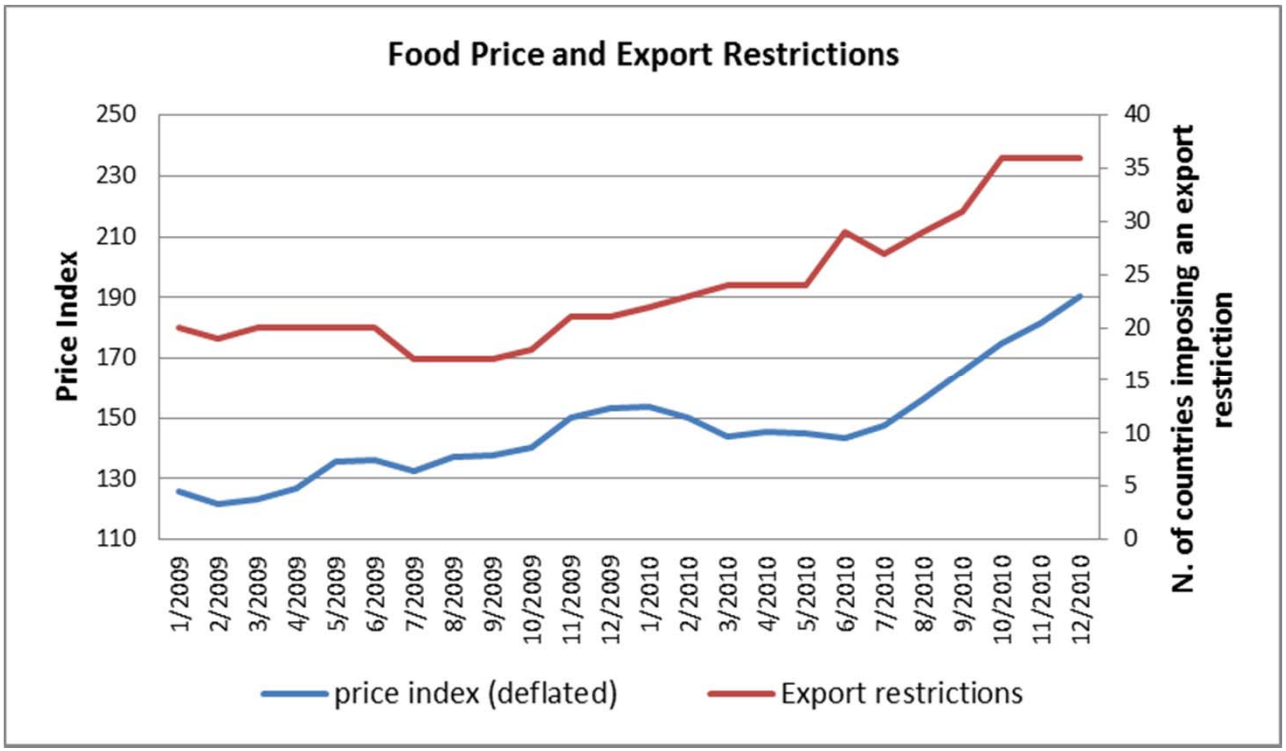
Motivation

- **Rising food prices** have been a key concern
- **Export policy** is considered a contributing factor:
  - "Export restrictions play a direct role in aggravating food crises" (Lamy, 2011)



Research question and main findings

- **How does export policy interact with food prices?**

- Export measures create a "**multiplier effect**"
  - High food prices trigger export restrictions that exacerbate the rise of the world price and feed into even more restrictive policies
  - Low food prices lead exporters to set export promotion measures that lower the world price and induce further support to exports

- Data for the **2008-10 food crisis** confirm the multiplier effect
  - Global restrictions in a product are positively correlated with the probability of imposing a new export restriction on that product
  - Restrictions had a positive and significant impact on world food prices

Structure of the presentation

- **Model**: export policy, loss aversion and food prices
  - Unilateral food export policy
  - Global interaction: multiplier effect
  - Extension: large exporters

- Empirical **evidence**
  - Testing the multiplier effect for the 2008-10 food crisis

- **Policy** implications
  - Export policy and the WTO

Related literature

- Trade policy and loss aversion:
  - Freund and Ozden (2008), Tovar (2009)
- Export policy and food prices:
  - Chaffour (2008), Bouet and Laborde (2010), Headey (2011), Anderson and Martin (2011), Ivanoic, Martin and Mattoo (2011)
- Complementarities and multiplier effects:
  - Cooper and John (1988), Cooper (1999)

The model: trade policy and loss aversion

- **Small open economy** with two sectors (numeriaire and food) and two factors (labor and land)
  - Food is produced with constant return technology $y = f(l,L)$ and is exported at international price p^*

- Two groups of agents:
  - "**Consumers**" that supply labor inelastically and receive a fixed wage
  - "**Producers**" that own land and earn the rent from the specific factor

- The **government** can intervene in the food sector by imposing an export tax (subsidy) $t > 0$ (< 0)
  - The tax creates a wedge between domestic and world price: $p = p^* - t$

The model: trade policy and loss aversion

- Individual utility displays **loss aversion**

$$U = c_0 + u(c) - I \cdot h(\overline{U} - c_0 - u(c))$$

- **Aggregate welfare** is *G(p) = W(p) + H(p)*, where
  - *W(p)* is standard social welfare and *H(p)* is aggregate loss aversion
  - In this context, whenever the price of food is
    - high ($p > \bar{p}$), consumers experience a welfare loss
    - low ($p < \underline{p}$), producers experience a welfare loss

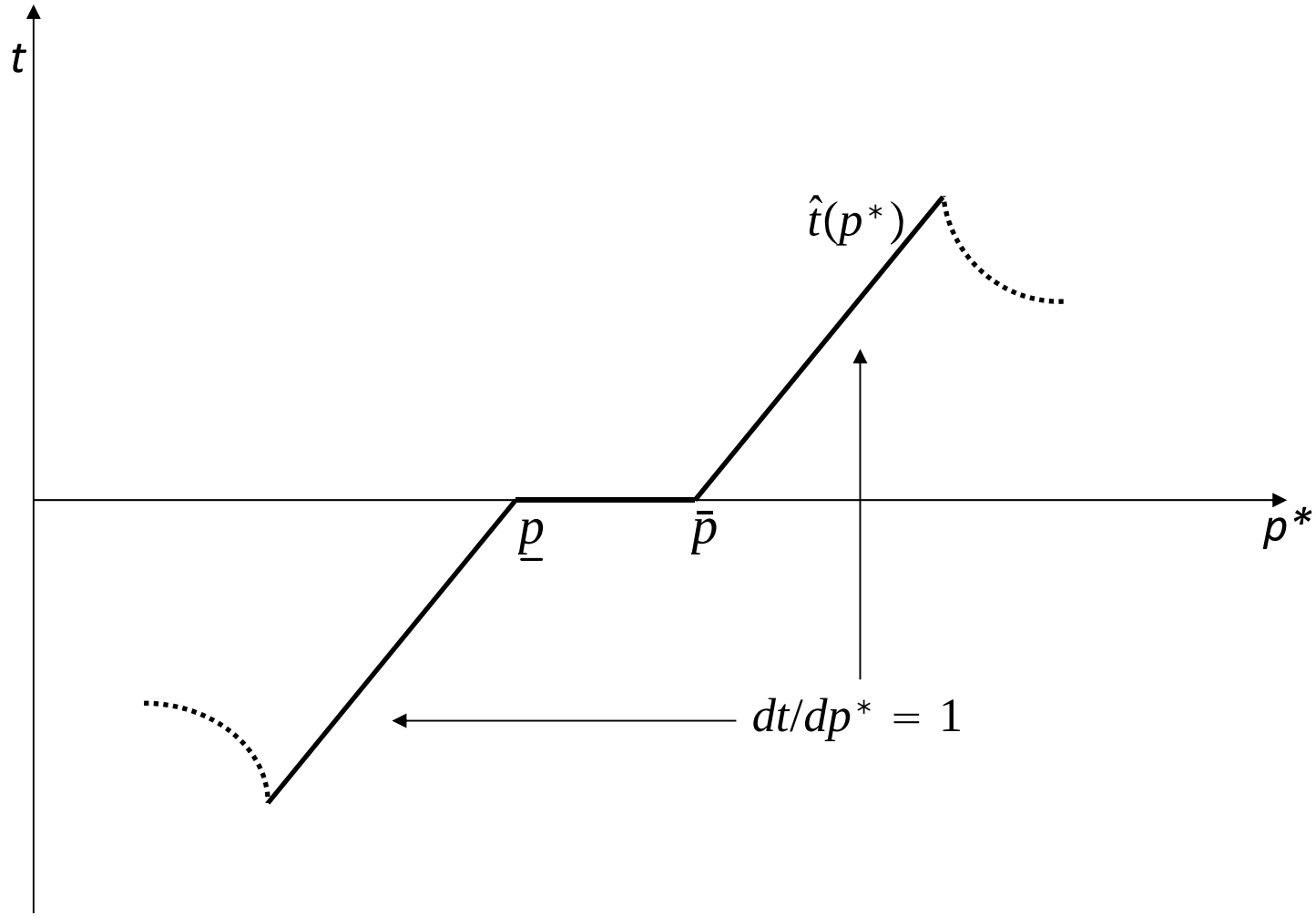
➢ <u>The government trades off the efficiency cost of export policy with the benefit of shielding citizens from large welfare losses</u>

Unilateral export policy under loss aversion

- **Proposition 1**
  - For $p^* \in (\underline{p}, \bar{p})$, the optimal policy is free trade.
  - For $p^* \leq \underline{p}$, the optimal policy is an export subsidy. There is a region of full producer compensation where $\hat{s} = \underline{p} - p^*$
  - For $p^* \geq \bar{p}$, the optimal policy is an export tax. There is a region of full consumer compensation where $\hat{t} = p^* - \bar{p}$

- **Intuition**:
  - For intermediate food prices, policy problem corresponds to standard welfare maximization
  - For high or low prices, government intervenes to offset loss aversion

Unilateral export policy under loss aversion



Export policy and the multiplier effect

- Consider now a continuum of identical small exporters and focus on the symmetric equilibrium, where $t_i = t \ \forall i \in [0,1]$

- The equilibrium condition in the **global food market** is

$$x(p^* - t) = m(p^*) \quad \text{where} \quad x(p^* - t) = \int_0^1 x_i(p^* - t)di$$

  – This defines the world food price as a function of trade policy of all exporting countries. It can be shown that *dp*/dt ∈(0,1)*

Export policy and the multiplier effect

- **Proposition 2**
  - Along the regions of compensating protection, a multiplier effect characterizes export policy. In particular, it is

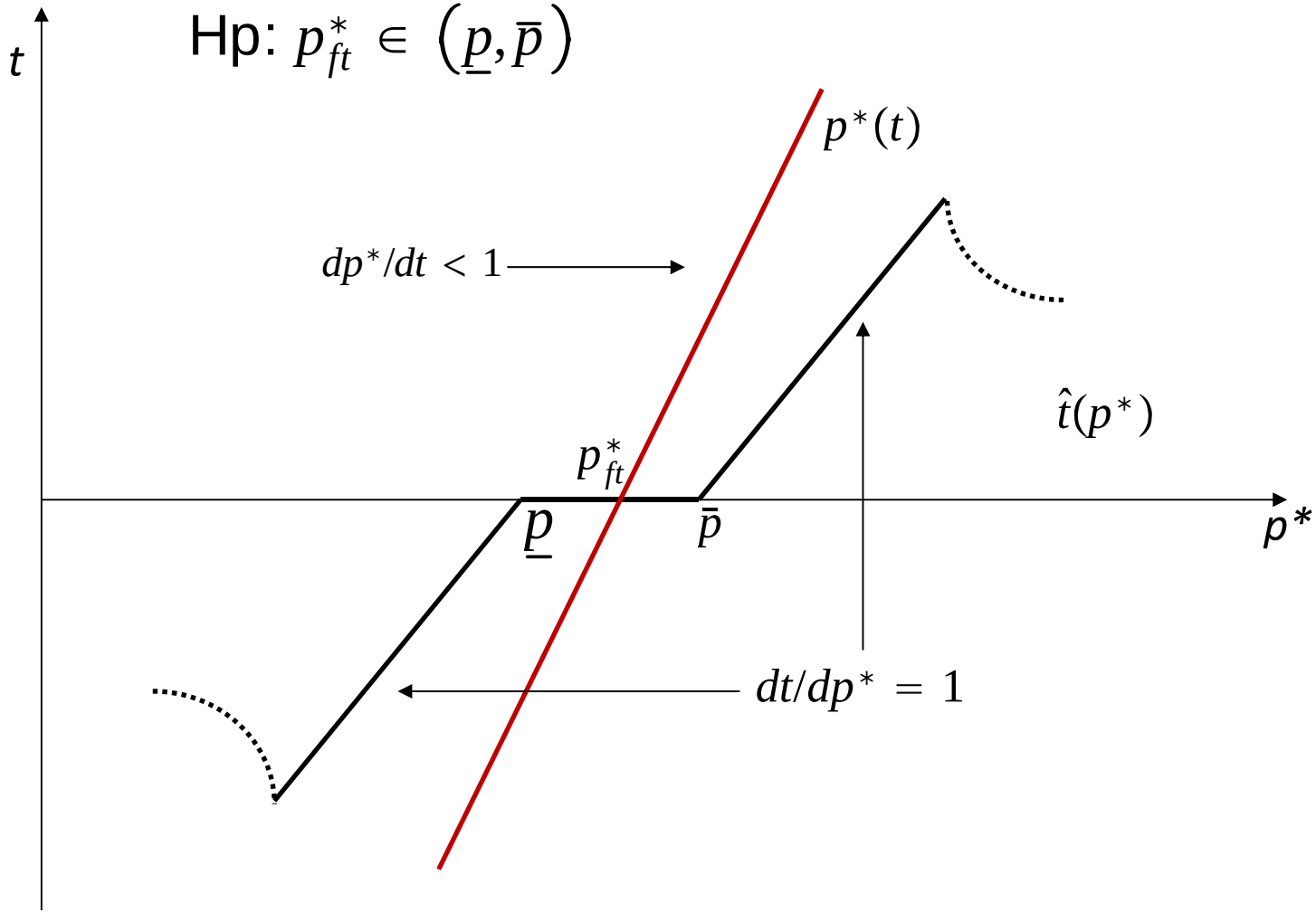
$$\frac{dt}{dp_{ft}^{*}} = \theta \frac{\partial t}{\partial p_{ft}^{*}}$$

where $p_{ft}^{*} = p^{*}(t = 0)$ and $\vartheta > 1$

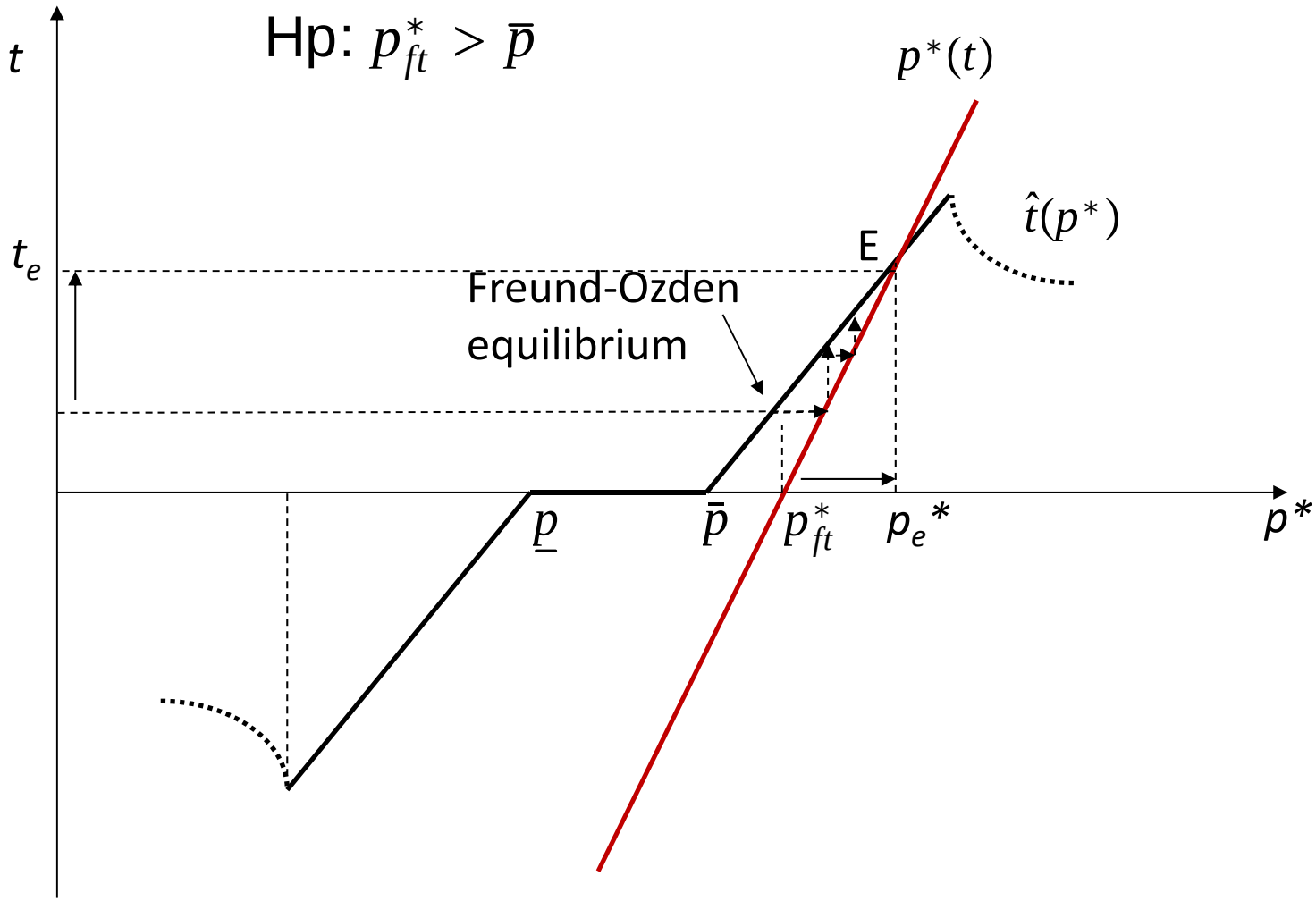
  - There is no multiplier effect when the international price under free trade is such that $p_{ft}^{*} \in (\underline{p}, \bar{p})$

- **Intuition**:
  - there is a complementarity between export policy and food prices

The free trade equilibrium



Export taxes and the multiplier effect



Extension: large exporters

- Several food sectors are characterized by large exporters
  - Focus on **two large exporting countries**

- Equilibrium in the global food market is now

$$m(p^*) = x(p^* - t_1) + x(p^* - t_2)$$

  - this implicitly defines $p^*(t_1, t_2)$

- In the region of full consumer compensation, the equilibrium export policy is determined by the system

$$\begin{cases} t_1 = p^*(t_1, t_2) - \bar{p} \\ t_2 = p^*(t_1, t_2) - \bar{p} \end{cases}$$

Extension: large exporters

- **Proposition 3**
  - If countries are large, their export policies along the region of compensating protection are strategic complements:

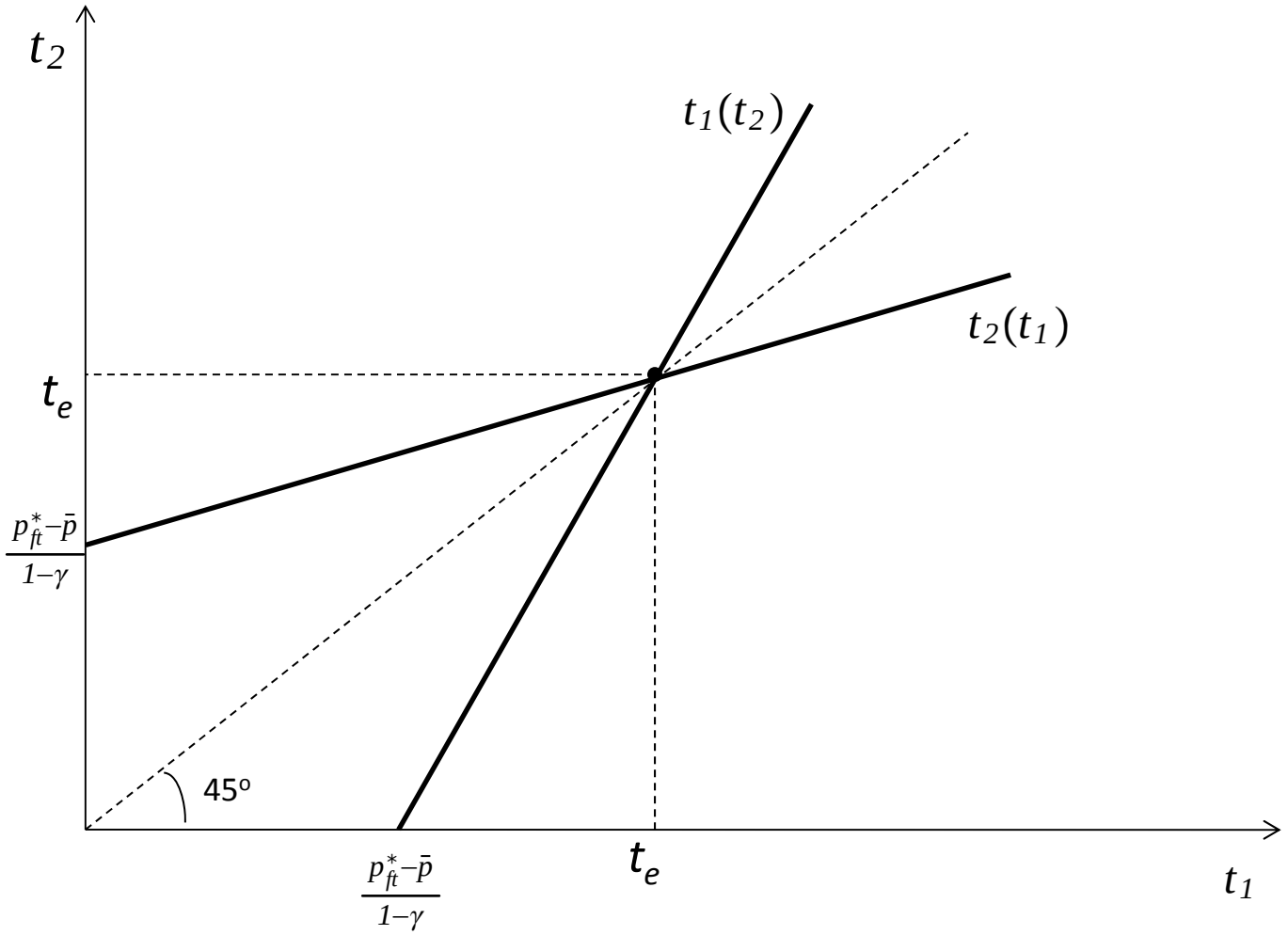
$$dt_i/dt_{-i} \in (0,1) \text{ for } i=1,2$$

  - Along these regions, a multiplier effect characterizes export policy:

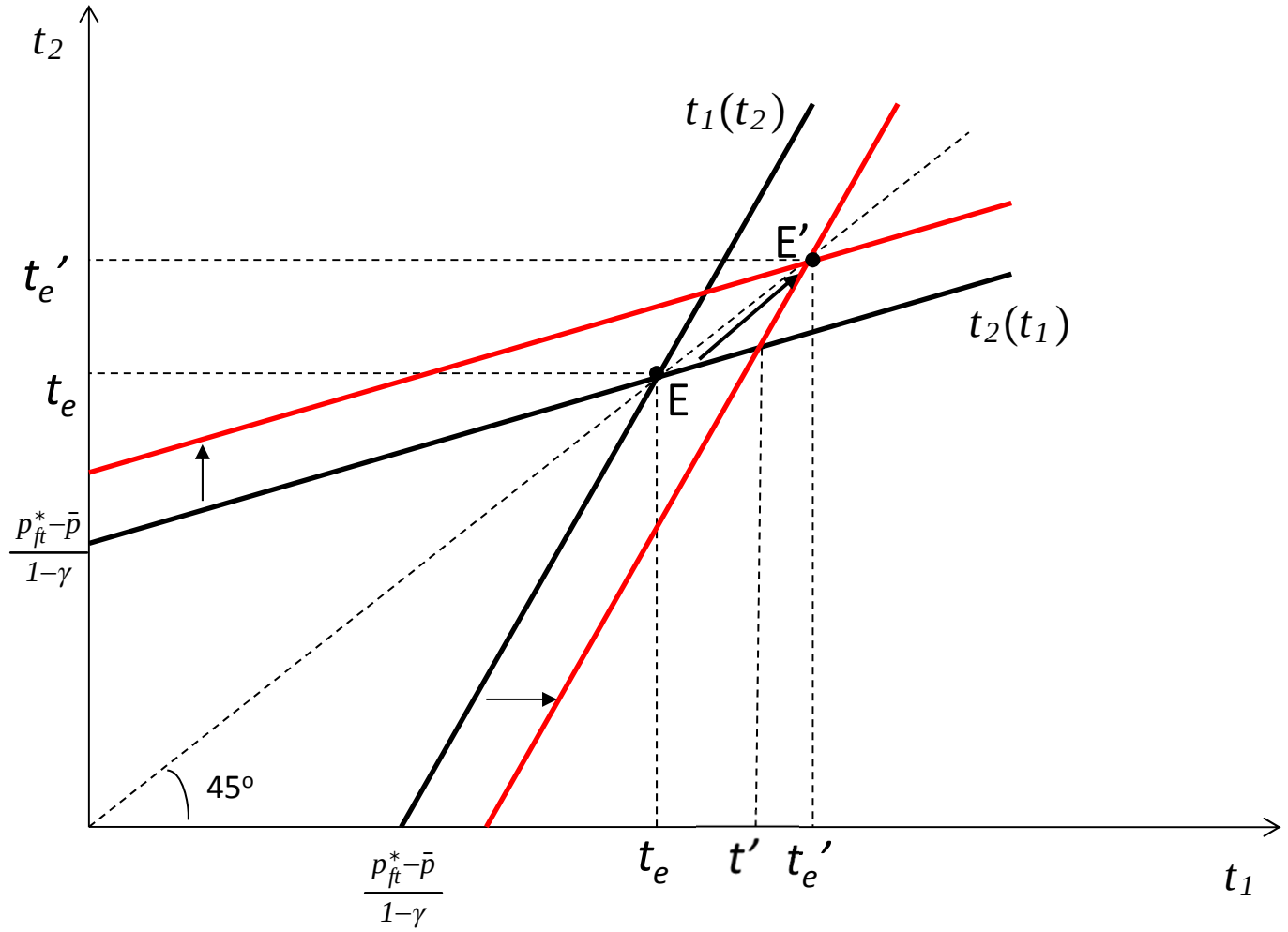
$$\frac{dt_i}{dp_{ft}^*} = \phi \frac{\partial t_i}{\partial p_{ft}^*} \text{ where } \phi > 1$$

- **Intuition**:
  - Strategic complementarities magnify common shocks

Extension: large exporters



Extension: large exporters



Discussion

- Two simplifying assumptions so far:
  - Governments maximize social welfare
  - Importers do not alter their trade policy

- **Political economy**:
  - When governments weigh more heavily producers' interests, an export subsidy is the equilibrium policy for intermediate food prices
  - But regions of full producer and consumer compensation still exist

- **Import policy**:
  - Importers are likely to react to changes in international prices if their agents face loss aversion
  - The interaction of export and import policy may magnify price effects

Empirical analysis

- We investigate two issues:

1. We study the **determinants of export restrictions**
   - Estimate the impact of prices and global export policies at *t-1* on the probability of imposing an export restriction at *t*

2. We study the **impact of export restrictions on food prices**
   - Estimate a simultaneous equation model of food prices and export policy

Empirical analysis

- We focus on the time period 2008-2010 which is characterized by **exceptionally high food prices**
  - During this period, food prices were 60 per cent higher than average prices during the period 1990-2006
  - We assume that for 2008-10 $p > \overline{p}$

- Data on export and import policy implementation:
  - **WTO Monitoring Reports** (TMR) of October 2009 and November 2010 and the **Global Trade Alert** (GTA) dataset

- Data on nominal prices, trade flows, etc. are from IMF, FAO, UN databases

hscode	Product Name	N Exp. Restrictions	% of trade covered by exp restrictions
0203	*Meat of swine, fresh, chilled or frozen*	1	0.001
1509	*Olive oil and its fractions, whether or not refined*	2	0.001
1507	*Soya-bean oil and its fractions*	4	0.023
1207	*Other oil seeds and oleaginous fruits*	1	0.0
1508	*Ground-nut oil and its fractions*	2	0.0
1514	*Rape, colza or mustard oil and fractions*	5	0.1
1201	*Soya beans, whether or not broken*	2	0.5
1512	*Sunflower-seed, safflower or cotton-seed oil and fats*	5	0.6
0204	*Meat of sheep or goats, fresh, chilled or frozen*	1	0.6
1504	*Fats and oils and their fractions*	2	0.8
0405	*Butter and other fats and oils derived from milk*	6	0.9
1007	*Grain sorghum*	2	1.0
1701	*Cane or beet sugar and chemically pure sucrose*	4	1.2
0207	*Meat and edible offal, of the poultry of heading 0*	1	1.6
1208	*Flours and meals of oil seeds or oleaginous fruits*	1	2.3
0201	*Meat of bovine animals, fresh or chilled*	7	3.8
0901	*Coffee, whether or not roasted or decaffeinated*	1	4.0
0703	*Onions, shallots, garlic, leeks and others*	1	9.3
1001	*Wheat and meslin*	9	14.1
1005	*Maize (corn)*	6	16.0
1003	*Barley*	3	22.4
1006	*Rice*	13	34.6
1511	*Palm oil and its fractions, whether or not refined*	4	46.7
1801	*Cocoa beans, whole or broken, raw or roasted*	2	50.1
	Total	85	

Determinants of export restrictions

- We regress the following specification for a set of 77 exporters and 29 commodity products:

$$Prob(ER_{ikt} = 1) = \beta_o + \beta_1 \ln P_{k(t-1)} + \beta_2 \ln GRE_{k(t-1)} + \beta_3 \ln GTR_{k(t-1)} + \\ + \beta_4 Share\ Agric.\ VA_i + \beta_5 \ln Exp_{iky} + \lambda_t + \gamma_k + \varepsilon_{ikt}$$

  - $ER_{ikt} = 1$ if country *i* imposes an export restriction on product *k* at time *t*
  - $P_{k(t-1)}$ is the deflated world price of product *k* at time *t-1*
  - $GRE_{k(t-1)} = \sum_i \left(\frac{Exp_{ik}}{World\ Exp_k} Exp\ restriction_{ik(t-1)} \right)$
  - $GTR_{k(t-1)} = \sum_i \left(\frac{imp_{ik}}{World\ imp_k} tariff\ reduction_{ik(t-1)} \right)$

Determinants of export restrictions

	All food products	All food products	All food products	All food products	All food products	All food products	Staple products	Staple products	Staple products
	Logit	LPM	LPM	Logit	LPM	LPM	Logit	Logit	Logit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
log Int. Prices $_{t-1}$	0.001*	0.001*	0.001*	0.0004*	0.001*	0.001*	0.038*	0.011	0.034**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.020]	[0.009]	[0.017]
log quarterly Exp	0.001**	0.002**	0.001	0.001**	0.002**	0.001	0.001**	0.001**	0.001**
	[0.000]	[0.001]	[0.001]	[0.000]	[0.001]	[0.001]	[0.001]	[0.000]	[0.001]
Share Agr. Va	0.056*	0.147		0.055*	0.147		0.077**	0.067**	0.073**
	[0.033]	[0.091]		[0.033]	[0.091]		[0.037]	[0.034]	[0.036]
Global Restrictions $_{t-1}$ (weighted)				0.019**	0.084**	0.084**		0.041**	
				[0.009]	[0.039]	[0.039]		[0.019]	
Global tariff reductions t-1 (weighted)				0.002	0.004	0.004		-0.005*	-0.003
				[0.001]	[0.003]	[0.003]		[0.003]	[0.002]
Time (monthly) FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE			Yes			Yes			
Observations	43186	63548	63548	43186	63548	63548	7716	7716	7716
R-squared		0.022	0.14		0.024	0.142			

Standard errors clustered at country level. *** p<0.01, ** p<0.05, * p<0.1.

Large exporters and global export restrictions

VARIABLES	LPM	LPM	LPM	LPM	LPM	LPM	LPM	LPM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log Int. Prices $_{t-1}$	0.001**	0.001**	0.0001	0.0001	0.0001	0.0001	0.0004	0.001
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
log quarterly Exp	0.001**		0.001**		0.001**		0.001**	
	[0.000]		[0.000]		[0.000]		[0.000]	
big exporter	0.033	0.039*	0.027*	0.033*	0.027*	0.033*	-0.011**	-0.007
	[0.020]	[0.022]	[0.016]	[0.017]	[0.016]	[0.017]	[0.005]	[0.005]
log Int. Prices t-1 x Big Exporter			0.016*	0.016*	0.016*	0.016*	0.003*	0.003*
			[0.009]	[0.009]	[0.009]	[0.009]	[0.001]	[0.001]
Global Restrictions $_{t-1}$ (weighted)					0.082**	0.082**	0.014	0.014
					[0.039]	[0.039]	[0.012]	[0.011]
Global Exp. Restr. (weighted) x Big Exporter							1.717***	1.721***
							[0.529]	[0.530]
Observations	63280	63280	63280	63280	63280	63280	63280	63280
R-squared	0.026	0.025	0.031	0.03	0.034	0.033	0.116	0.115

Standard errors clustered at country level. *** p<0.01, ** p<0.05, * p<0.1.

Other control variables included in the regression are the share of agricultural value added and product and time FE.

Endogeneity: Two approaches

1. **Lagged explanatory variables** approach

2. **Instrumental variables** approach

   – Instruments for international food prices of product *k*:
     - Total level and variability of rainfall for large producers of product *k*

   – Instruments for global restrictions for product k:
     - Elections in large producers of product *k* and total number of restrictions for products *different* from *k*

➢ <u>Empirical results hold for both approaches</u>

Determinants of export restrictions (IV regression)

	All exporters	Big exporters	All exporters	All exporters	All exporters	All exporters	Big exporters	Big exporters
	LPM	LPM	IV	IV	IV	IV	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log Int. Prices $_{t-1}$	0.001*	-0.0008	0.161**	0.161**	-0.0007	0.001	0.136	0.051
	[0.000]	[0.001]	[0.077]	[0.078]	[0.011]	[0.010]	[0.201]	[0.211]
Global Restrictions $_{t-1}$ (weighted)	0.082**	1.685***			0.110*	0.110*	1.647***	1.655***
	[0.039]	[0.480]			[0.066]	[0.066]	[0.593]	[0.601]
Time (monthly) FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes		Yes		Yes		Yes
Observations	63548	2236	39434	39434	39434	39434	1435	1435
Hansen J statistic			1.286	1.222	3.563	3.406	0.902	0.786
p-value of Hansen J statistic			0.257	0.269	0.168	0.182	0.637	0.675

Standard errors clustered at country level. *** p<0.01, ** p<0.05, * p<0.1.

Other control variables are the share of agricultural value added and the log of quarterly exports.

Impact of export restrictions on food prices

- From the theory, food prices are influenced by export restrictions, but export restrictions respond to food prices

- We use a simultaneous equation system to estimate the **overall effect of export restrictions** in food sector *k* on its price

$$\begin{cases} \Delta \ln p^*_{kt} = \alpha_0 + \alpha_1 \Delta ER_{kt} + \alpha_2 \Delta Rainfalltop5_{kt} + \alpha_3 \Delta Rainfallvartop5_{kt} + \alpha_4 \Delta Energy_t + \gamma_k + \varepsilon_{kt} \\ \Delta ER_{kt} = \beta_0 + \beta_1 \Delta \ln p^*_{kt} + \beta_2 \Delta Elections\ top5_{kt} + \beta_3 \Delta ER_{-kt} + \lambda_t + \gamma_k + u_{kt} \end{cases}$$

  - $ER_{kt} = \sum_i Exp\ restriction_{ikt}$
  - $Rainfalltopf_{kt}$, $Rainfallvartopf_{kt}$, $Electionstop5_{kt}$, Er_{-kt} are the instruments used in the IV regression

Impact of export restrictions on food prices

Second stage results						
Dep var: $\Delta_{t-(t-x)}$ log prices	x=1 month	x=2 months	x=3 months	x=4 months	x=5 months	x=6 months
$\Delta_{t-(t-x)}$ N. export restrictions	-0.0114	0.0281	0.0435	0.0558*	0.0752*	0.1069**
	[0.031]	[0.027]	[0.030]	[0.033]	[0.041]	[0.054]
$\Delta_{t-(t-x)}$ log rainfall	0.0209	0.0168	0.0138	0.0125	0.0118	0.0116
	[0.017]	[0.016]	[0.015]	[0.015]	[0.015]	[0.016]
$\Delta_{t-(t-x)}$ rainfall deviation	-0.001	0.0003	0.0009	0.0006	0.0003	0.0002
	[0.004]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
$\Delta_{t-(t-x)}$ log energy prices	1.2319	1.021	0.415	0.1926	0.0945	-0.0817
	[1.019]	[0.691]	[0.482]	[0.421]	[0.427]	[0.504]
Observations	630	612	594	576	558	540
F-statistic from first stage regression	37.3	38.27	22.02	14.39	29.57	8.86
P-value F statistic	0.00	0.00	0.00	0.00	0.00	0.00

Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Regressions include time FE.

Conclusions and policy implications

- The paper documents an **export policy multiplier effect**
  - Exporters respond to global food prices and, in turn, food price changes feed into more export policy activism
  - A novel dataset on export restrictions confirms the role of export policy in the 2008-10 food crisis

- This analysis confirms a global welfare rationale for **further regulation of export policy**
  - Negotiated commitments to bind export subsidies and taxes would limit the multiplier effect on food prices
  - Value of subsidy (tax) commitments is more relevant than what is perceived at times of high (low) food prices