Fruits and Vegetables Model
with an exercise in unintended consequences

Hoa Huang and Wyatt Thompson

Invited Paper prepared for presentation at the International Agricultural Trade Research Consortium's (IATRC's) 2018 Annual Meeting: Interlinkages among Global Value Chains, Trade, and Transformation of the AgriFood Industry, July 25-27, 2018, Whistler, BC, Canada.

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Presented at the International Agricultural Trade Research Consortium Meeting of July 25-27, 2018

Hoa Hoang and Wyatt Thompson

University of Missouri

This material is based upon work supported by the U.S. Department of Agriculture, Office of the Chief Economist, under Agreement #58-0111-17-015, and the USDA National Institute of Food and Agriculture, Hatch project number MO-HASS0024. Any opinion, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture nor the University of Missouri.

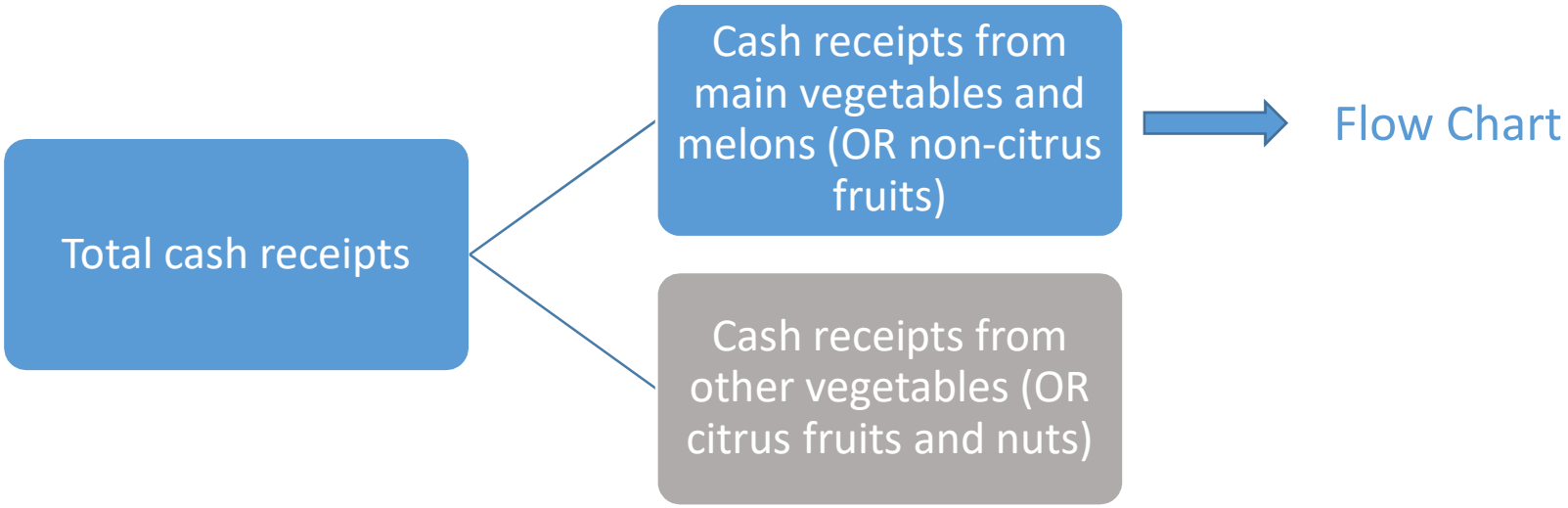
Model purposes

- Now
  - Projections for vegetable and fruit cash receipts
  - Part of total U.S. farm income projections
- Future
  - Policy analysis: how policy changes affect U.S. vegetable and fruit markets, trade, income
- Scope
  - Potatoes are modeled separately
  - Omits mushrooms, include melons (consistent with ERS's classifications)

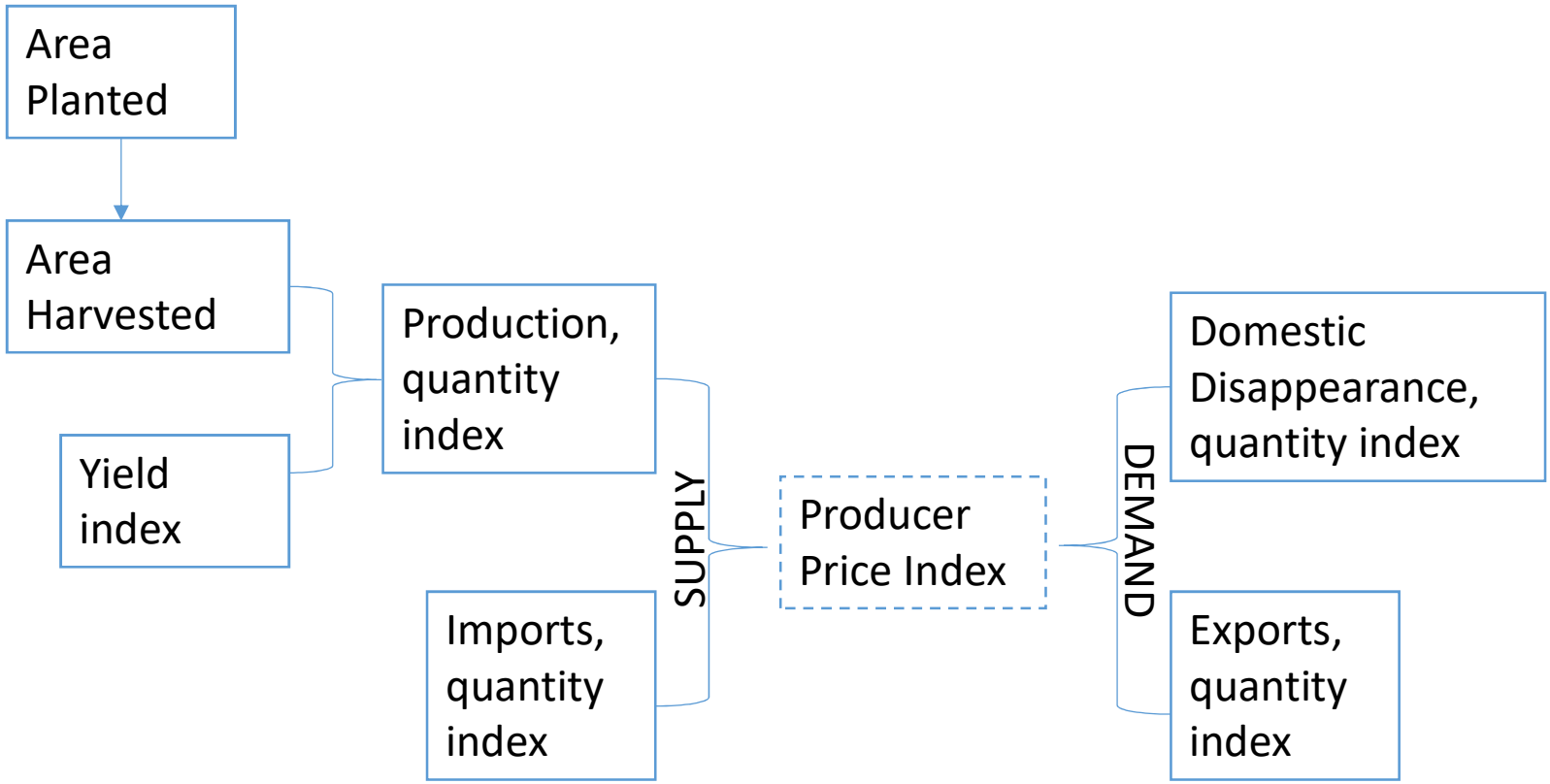
Data

Variable	Source
Area	NASS
Total value of trade	FAS GATS (HS-6), aggregated over commodities
Farm receipts	ERS farm income statistics
Producer price indices	BLS for the closest vegetable and fruit sub-groups
Macroeconomic	IHS Markit
Quantity indices	Calculated from values and price indices
Yield	Calculated from area and production
Domestic disappearance	Calculated from production and trade

Model structure



Flow chart for fresh vegetable and non-citrus fruit models



Quantity index = Value (mil. $)/PPI

Cash receipts = Production quantity index * PPI

Estimated elasticities

Price elasticity	Short-run, 2013-2015	Long-run
FRESH VEGETABLE MODEL		
Vegetable Area Planted	0.31	2.06
Vegetable Imports	0.27	0.84
Vegetable Exports	-0.98	
Domestic Disappearance	-0.71	
NONCITRUS FRUIT MODEL		
Noncitrus Fruit Bearing Acreage	0.01	0.08
Noncitrus Fruit Imports	0.02	
Noncitrus Fruit Exports	-0.04	
Domestic Disappearance	-0.36	

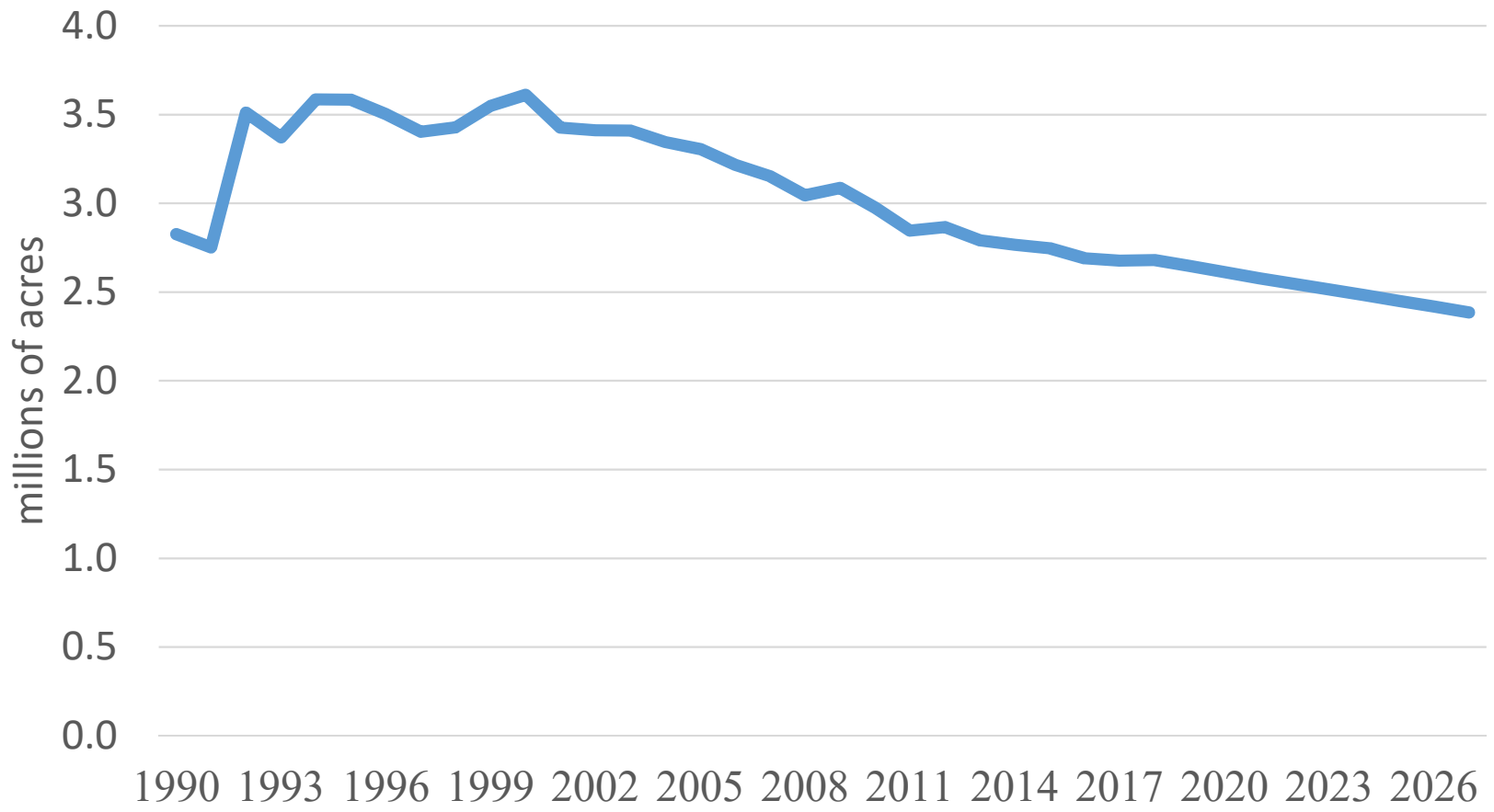
Projections

Projected fruit and vegetable market conditions and farm income – successful in first goal

Example: vegetable market and income projections of earlier this year

Vegetable Area planted

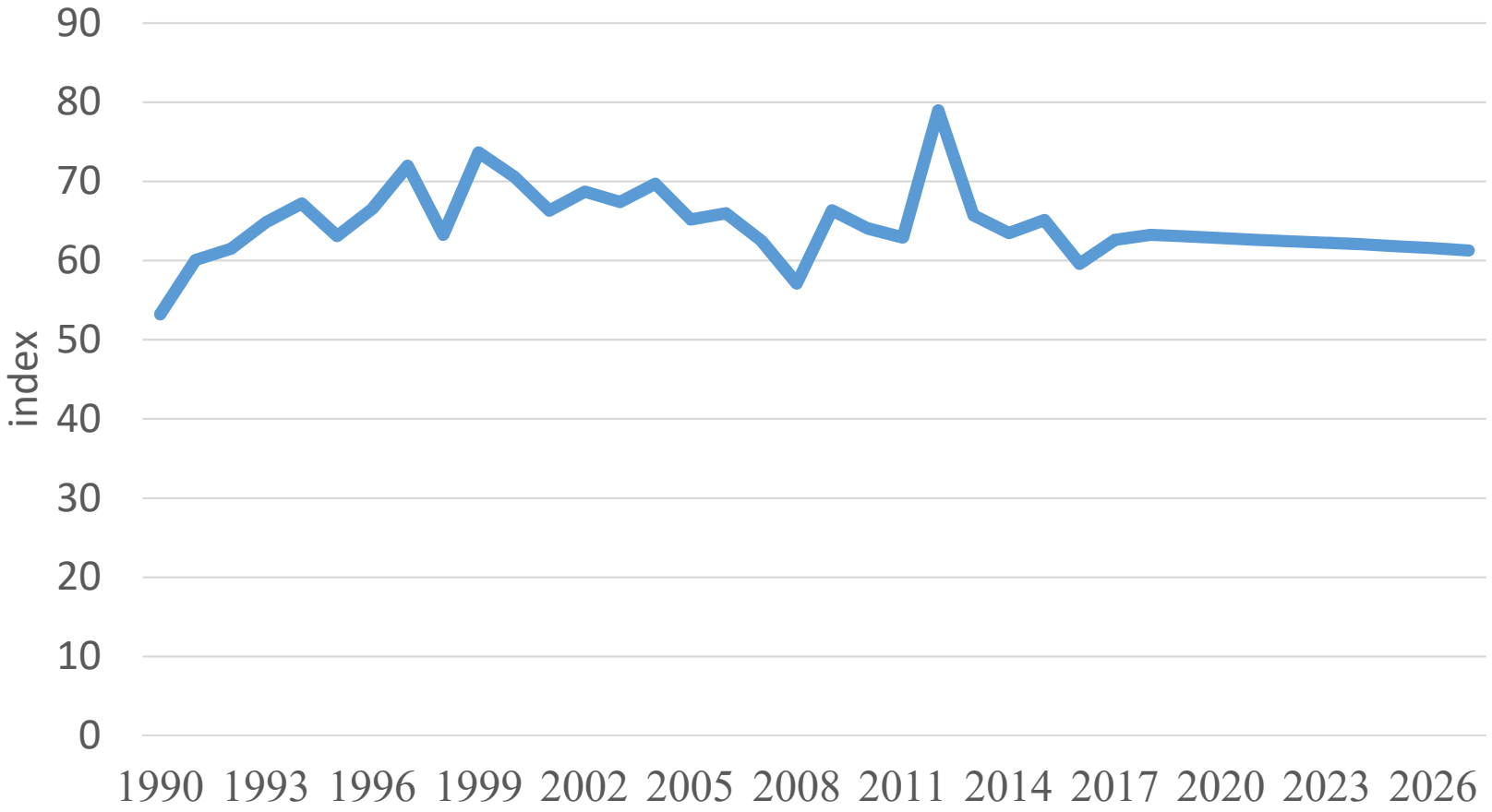
Continued decline



Sources: USDA for certain historical data and FAPRI-MU 2018 Baseline projections.

Vegetable production

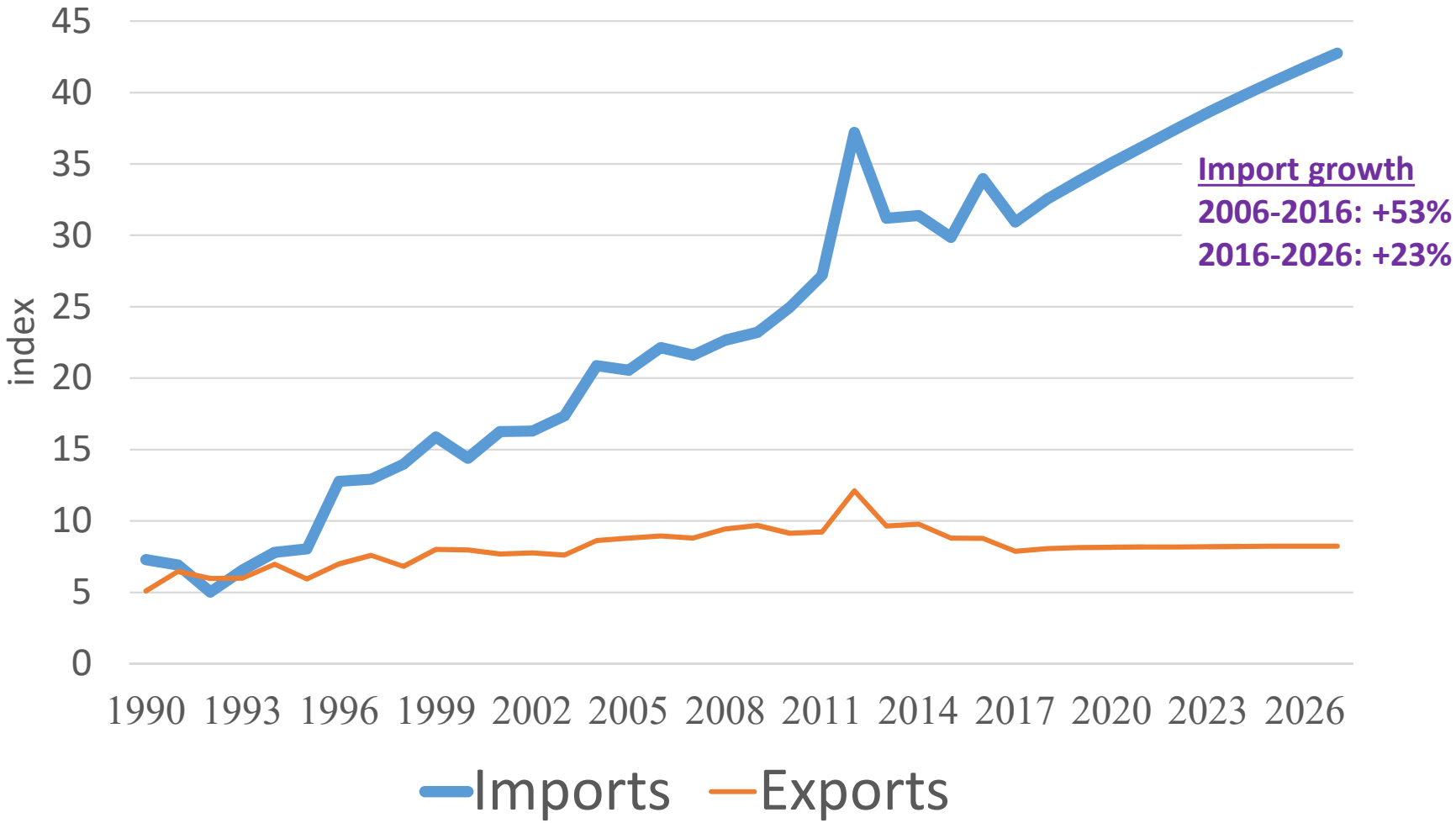
Rising yields sustain production



Sources: USDA for certain historical data and FAPRI-MU 2018 Baseline projections.

Vegetable trade

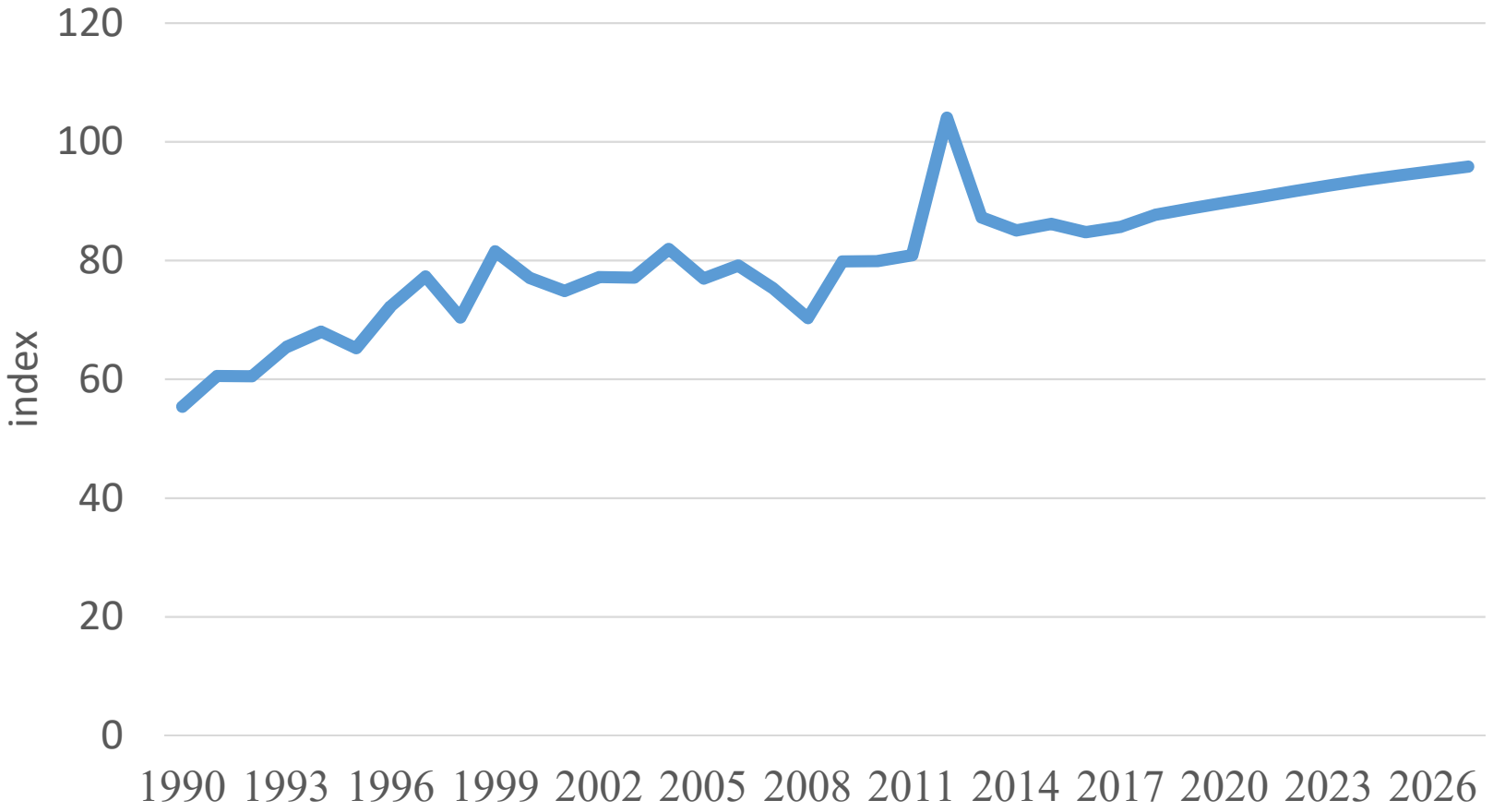
Import expansion projected to continue, flat exports



Sources: USDA for certain historical data and FAPRI-MU 2018 Baseline projections.

Vegetable domestic use

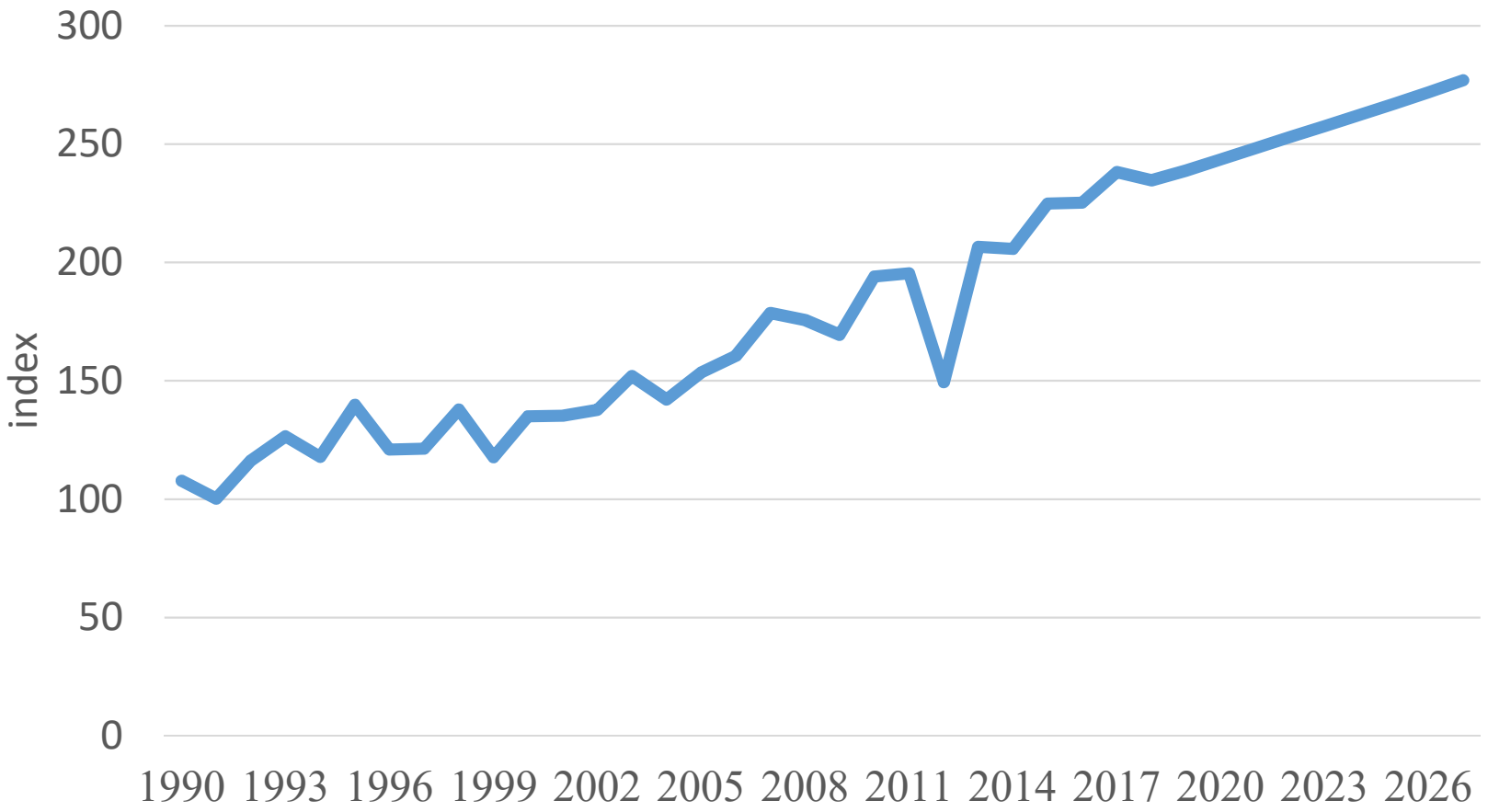
Income and population growth push up demand



Sources: USDA for certain historical data and FAPRI-MU 2018 Baseline projections.

Vegetable price

Rising demand offsets strong imports



Sources: BLS for certain historical data and FAPRI-MU 2018 Baseline projections.

Policy Analysis

Experiment to test ability how a policy change affects one of these markets – *preliminary*

Thought experiment: implications for vegetable markets if US program payments are coupled and affect vegetable area

Program payments and vegetables?

Theory

- Decoupling literature:
  - United States base payments can keep land in crop use
  - Implies effects on vegetables

- Just and Kropp (2013):

… when profits associated with the acceptable uses decline relative to the profits of the other uses, the production distortion associated with decoupled payments can be larger than the production distortion from an equivalent fully-coupled subsidy under very general and plausible conditions—the elasticity of the extensive margin is larger than the elasticity of the intensive margin and the yield disparities are increasing (the optimal yield on low quality land increases more slowly than the optimal yield on all land).

Empirical results

- Just and Kropp (2013)
  - Discuss a hierarchy of activities:
    1) annual crops
    2) vegetable and fruit
    3) fallow
  - Discuss trends in profitability
  - Estimate corn area, fertilizer, and seed input demands

    Use selected ARMS data
  - Use results to compare extensive and intensive margins

JK estimation results (page 1061)

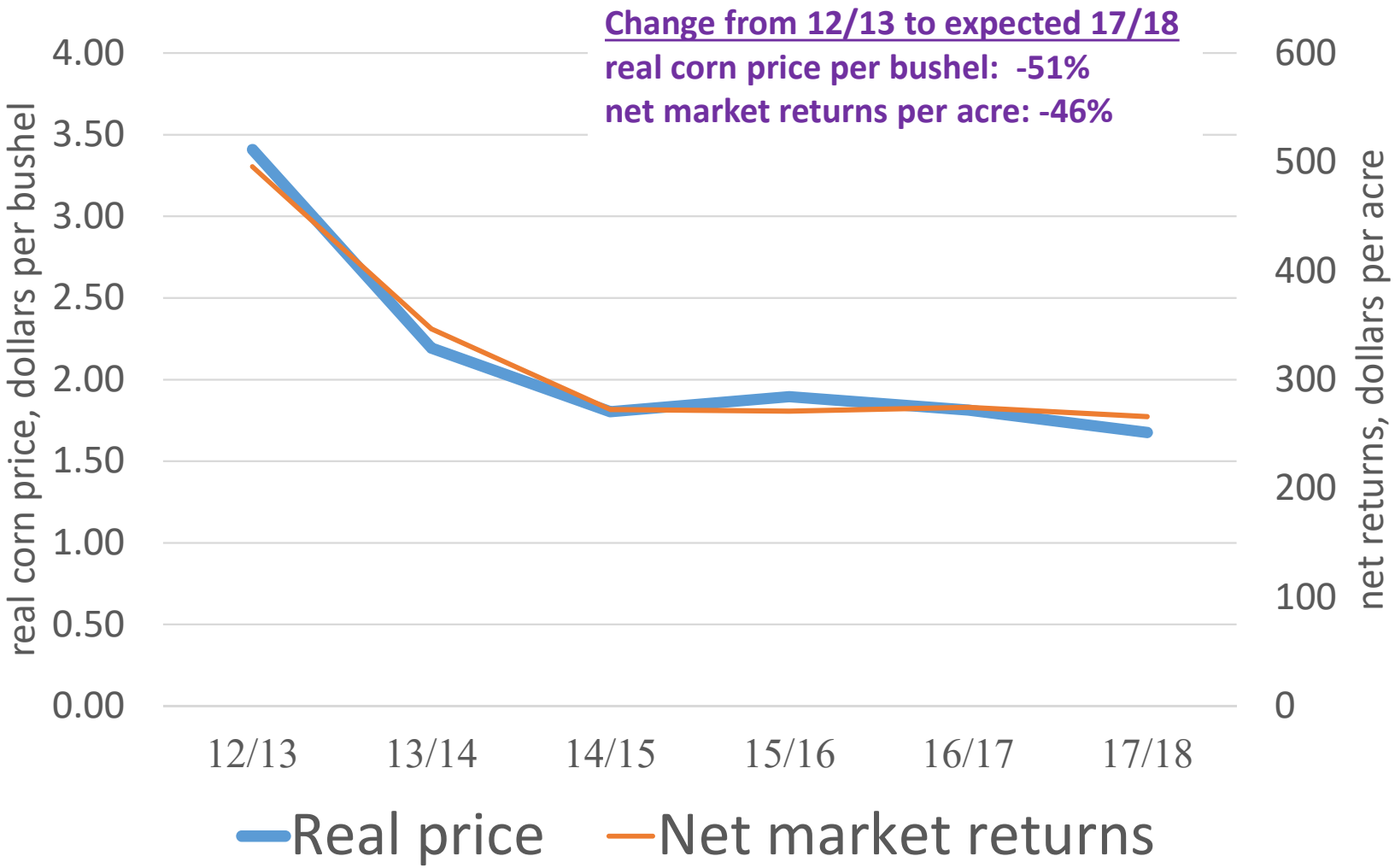
Table 2. Elasticities of the Intensive and Extensive Margins for U.S. Corn Production

	Dependent Variable		
	Intensive Margin		Extensive Margin
Covariate	log(seed rate)	log(nitrogen)	log(acres)
log(expect price)	0.3152***	0.8686***	2.9332***
	(0.0369)	(0.1572)	(0.3093)
log(seed cost)	0.0050***	0.0175***	0.0102
	(0.0018)	(0.0063)	(0.0129)
log(fertilizer cost)	−1.6181***	−0.2077	1.4078***
	(0.0398)	(0.1266)	(0.2154)
log(Yield_{t-1})	0.3865***	0.6696***	0.7428***
	(0.0195)	(0.0671)	(0.1423)
Intercept	14.3866***	−2.2217	−20.5959***
	(0.3660)	(1.3904)	(2.6734)
No. of Obs.	8,239	7,855	6,271
R-Squared	0.339	0.1683	0.1472

Note: Triple asterisk (***) denotes 1% significance level. Data are taken from the Corn Crop Production Practices (Phase II) Agricultural Resource Management Survey administered by the USDA-NASS for the years 1996, 2001, and 2005. Coefficient estimates are calculated using ordinary least squares and state-level fixed effects. Standard errors are computed using a jackknife procedure. Standard errors are in parentheses. State-level fixed effects are not reported.

Elasticities

Corn returns have fallen



Sources: USDA historical data, IHS Markit price deflator, and FAPRI-MU 2018 Baseline.

What would this result mean for vegetable markets?

Assumed impact on vegetable area?

- Their study: 2.9 elasticity of corn area with respect to corn price increases vegetable and fruit area
- Take portion of their estimated impact for 2013/14-2020/21 *
  - 2.9 elasticity for corn area real price change (after their publication) → -12.5 million acres corn average annual effect
  - Assume 14% goes to fruits and vegetables (share who participated in pilot program) → about 1.75 million acre change
  - Half allocated to vegetable area (actual share is 60%)

Shock builds to +0.874 million acres (before price effects)

+0.13 million acres initially

Starts in 2016

** Uses the immediate effect of one year. Their estimate of the full effect on area over time is many times larger.*

Implications for vegetable markets

	First year	Tenth
Area planted	+5%	+14%
Production	+5%	+14%
Imports	-1%	-5%
Total supply	+3%	+6%
Domestic use	+3%	+6%
Exports	+4%	+11%
Total demand	+3%	+6%
Price	-4%	-8%
Gross cash receipts	+1%	+4%

Successes and challenges

- Model fruit and vegetable markets
  - Can project market conditions
  - Initial steps towards policy analysis
- Limitations
  - A new model

    Data and parameters
  - Aggregation – Disaggregation tradeoff

    Does not explicitly represent:

    disparate goods, seasonal effects, transportation and perishability

Appendix

Classifications

	Fresh vegetables and melons*
1	Artichokes
2	Asparagus
3	Beans, Green lima
4	Beans, Snap
5	Broccoli
6	Cabbage
7	Cantaloupes
8	Carrots
9	Cauliflower
10	Celery
11	Corn, Sweet
12	Cucumbers
13	Garlic
14	Honeydews
15	Lettuce
16	Onions
17	Peas, Green
18	Peppers, Bell
19	Peppers, Chile
20	Pumpkins
21	Spinach
22	Squash
23	Tomatoes
24	Watermelons
	Other vegetables
1	Dry beans
2	Dry peas
3	Lentils
4	Sweet potatoes
5	Taro
	*Note: excluding mushrooms and potatoes

Classifications

	Noncitrus fruits
1	Apples
2	Apricots
3	Avocados
4	Cherries
5	Dates
6	Figs
7	Grapes
8	Nectarines
9	Olives
10	Peaches
11	Pears
12	Plums and prunes
13	Bananas
14	Blackberry group
15	Blueberries
16	Cranberries
17	Guavas
18	Kiwifruit
19	Papayas
20	Raspberries
21	Strawberries
	Citrus fruits and nuts
1	Grapefruit
2	Lemons
3	Oranges
4	Tangelos
6	Tangerines
5	Coffee
7	Almonds
8	Hazelnuts
9	Macadamia nuts
10	Pecans
11	Pistachios
12	Walnuts