Trade Policies and Food Price Volatility

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Outline

- Theory – policy motivations & model
- Data and model estimation
- Implications for price volatility
- Implications for policy

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Theory - Motivation of policy makers

- Sharp adjustments in staple food prices can be politically costly
  - Literature points to loss aversion models
    - Consumers losing from higher prices react more strongly than producers
    - Producers losing from lower prices react more strongly than consumers

- But there is also a political-economy equilibrium to be respected
  - Grossman-Helpman: protection level is a balance between political interests
    - On average agricultural producers tend to be protected in rich countries
    - Food consumers often favored in poor countries

- Conflict between the two motivations
  - Resisting international price changes upsets the political-econ. equilibrium
  - Example: If world price rises & domestic price doesn't, protection falls
  - And allowing international price changes to be transmitted causes political reaction from adversely affected groups
  - How do policy makers trade-off between these goals?

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How to capture these dual motivations?

- Nickell's model: forward-looking policy makers facing quadratic costs
  i. From adjusting prices $(p_t - p_{t-1})^2$
  ii. From being out of equilibrium $a(p_t - p_t^*)^2$

- Yields a cost function: $C_t = \sum_{s=0}^{\infty} \alpha^s \left[(p_{t+s} - p_{t+s-1})^2 + a(p_{t+s} - p_{t+s}^*)^2\right]$

- If p_t^* is nonstationary, this leads to a simple Error Correction Model
  - $\Delta p_t = \phi \Delta p_t^w + \theta(p_{t-1} - p_{t-1}^*) + \varepsilon_t$

    - ECM both captures behavior & solves statistical problems of integrated series!!

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Defining the desired price, p_t^*

- Political-economy models like Grossman-Helpman give us:
  - $P = (1+t^*)P^w$

  Where t^* is the political-economy equilibrium tariff, determined LR factors:
  - Whether a sector is organized or not
  - Elasticities of import demand
  - The share of domestic production in total consumption
  - Income & expenditure shares

  In logs, this is: $p^* = \beta_0 + \beta_1 p^w$

  - Where p* is LR eq price, β_0 is $(1+t^*)$, and β_1=1 under the G-H theory

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The ECM as a policy model

- The ECM is both a price transmission model:

$$\Delta p_t = \delta \cdot \Delta p_t^w + \theta(p_{t-1} - \beta_0 - \beta_1 p_{t-1}^w) + \varepsilon_t$$

- And a policy model:

$$\Delta \tau_t = (\delta - 1) \cdot \Delta p_t^w + \theta(p_{t-1} - \tau^* - \beta_1 p_{t-1}^w) + \varepsilon_t$$

where $\tau = (p - p^w)$ is the rate of protection in logarithms

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Regression divides price changes into systematic & idiosyncratic

- A systematic component $s_t = \phi \Delta p_t^w + \theta(p_{t-1} - \tau^* - \beta_1 p_{t-1}^w)$
- An idiosyncratic component, ε_t
  - Uncorrelated so the variance of domestic prices is the sum of their variances:

$$\sigma_p^2 = \sigma_s^2 + \sigma_\varepsilon^2$$

- The systematic response reduces volatility of domestic relative to world prices
  - But increases volatility of world prices
    - because these responses are correlated across countries
- The idiosyncratic component increases domestic price volatility
  - But little impact on world price volatility
    - Not correlated across countries

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Data & estimation

- Data on producer and external reference prices obtained from Distortions to Agricultural Incentives (Anderson 2008) & AgIncentives studies up to 2021
  - 29 usable economies, including the EU as one

- These annual data are designed to measure the level of protection
  - Choose comparable commodities
  - Producer prices are domestic market prices
  - External reference prices are world prices adjusted for transport & marketing costs and degree of processing
    - Including changes in direction of trade

- Only differences between producer & reference prices are due to policy
  - Capture the impacts of policies such as export bans, quotas, TRQs…

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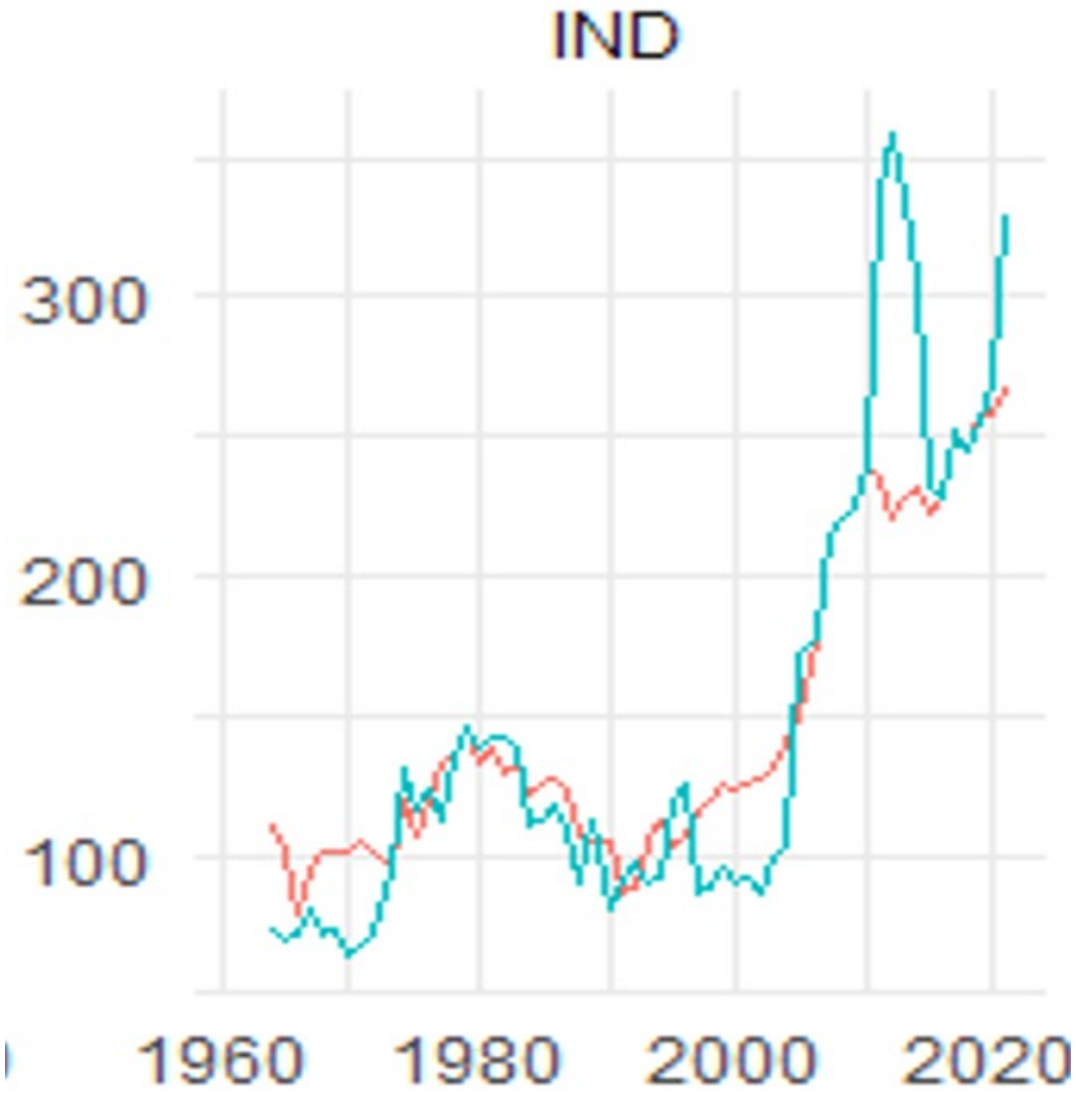
What we expected– India wheat



Producer Price

External Ref Price

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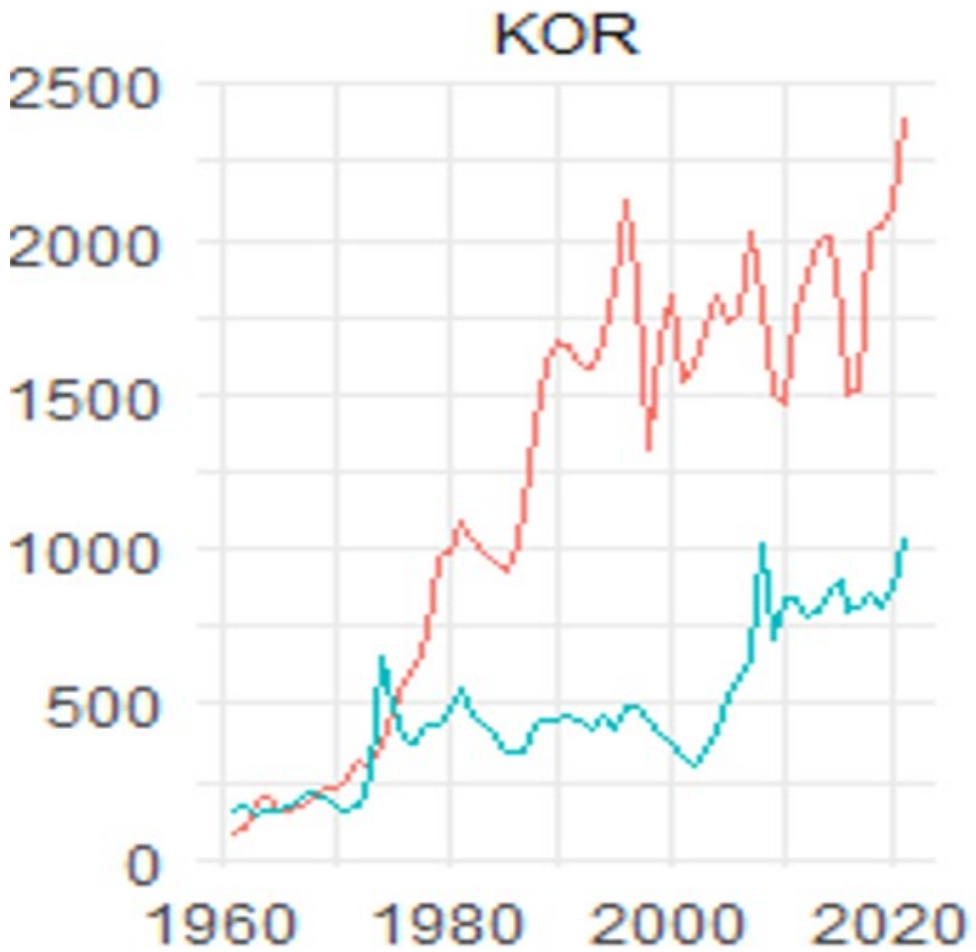
What we often see: Korea Rice



Producer Price

External Ref Price

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Integration & Cointegration Tests for Rice

- Price levels are mostly non-stationary
- First differences of prices almost all stationary
- Domestic prices co-integrated with external reference prices in most cases

- Wheat data have similar properties

	Price levels		First differences		Cointegration
	p^d	p^w	Δp^d	Δp^w	
AUS	-4.18***	-5.25***	-5.92***	-6.24***	-4.31**
BGD	-0.82	-2.24	-4.31***	-4.13***	-3.85*
BRA	-2.35	-2.15	-5.49***	-4.59***	-5.36***
CHN	-2.96	-1.57	-3.80***	-3.79***	-4.03**
ECU	-1.85	-1.86	-6.18***	-4.55***	-3.70**
EUR	-1.41	-2.58	-6.07***	-6.31***	-3.05
IDN	-2.23	-3.22	-5.56***	-5.21***	-3.09
IND	-2.37	-2.26	-6.04***	-4.55***	-5.37***
JPN	-0.82	-3.09	-5.02***	-5.56***	-2.46
KAZ	-1.57	-2.73	-2.94	-3.03*	-3.84*
KOR	-1.14	-3.17	-5.86***	-5.32***	-2.83
LKA	-3.58**	-4.20***	-7.14***	-6.81***	-4.25***
MEX	-3.06*	-2.87	-4.11***	-3.25*	-4.62**
NGA	-2.22	-3.08*	-6.75***	-5.99***	-4.65***
NIC	-1.84	-1.84	-3.06**	-3.41**	-4.45**
PAK	-2.21	-1.93	-7.56***	-5.45***	-4.96***
UGA	-2.46	-3.10*	-4.53***	-4.99***	-4.46***
USA	-2.90*	-2.88*	-5.91***	-5.34***	-3.55*
VNM	-2.25	-1.69	-3.61**	-4.10***	-3.64*
ZMB	-2.6	-2.26	-4.19***	-5.45***	-3.64**

Estimation

- Estimate Error Correction Models using Nonlinear Least Squares
  - Provides estimates of short & long run parameters
    - With unbiased significance tests

- $$\Delta p_t = \phi \Delta p_t^w + \theta(p_{t-1} - \tau^* - \beta_1 p_{t-1}^w) + \varepsilon_t$$

- Interested in short-run price transmission, ϕ ; error correction, θ; equilibrium tariff rate, τ^*; coefficient on world price, β_1; idiosyncratic volatility of ε_t
    - Add trend terms to deal with changes in equilibrium tariffs

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ECM Results for rice, $\beta_1 \equiv 1$, coefficients & t-statistics

	Short term adjustment	Speed of adjustment	Equil tariff	Trend	Trend squared	R^2	Sample (years)	RMSE
	δ	θ	β_0	β_2	β_4			
AUS	0.94	-0.42	0.20	-0.004		0.97	61-21	0.05
	39.3	*-3.7*	*7.0*	*-5.0*				
CHN	0.42	-0.31	-0.56	0.025		0.37	81-21	0.12
	3.8	*-3.3*	*-4.1*	*4.6*				
EUR	0.75	-0.16	-0.60	0.06	-0.001	0.67	57-21	0.20
	10.8	*-2.2*	*-1.3*	*1.7*	*-1.6*			
IDN	0.60	-0.47	0.15	-0.022	0.001	0.47	75-21	0.15
	5.2	*-3.7*	*1.0*	*-1.5*	*2.3*			
IND	0.73	-0.67	-0.83	0.028	-0.0003	0.71	65-21	0.18
	7.5	-5.6	-7.3	3.0	-1.8			
JPN	0.15	-0.15	0.38	0.092	-0.001	0.21	55-21	0.12
	1.6	*-2.8*	*1.1*	*4.3*	*-4.1*			
KOR	0.05	-0.19	-0.25	0.08	-0.001	0.16	55-21	0.15
	0.4	*-3.1*	*-0.7*	*3.6*	*-3.0*			
PAK	0.43	-0.36	-0.25	-0.02	0.001	0.44	61-13	0.18
	4.3	*-3.9*	*-1.0*	*-1.2*	*1.8*			
PHL	0.31	-0.23	0.18	-0.02	0.001	0.39	62-21	0.10
	5.3	-3.6	0.9	-1.3	2.6			
USA	0.73	-0.10	0.13			0.92	55-21	0.06
	27.5	*-2.1*	*1.7*					
VNM	0.71	-0.57	-0.33	0.04	-0.001	0.63	86-21	0.15
	6.7	*-3.8*	*-2.4*	*2.4*	*-2.3*			

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Takeaways from ECM analysis for rice

- Models selected using general to specific methodology
  - Constraint that $\beta_1 \equiv 1$ implied by economic theory & not rejected by the data
    - Allows estimation of equilibrium protection rates & trends where needed
- Short run coefficient of price transmission varies between 0 and 1
  - Countries with strong price insulation have coefficients close to 0
  - Price-taking exporters have values close to 1
  - Highly significant in most cases
- Error-correction terms generally lower
  - Range from -0.1 to -0.67
- Big variation in R^2 and in RMSE for idiosyncratic protection shocks

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ECM Results for wheat, $\beta_1 \equiv 1$, coefficients & t-statistics

	Short term adjustment	Speed of adjustment	Equil tariff	Trend on eq tariff	Trend sq on eq tariff	R^2	Sample (years)	RMSE
	δ	θ	β_0	β_2	β_4			
ARG	0.91	-0.57	-0.21			0.83	60-21	0.19
	16.6	*-4.8*	*-4.9*					
AUS	0.93	-0.53	0.07	-0.001		0.96	61-21	0.04
	38.2	*-4.8*	*3.3*	*-2.4*				
BGD	0.75	-0.87	0.12	-0.005		0.60	74-04	0.19
	3.0	*-4.5*	*1.5*	*-1.1*				
CAN	0.98	-0.24	0.05	-0.001		0.99	61-21	0.02
	90.6	*-2.9*	*2.5*	*-1.6*				
CHE	0.33	-0.16	1.45	-0.03		0.22	79-21	0.11
	3.0	*-1.9*	*6.4*	*-3.7*				
CHN	0.39	-0.29		0.01		0.33	81-21	0.12
	3.8	*-2.4*		*4.1*				
EUR	0.86	-0.21	0.47	-0.008		0.80	57-21	0.17
	15.5	*-2.7*	*2.1*	*-1.3*				
IND	0.13	-0.09		0.01		0.13	64-21	0.08
	1.7	*-1.8*		*1.2*				
JPN	0.10	-0.08	-0.20	0.091	-0.001	0.16	55-21	0.12
	2.3	*-2.7*	*-0.4*	*2.3*	*-2.5*			
RUS	0.97	-0.73	-0.09			0.90	92-21	0.09
	13.9	*-5.7*	*-3.6*					
USA	0.83	-0.13	0.11			0.92	55-21	0.06
	25.8	*-1.8*	*1.9*					

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Takeaways from ECM for wheat

- Short run coefficients between 0 and 1
  - Typically high in exporters like Argentina, Australia, Russia, USA
  - Quite high in countries like Bangladesh (and Zimbabwe)
  - Quite low in China (0.39); India (0.13); Switzerland (0.33)
- Error Correction terms generally larger than for rice (-0.09 to -0.73)
- Big variation in R^2 and idiosyncratic policy shocks (RMSE)

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Implications for world price stability

- The systematic component of price insulation reduces the volatility of domestic prices relative to world prices
- But this price insulation increases the volatility of world prices.
  - Lower price transmission reduces incentives for producers & consumers to respond to price changes
    - If we assume equal elasticities, estimate impacts using market shares

	Rice	Wheat
Price transmission elasticity	0.57	0.52
Price magnification factor	1.75	1.91

- Roughly doubles the impacts of shocks on world market prices
  - Since the cost of price volatility is determined by the variance of price, quadruples the cost of volatility to people facing world prices

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Impacts at country level

- In many countries, the price stabilizing-effects of price insulation are dissipated or outweighed by idiosyncratic price shocks
  - e.g. when export bans generate domestic price volatility, administered price supports are updated infrequently, or price support schemes collapse

- Idiosyncratic policy volatility reduces the benefits many countries obtain from price insulating policies
  - In over 25% of our countries, this effect is large enough to outweigh the stabilizing impacts- even relative to the magnified volatility of world prices.

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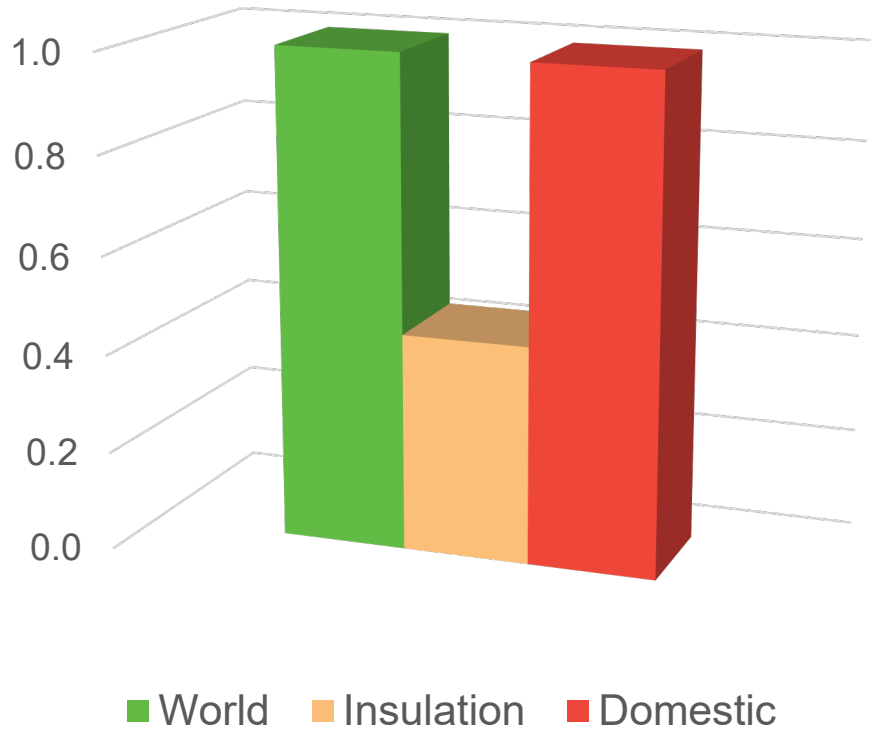
Decomposing variance at country level, simple average for rice



- Green bar: Domestic price variance with no policy intervention (=world price variance)
- Orange bar: Domestic price variance with systematic policy responses (intentions based on model results)
- Red: Domestic price variance observed (includes systematic and idiosyncratic shocks)

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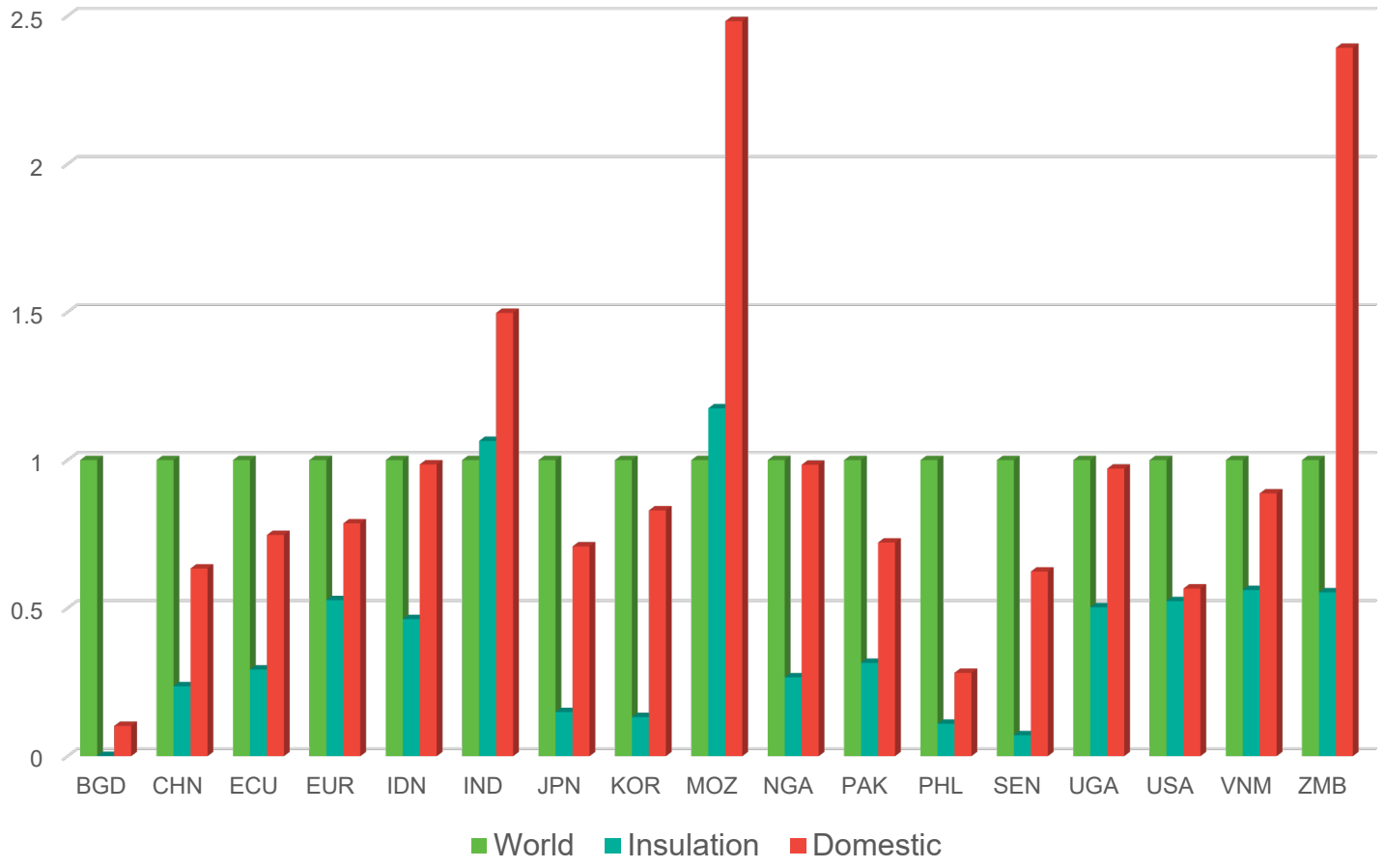
Decomposing price variance in rice, country cases



- Effectiveness of policy in reducing volatility varies enormously
- Some country policies vastly increased volatility even without considering magnification of world price volatility
- Of the countries considered, only BGD and, perhaps, PHL would have lower price volatility after magnification of world price volatility
- Even in China, considerable random volatility

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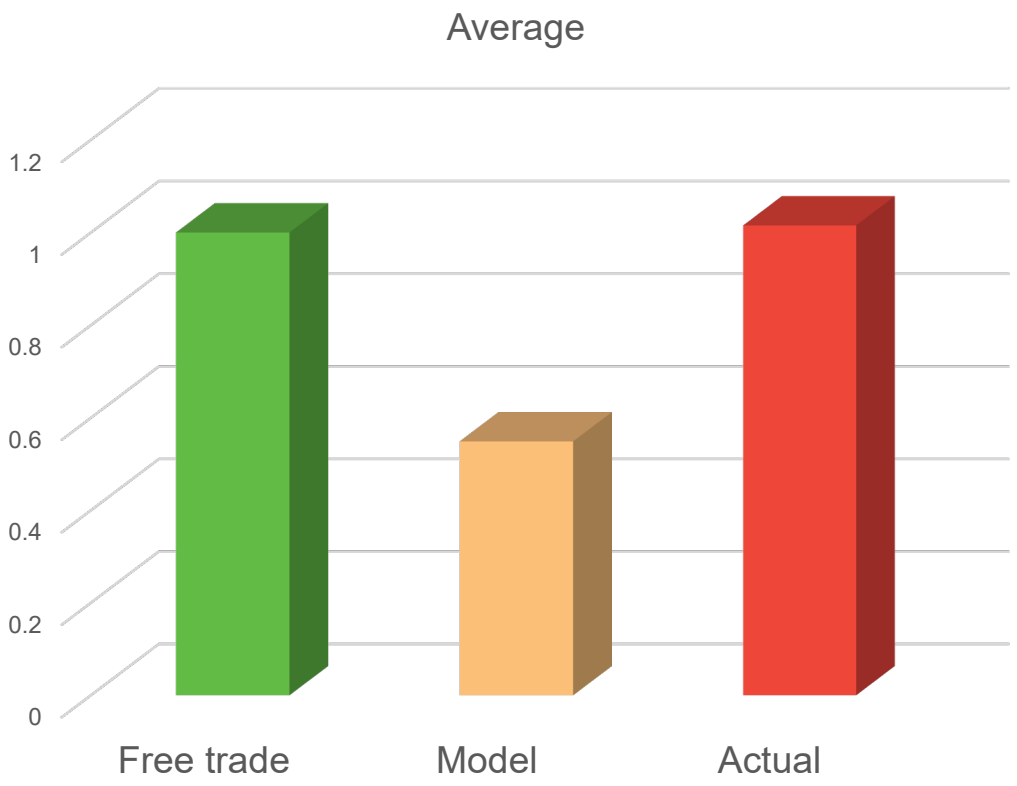
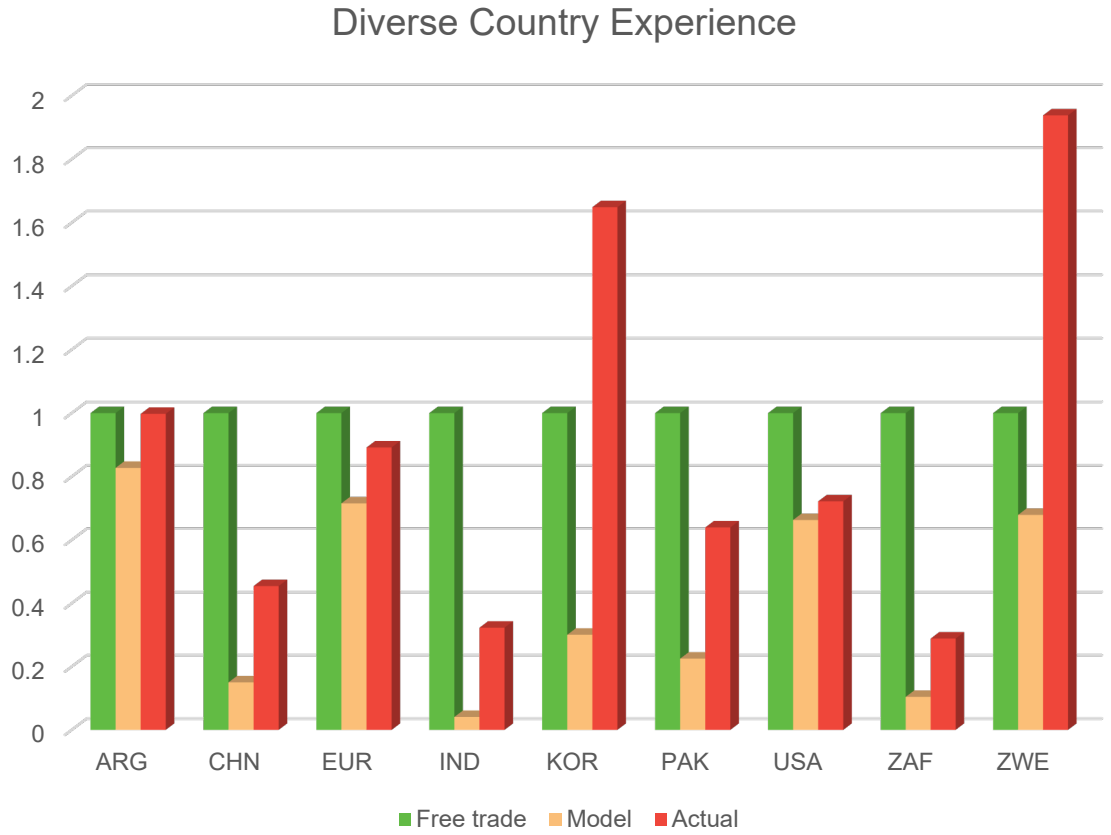
Similar patterns in wheat markets, Variance index





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Implications for Markets

- Systematic policy responses, designed to insulate economies from world prices, can be effective in reducing price volatility of *individual* countries
  - Collectively ineffective because they raise the volatility of world prices
  - In the absence of idiosyncratic policy volatility, this is a zero-sum game
    - Those who insulate more than the average have lower volatility than in the absence of policy intervention

- Idiosyncratic policy shocks, such as those from use of quantitative restrictions like export bans, increase domestic price volatility
  - Turns the policy game from zero to negative-sum game
    - Hardly any countries insulate and minimize idiosyncratic shocks enough to end up with lower domestic price volatility

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Policy implications

- National policy reform
  - Recognizing the importance of idiosyncratic policy shocks builds a strong case for policy reform in many countries
  - Moving from discretionary to simple rules-based approaches could lower price variability
    - And reduce the need for beggar-thy-neighbor price insulating policies
  - Also a strong case for moving away from quantitative restrictions and discontinuous policies like minimum price supports

- Global policy reform
  - Recognizing the magnification effect of price insulating policies makes a strong case for global rules to restrain these policies

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Conclusions

- Trade policies for food staples respond strongly to changes in world prices
  - But policy makers also have in mind political-economy influences
    - High support in rich countries, low or negative support in poor
- Error correction model incorporates both policy influences
  - And deals with statistical problems associated with integrated series
- Find substantial degree of insulation
  - Doubles the impacts of shocks on world market prices
    - Quadruples the cost of volatility in world prices
- Idiosyncratic policy volatility/inefficiency varies between countries
  - Almost all countries have worse outcomes than initial world market volatility
  - Enormous need for policy reform

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