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Modeling and Forecasting Agricultural Commodity Support in the Developing Countries

Isaac Miller, Julian Binfield, Jing Zhao, and Wyatt Thompson

Selected Paper prepared for presentation at the International Agricultural Trade Research Consortium's (IATRC's) 2017 Annual Meeting: Globalization Adrift, December 3-5, 2017, Washington, DC.

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Modeling and Forecasting Agricultural Commodity Support in the Developing Countries

ISAAC MILLER, JULIAN BINFIELD, JING ZHAO, WYATT THOMPSON

IATRC, DECEMBER 3-5， 2018

The project

We want to investigate how agricultural support has evolved in different countries

- In particular the link between income and support

This has varied between countries. In general:

- Agriculture tended to be taxed in less developed or developing countries
- Developed countries were more likely to subsidize their agriculture

Using market support data from those countries for 1961–2011 from the World Bank Agricultural Distortion database, estimate econometric models

Aim is to then use projections of macroeconomic and other variables to generate estimates of future agricultural commodity support measures

Building on past work

Anderson and Nelgen (2012) examine the factors driving nominal rates of assistance (NRAs) of six key crop products, including rice, wheat, maize, soybean, sugar and cotton,

- find that supported level tended to grow as a country's per capita income rose

Zhao, Miller and Thompson have a recent publication paper named "Modeling and Extrapolating Wheat producer Support Using Income and other Factors", Journal of Agricultural Economics, October 2017

In this project we will extend our research to an assessment of more commodities

Also have a broader look at the relationship between incomes, NRAs and other measures of support

Primary research goals

Analyze how agricultural support programs evolved in the past, particularly in key developing countries

Identify the major factors that influence agricultural support over time using econometric methods

Forecast agricultural commodity support in the developing countries for the medium-term future

Put these results in perspective through some comparisons to developed countries' support and to WTO commitments

Countries and Commodities

Countries: China, India, Brazil, Russia (emerging countries)

- Includes agricultural commodity importers and exporters
- Include a range of policy environments
- Include differing macroeconomic environments

Commodities: Wheat, Cotton, Maize, Sugar

- Widely produced
- Contains food crop, feed crop
- Different markets and policy environments

Agricultural policy for protection

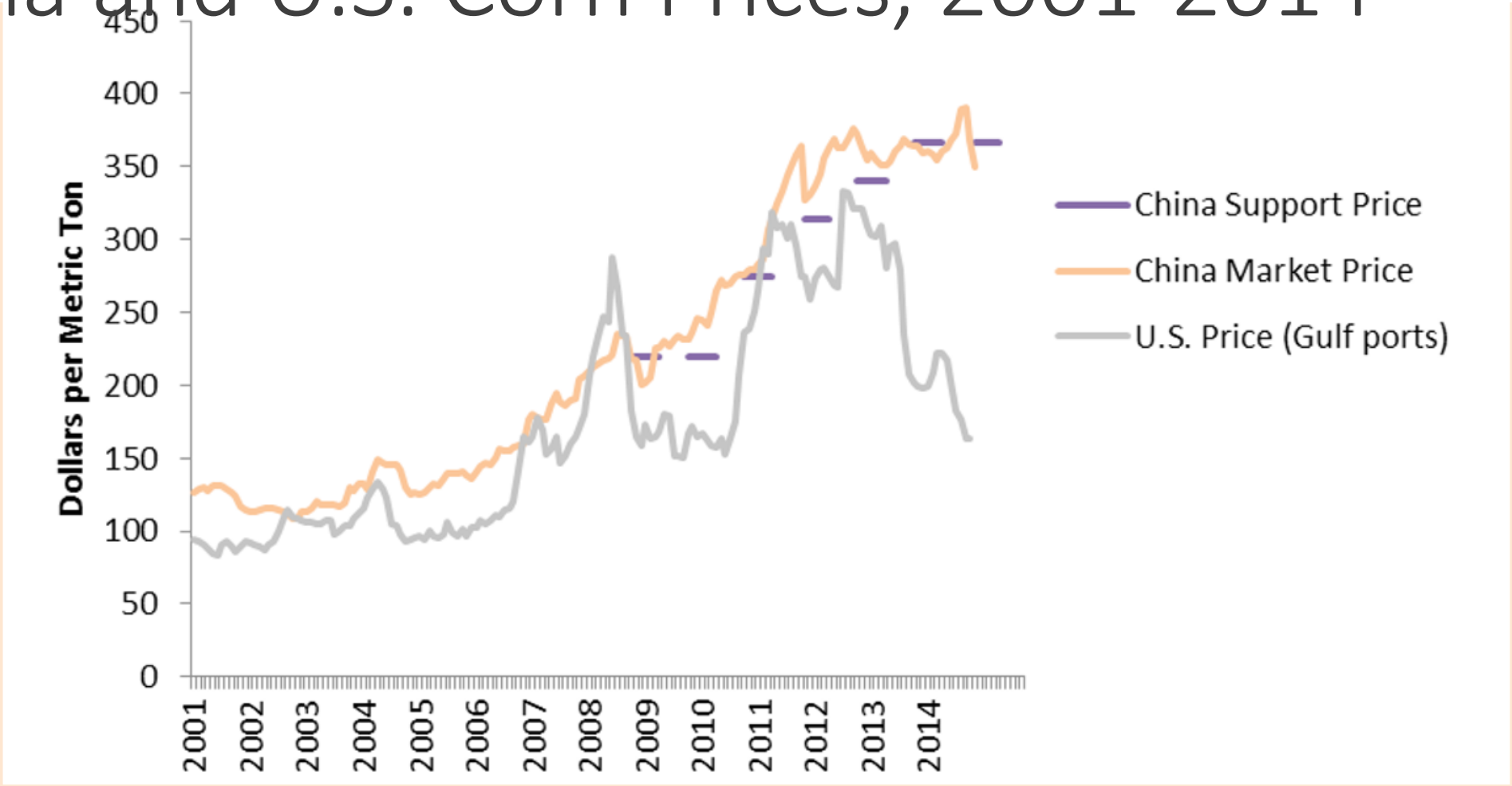
Direct interventions

- Tariffs
- Import and export quotas
- Export subsidies
- Sanitary and phytosanitary restrictions

Indirect interventions

- ➢ Exchange rate management
- ➢ Marketing supports
- ➢ Input subsidies and tax exemptions
- ➢ Long-term investment assistance

China and U.S. Corn Prices, 2001-2014



Note: China prices converted to U.S. dollars at the official exchange rate.

Source: China National Development and Reform Commission, China National Grain and Oils Information Center, and U.S. Department of Agriculture.

Agricultural Distortions database ---World Bank

Time period: 1955-2011

Countries : 75

Commodities : almost all major

Major indicators: NRA, Nominal Rate of Assistance, by product

Definition of NRA: farmers' gross return with/without policy

$$\boldsymbol{NRA} = \frac{\boldsymbol{Gross\ return\ with\ government\ policy - gross\ return\ without\ government\ policy}}{\boldsymbol{gross\ return\ without\ government\ policy}}$$

NRA=NRA_O(output) +NRA_I(input), NRA_O=NRA_B+NRA_D

NPS, non-product specific support

Major factors

Variable Name	Definition
NRA (NRA_B, NRA_D, NRA_I)	Indicators of aggregate market distortion
INC	Real GDP per capita
APR	Agricultural population rate
PAL	Per capita agricultural land
D_1, D_2, D_3	Dummy for food crisis or slump(73-74, 86-88,06-08)
DUMMY (TM,TH)	Dummy for trade status
S	Dummy for WTO membership

Econometric model

$$\boldsymbol{y_{it} = \alpha + \rho y_{i,t-1} + x_{it}'\beta + d_i'\delta + \varepsilon_{it}}$$

y_{it} stands for NRA or one of its components,

$x_{it} = \left(Inc_{i,t-1}, Inc_{i,t-1}^2, Inc_{i,t-1}^3, APR_{it}, PAL_{it}, D_{1it}, D_{2it}, D_{3it}, TM_{it}, TH_{it}, S_{it}\right)'$,

d_i represent a vector of *N-1* binary country indicators,

ε_{it} is an idiosyncratic error term.

Estimation method: OLS Fixed effect model---best linear predictors

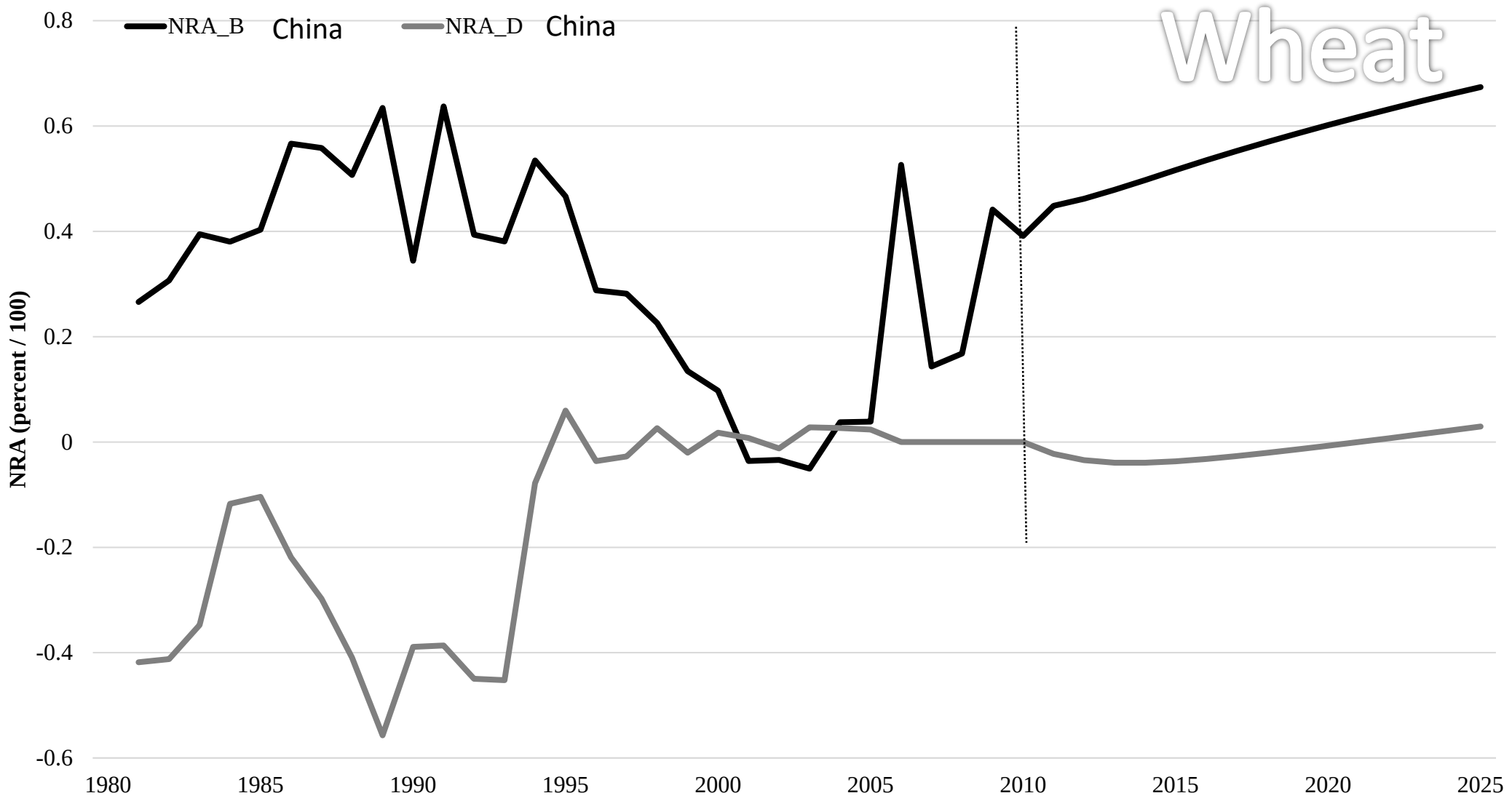
Preliminary results

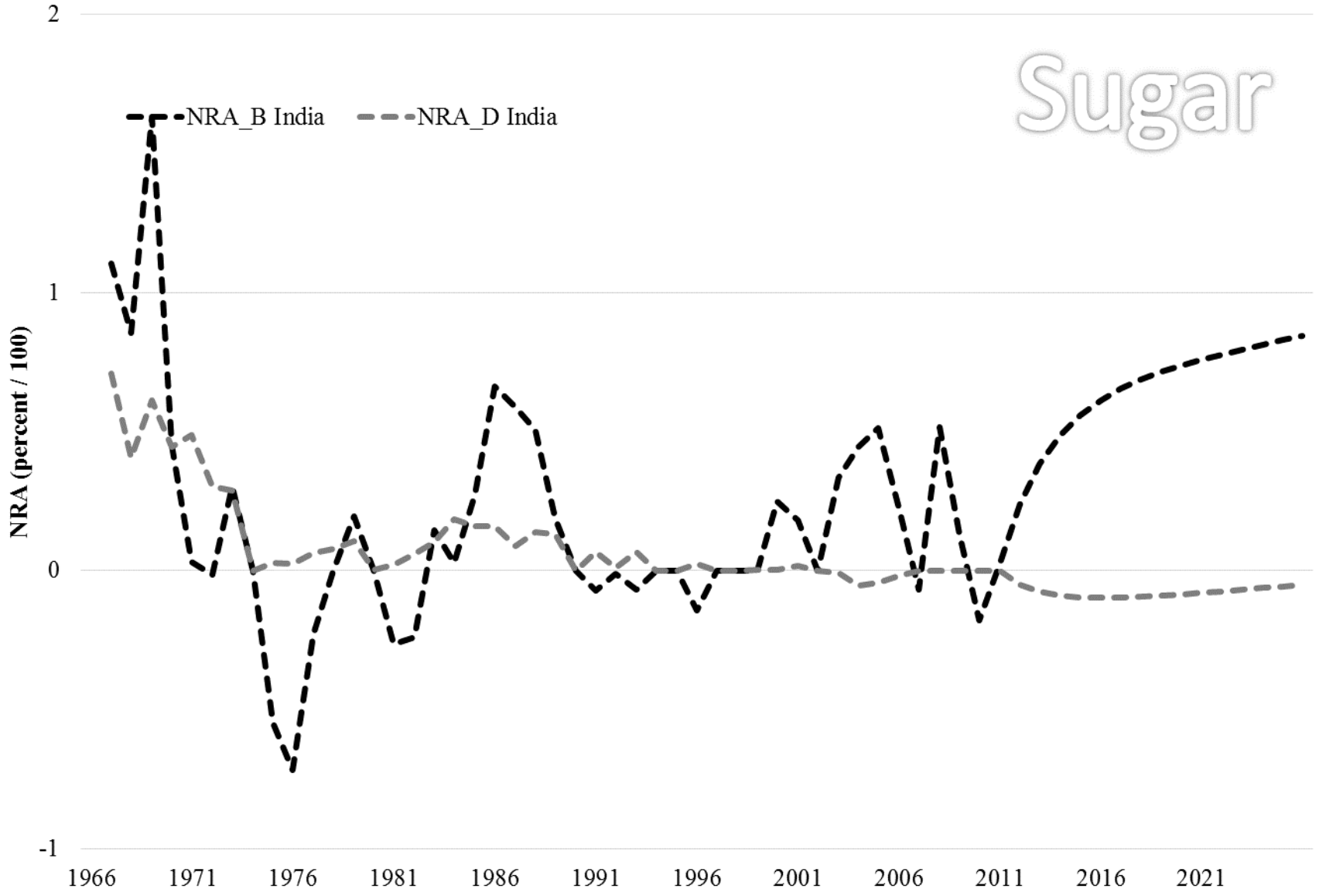
Estimation results for different commodities

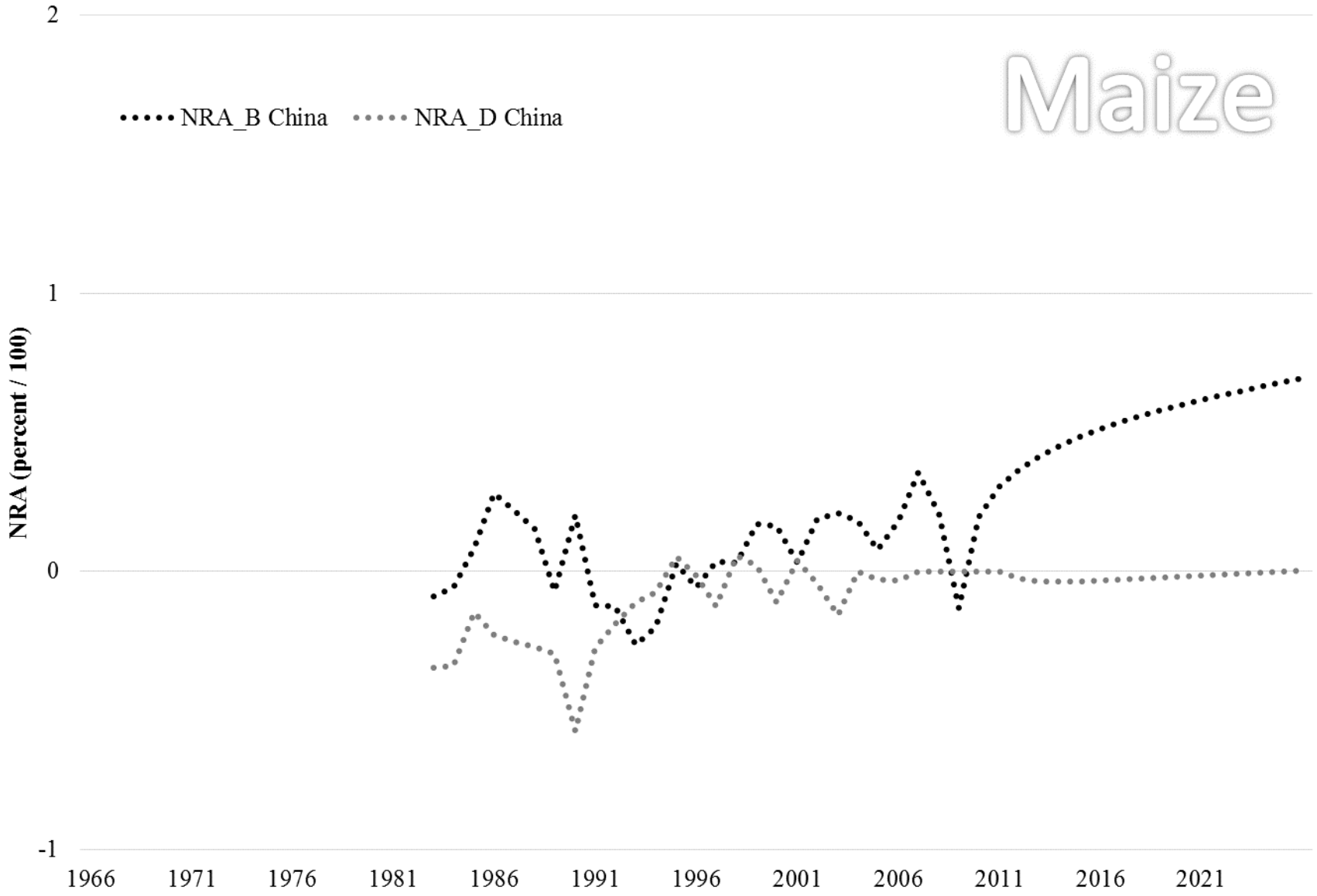
Forecasting of support levels in different countries

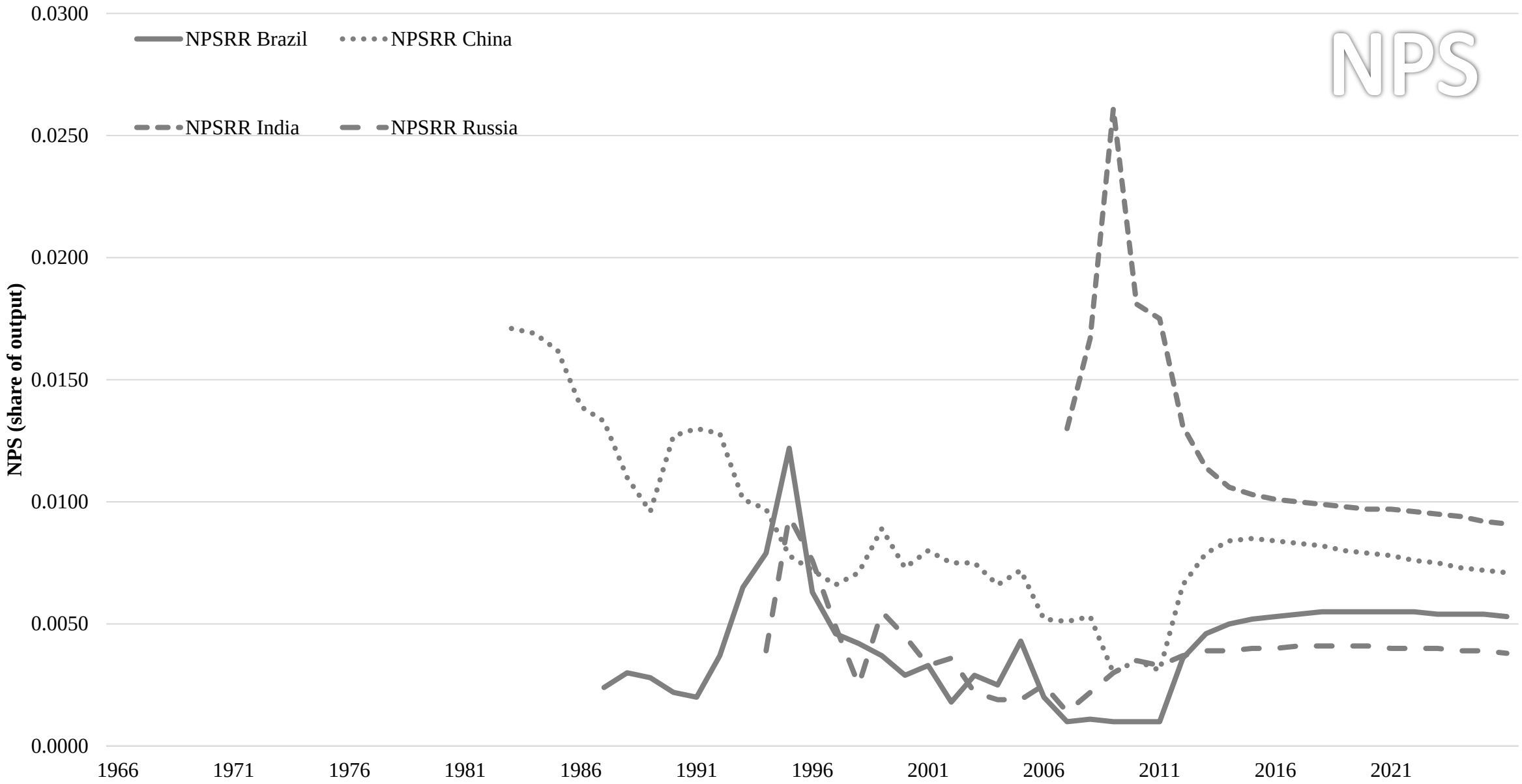
Estimation Results

	Wheat		Maize		Sugar		Cotton	
	NRA_B	**NRA_D**	**NRA_B**	**NRA_D**	**NRA_B**	**NRA_D**	**NRA_B**	**NRA_D**
NRA(B/D)_lag	0.59***	0.66***	0.54***	0.45***	0.68***	0.58***	0.51***	0.47***
INC_lag	-1.67**	-0.25	-2.71***	-0.48*	-3.08*	-0.76*	-0.21	0.34
INC_lag^2	0.24**	0.03	0.40***	0.06*	0.44**	0.10*	0.07	-0.06
INC_lag^3	-0.01**	0.00	-0.02***	0.00*	-0.02**	0.00*	0.00	0.00
APR	0.17	-0.06	0.43**	0.05**	0.13	0.07*	0.06*	0.06*
PAL	0.00	0.00	-0.01***	0.00	0.00	0.00**	0.01**	0.01**
S	-0.04*	-0.03***	-0.01	-0.01	0.10**	-0.01	0.08	0.01
73-74	-0.28***	-0.03**	-0.23***	-0.01	-0.57***	-0.01**	-0.04	0.00
86-88	0.26***	-0.01	0.19***	0.01	0.04	-0.02	-0.02	0.01
06-08	-0.09***	0.01	-0.08***	0.00	-0.25***	0.00	0.01	0.02
TM	0.07***	0.02	-0.02	0.01	0.06	0.01	0.01***	0.08***
TH	0.11**	-0.04	-0.04	-0.05	0.01**	-0.04**	-0.08	-0.04


NRA_B China
NRA_D China
Wheat
NRA (percent / 100)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025


Sugar
NRA_B India
NRA_D India
NRA (percent / 100)
2
1
0
-1
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
2021


Maize
NRA_B China
NRA_D China
NRA (percent / 100)
2
1
0
-1
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
2021


NPS
NPSRR Brazil
NPSRR China
NPSRR India
NPSRR Russia
NPS (share of output)
0.0300
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2016
2021

Linking NRA, projections of NRA with WTO notifications

No direct link between NRAs and WTO notifications, are different things

- One calculated in a systematic way from actual market data etc
- One generated according to rules but often deviating from actual support
- WTO notifications can stay the same when markets change, or countries can change the way that they notify the same policies

Purpose of project not to forecast notifications

Just want to investigate the relationship between NRAs and WTO notifications

Can then link income to notifications and look at impact of changing incomes on notifications

WTO notifications, Brazil

Large exporter of many products

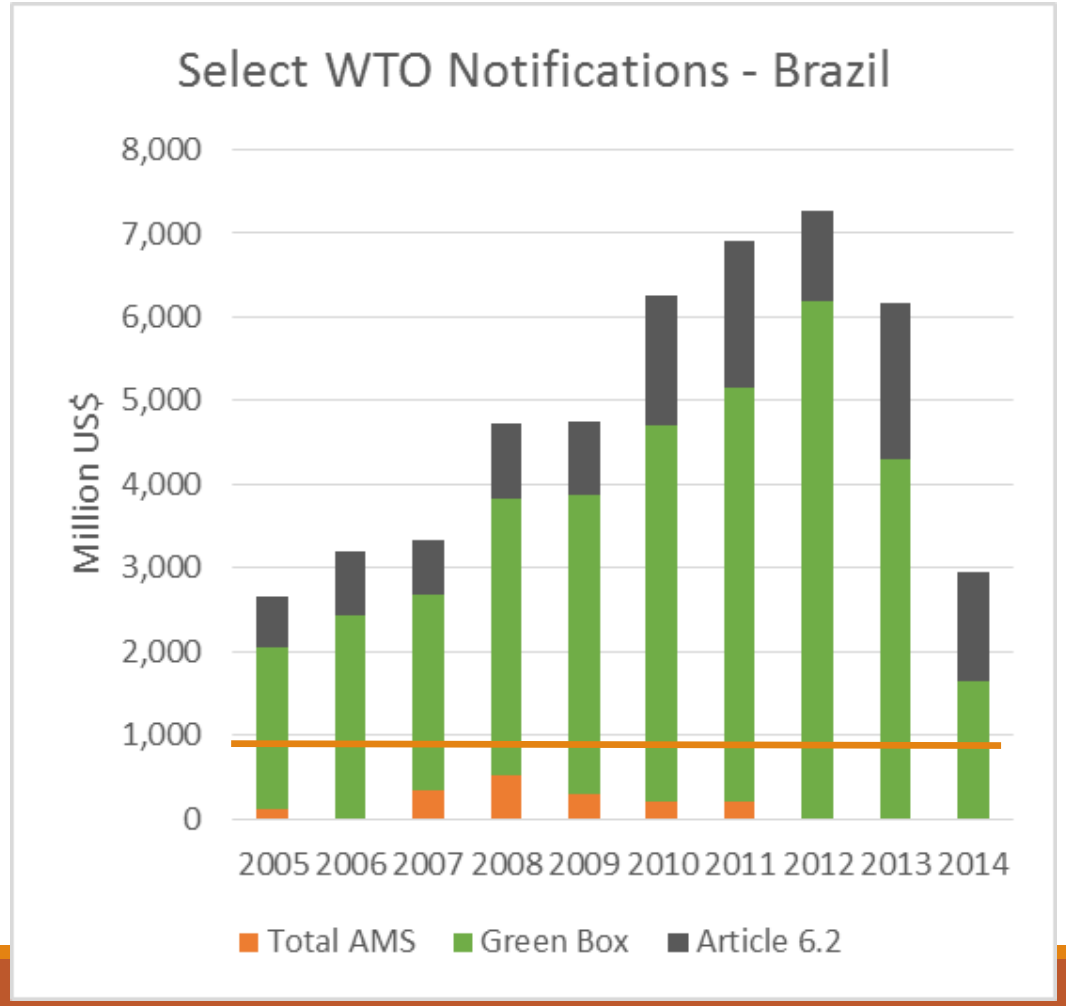
Previously had negative NRA_B

Over time NRA_B has tended towards zero

Model wants NRA_B to become positive, NRA_D to stay low

Ag support has risen, but not part of AMS

Using Article 6.2 exemption and green box



WTO notifications, Russia

Joined WTO in 2012

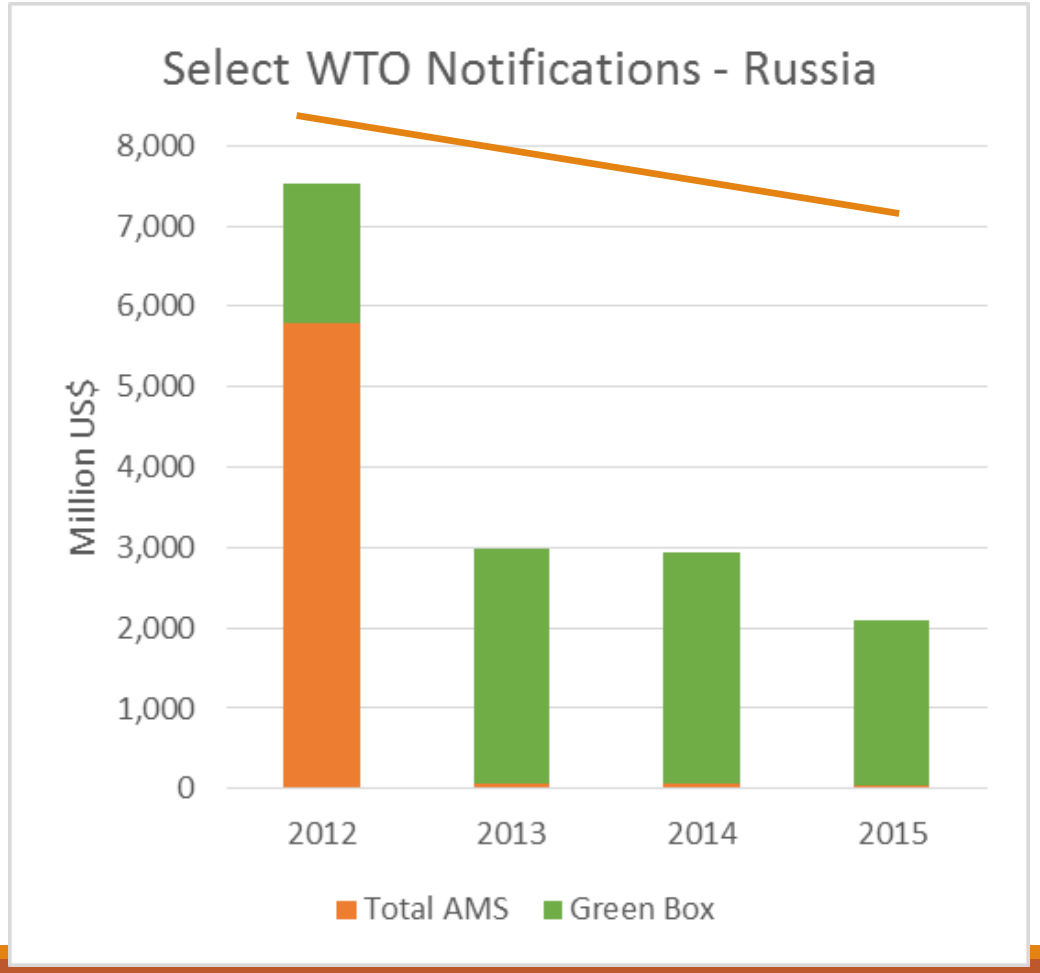
Mixture of policies:

- Crops exports often taxed

- Border protection for livestock products

Dataset ends pre-WTO, has negative NRA_B for wheat and maize

Our projections have NRA_Bs going positive



WTO notifications, India

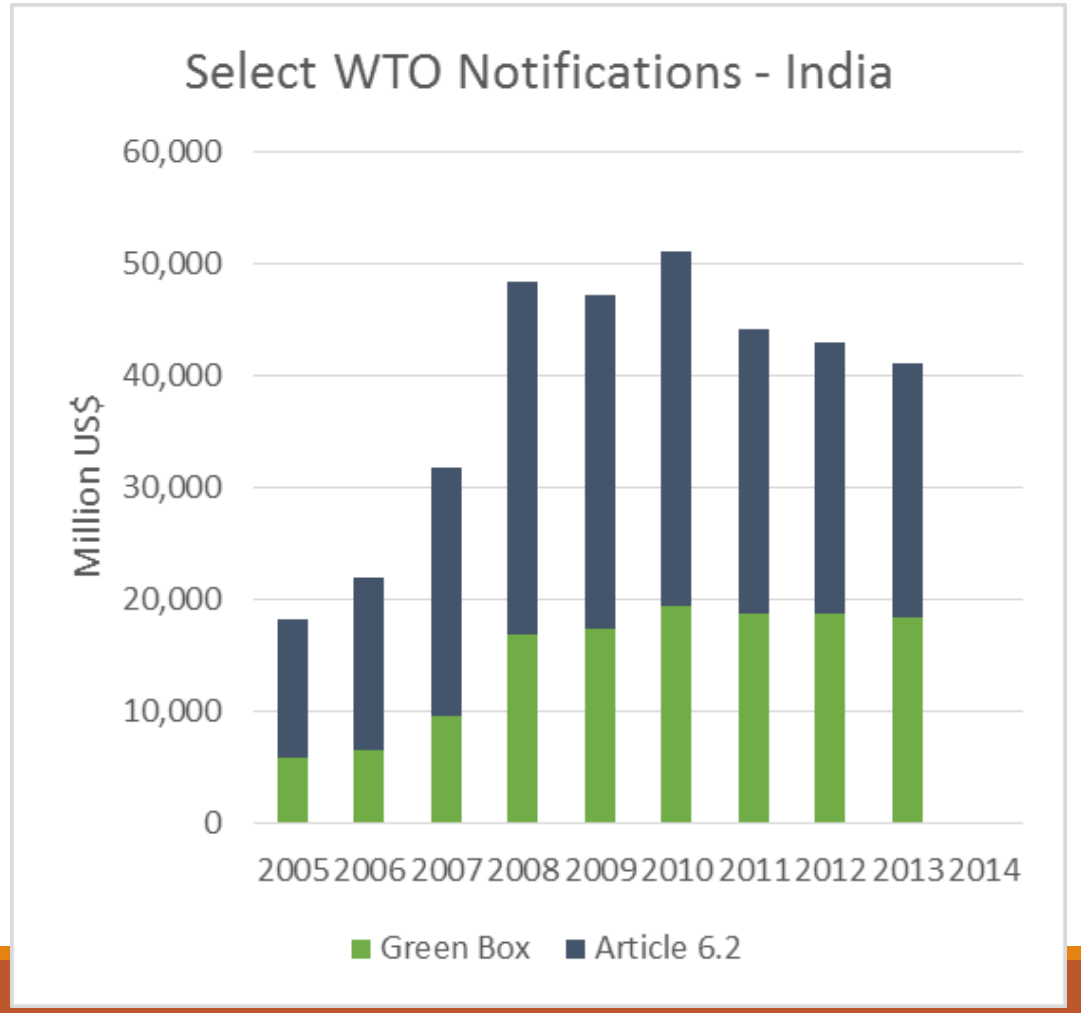
Self sufficiency also an important driver of policy

- Significant border controls, some non-tariff

- Significant state involvement in markets

Volatile NRA_Bs

Projections positive for cotton and sugar, slightly negative for wheat and maize

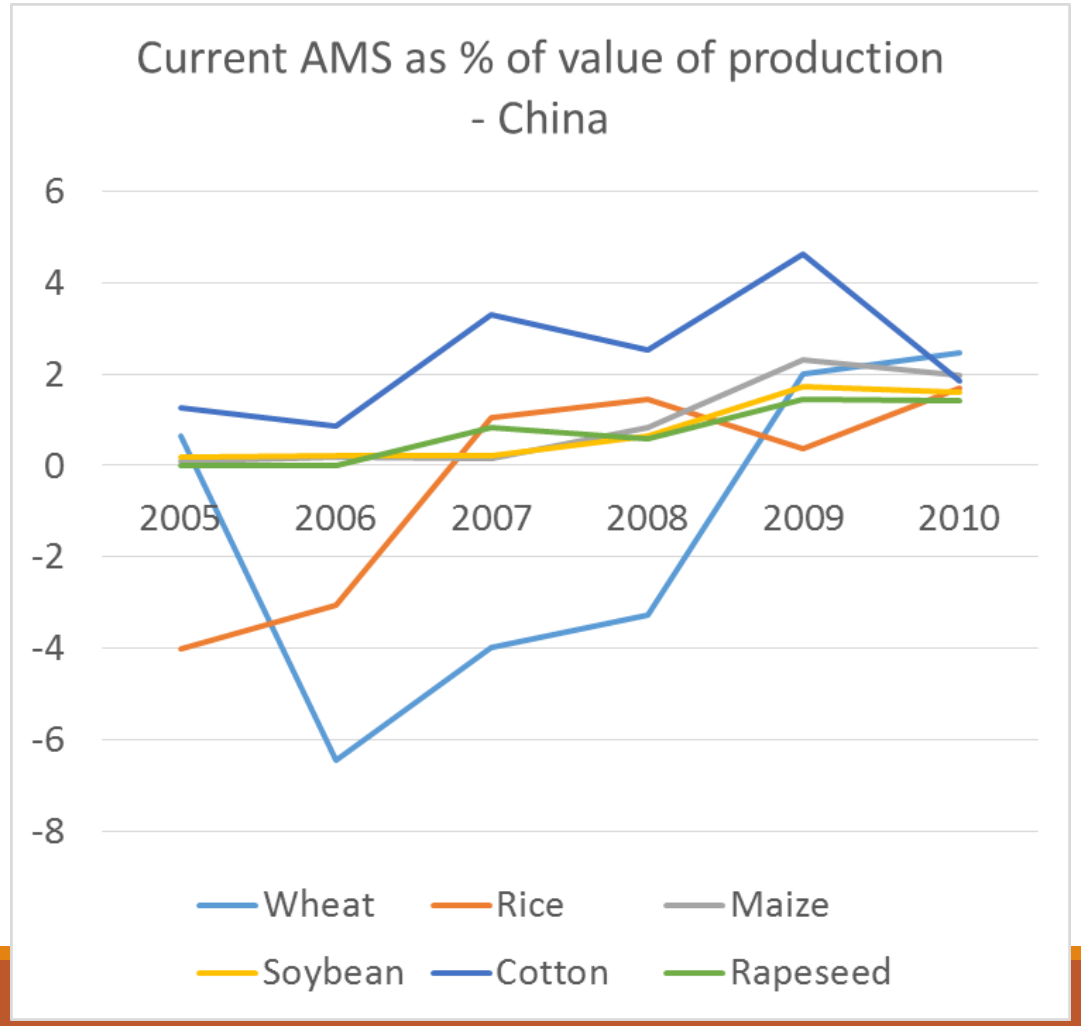


WTO notifications, China

China support for grains rising

Model only based on data to 2011 so missing relevant data

Trade off between border policies and domestic policies, with both potentially constrained by WTO



Progress report

We want to investigate the link between incomes and agricultural support

Use econometric model to link World Bank Agricultural Distortion database to income for select countries and commodities

The results vary by commodity, and result in different projected paths for agricultural support

We can use this to think about how agricultural support will evolve

What does this imply about WTO notifications?

Thanks!

Many thanks to the IATRC for commissioning this research.

Feel free to contact us with any comments or questions:

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