Assessing Differential Impacts of a Trade Agreement Using a Quantile Regression Approach

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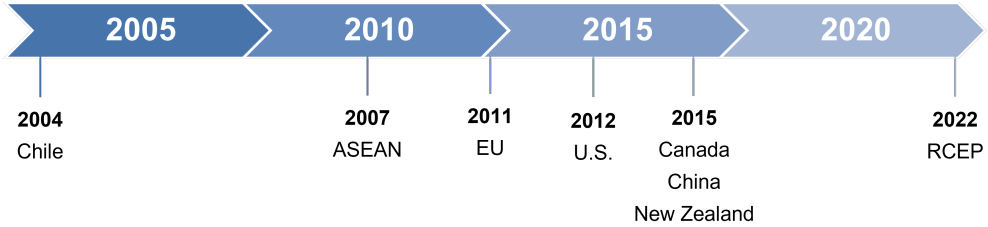
Introduction

- After the Doha Round, the regional or bilateral free trade agreements (FTAs) have increased around the world
  - Studies find that increasing imports/exports influence the profitability or the factor prices of the sectors that imports/exports are from China (e.g., Autor et al., 2013; Dix-Carneiro and Kovak, 2017; He, 2020; Yu et al., 2022).
- South Korean Case
  - 21 FTAs in effect with 59 countries (February 2023)
  - The imports of agricultural commodities increased while the production decreased

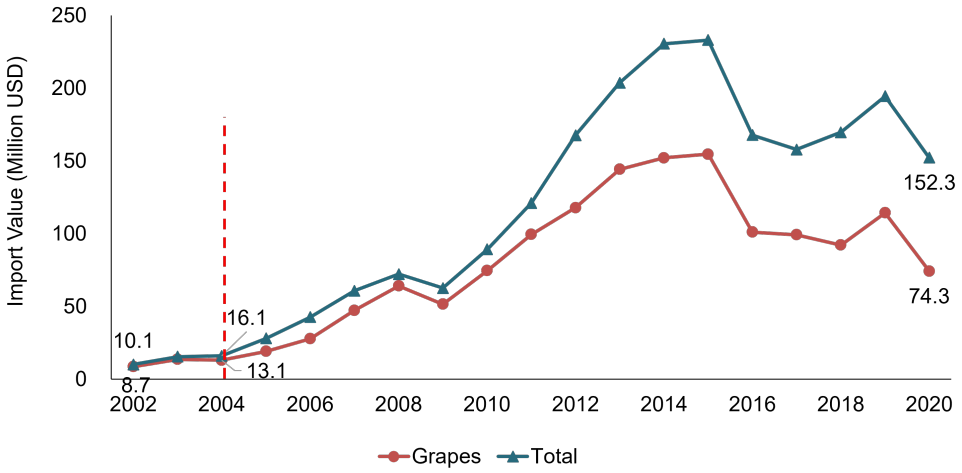
Research Question & Objectives

- Does the Korea-Chile FTA have differential impacts on the fruits and vegetable farms in South Korea?
  - Directly estimate the average impacts of the Korea-Chile FTA on the farms in South Korea using farm-level data
  - Estimate the differential impacts of the Korea-Chile FTA on agricultural profitability along the distribution of farm size.

FTAs in South Korea



Annual Agricultural Imports from Chile



Data

- Farm Household Economy Survey (FHES): provides a farm-level dataset
  - An annual survey on the economy of 3,200 sampled farm households
  - FHES provides farm businesses and households information (e.g. returns, costs, assets, liabilities, farm size, and types of agricultural commodities farm produced).
  - Panel data but survey samples and identifiers change every 5 years
- We focus on 5,251 farm-by-year observations from 2004 to 2007
  - Restrict samples to farms
    1. appeared in 2003 to capture the effect of both pre-FTA (2003-2004) and post-FTA (2006-2007)
    2. with any non-negative value of farm receipts
- Import data: extract using the 6-digit HS code from 2003 to 2007
  - All values are exchanged for KRW and deflated to 2003 KRW (UN Comtrade)

Dependent Variables

Definition of main dependent variables:

- Crop Revenue = sales revenue + self-consumption + inventory
- Farm Profit = crop revenue - farm operating costs
- Labor Cost = the amount paid for hired or family labor

Individualized Import

We compute the individualized import shock motivated by Autor et al. (2013):

$$Import\ Shock_{it}^{Chile} = \frac{Revenue_{i\ pre}^{F\&V}}{Total\ Revenue_{pre}^{F\&V}} \times Import_{t}^{F\&V,\ Chile} \tag{1}$$

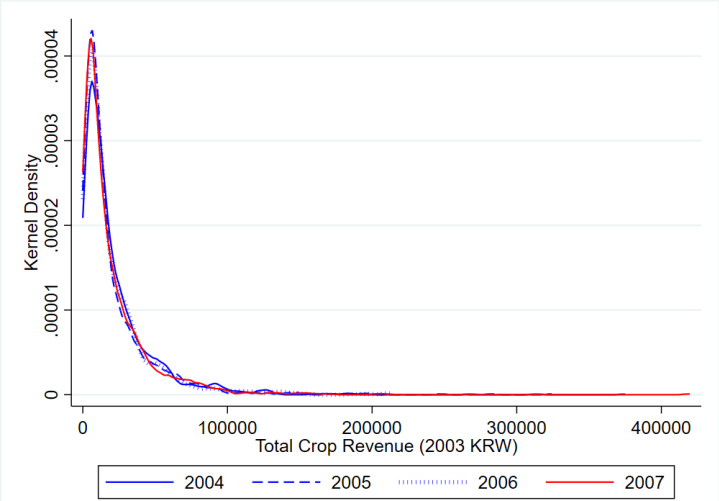
- $Revenue_{i\ pre}^{F\&V}$ is the average fruits and vegetables revenue for farm i in 2003–2004
- $Total\ Revenue_{pre}^{F\&V}$ is the average of national-level total fruits and vegetables sales revenue in 2003–2004
- $Import_{t}^{F\&V,\ Chile}$ is the import value of fruits and vegetables from Chile in year t where $t = \{2004, 2005, 2006, 2007\}$

Descriptive Statistics

VARIABLES	(1) 2004-2007 Average	(2) 2004	(3) 2005	(4) 2006	(5) 2007
Crop Revenue (2003 KRW)	20.82	22.10	20.30	20.44	20.07
(million 2003 KRW)	(26.78)	(27.59)	(27.24)	(25.07)	(26.82)
Farm Profit (2003 KRW)	12.04	13.11	12.64	11.86	10.19
(million 2003 KRW)	(18.52)	(19.76)	(20.24)	(16.04)	(17.10)
Labor Cost (2003 KRW)	0.957	0.927	0.968	0.914	1.025
(million 2003 KRW)	(3.414)	(2.782)	(3.941)	(3.254)	(3.723)
Share of Fruits and Vegetables	0.414	0.407	0.406	0.410	0.436
(%)	(0.336)	(0.339)	(0.331)	(0.338)	(0.333)
Fruit & Vegetables Import Exposure	399.8	377.8	346.0	410.4	473.5
(World, million 2003 KRW)	(747.5)	(699.3)	(641.7)	(750.7)	(887.9)
Fruit & Vegetables Import Exposure)	14.69	8.232	11.87	16.84	23.92
(Chile, million 2003 KRW)	(30.04)	(15.24)	(22.01)	(30.80)	(44.86)
Observations	5,251	1,592	1,250	1,192	1,217

Standard deviations are in parentheses. One million KRW 0.8 thousand USD (Source: FHES)

Distribution of Crop Revenue



Estimation

To estimate how the increased imports affect individual farm, we first consider the following estimation equation:

$$y_{it} = \beta_0 + \beta_1 Import\ Shock_{it}^{Chile} + X_{it}^{'}\Gamma + u_i + v_{st} + \epsilon_{it} \quad (2)$$

- y_{it} indicates crop revenue, farm profit, and labor cost for farm i in year t
- $Import\ Shock_{it}^{Chile}$ is individualized import defined by equation (1)
- $X_{it}^{'}$ is a vector of control variables for farm characteristics
- u_i and v_{st} are farm and province-by-year fixed effects

Quantile Regression

To assess the differential impacts, we consider the following unconditional quantile regression (UQR) (Firpo et al., 2009):

$$Q_y(\tau|X) = \beta_0(\tau) + \beta_1(\tau) Import\ Shock_{it}^{Chile} + u(\tau)_i + v(\tau)_t \tag{3}$$

where $Q_y(\tau|X)$ is the conditional τ-th quantile of y whose distribution is conditional on given covariates vector X, which includes the individualized import value, control variables, and farm and province-by-year fixed effects.

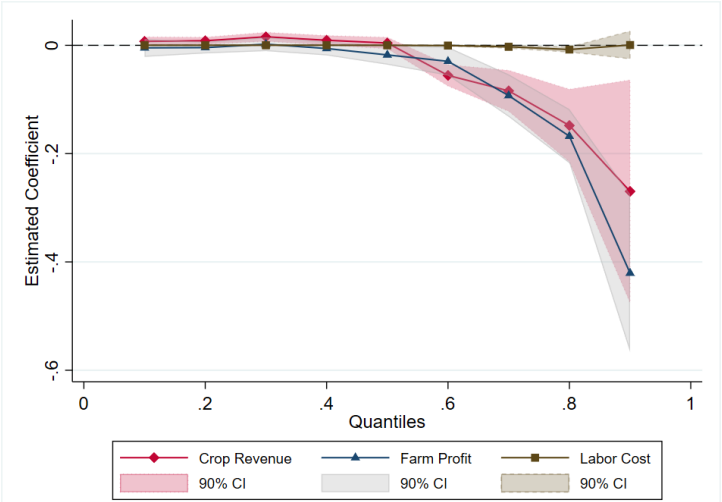
The UQR accounts for the individual-specific unobservables but uses predetermined quantiles so that the differential impacts can be estimated for "unconditional" quantiles.

Average Effects of Fruits and Vegetable Import Exposure on Farms

VARIABLES	(1) Crop Revenue (2003 KRW)	(2) Crop Revenue (2003 KRW)	(3) Profit (2003 KRW)	(4) Profit (2003 KRW)	(5) Labor Cost (2003 KRW)	(6) Labor Cost (2003 KRW)
F & V Import – Chile	-0.0285	-0.0560***	-0.0351*	-0.0593**	0.0056	0.0056
	(0.0186)	(0.0201)	(0.0195)	(0.0245)	(0.0059)	(0.0059)
Observations	4,864	4,864	4,864	4,864	4,864	4,864
Farm FE	Yes	Yes	Yes	Yes	Yes	Yes
Province-by-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes

Cluster-robust standard errors are clustered by province and year and reported in parentheses.

UQR Estimates of the Effect of Imports from Chile on Farms



Do F & V shares respond to import shocks?

We also consider the following equation to examine the effects of import exposure on the share of fruits and vegetables in total crop revenue:

$$Share\ of\ \ F\&V_{it} = \gamma_0 + \gamma_1 Import\ \ Shock_{it}^{Chile} + X_{it}'\Theta + u_i + v_{st} + \epsilon_{it} \tag{4}$$

where $Share\ of\ \ F\&V_{it}$ is the shares of the receipts from fruits and vegetables sales in total crop revenue for farm i in year t.

Effects of Import Exposure from Chile on the Share of Fruits and Vegetables in the Total Crop Revenue

	(1)	(2)	(3)	(4)	(5)
	OLS		UQR		
VARIABLES			$\tau = .25$	$\tau = .50$	$\tau = .75$
F & V Import – Chile	-0.0384***	-0.0338**	-0.0425***	-0.0691*	-0.0471
	(0.0140)	(0.0140)	(0.0142)	(0.0373)	(0.0363)
Observations	4,837	4,847	4,864	4,864	4,864
Farm FE	Yes	Yes	Yes	Yes	Yes
Province-by-Year FE	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes	Yes

Cluster-robust standard errors are clustered by province and year and reported in parentheses.

Robustness Checks

- We examine the robustness with respect to the following restrictions on samples, and all results remain robust.

- Additional sample restrictions:
  1. Weighted Import Exposure
  2. Expansion of Sample Period: 2003 to 2007
  3. Inclusion of Negative Inventory Values
  4. The inverse hyperbolic sine (IHS) transformation
  5. Fruits and Vegetable Import Exposure from the World

Concluding Remarks

- Findings
  - Overall, the fruits and vegetable imports from Chile have negative impacts on farms
  - The import exposure positively affects crop revenue and farm profit for low- and middle-sized of farms (between the 10th and the 60th quantiles), but negatively impacts large-sized farms (above the 60th quantile)
  - More imports from Chile cause farms to switch their crops
- Limitations and Remarks
  - We can only observe short-term effects of Korea-chile FTA on farms
  - We find that the immediate impact is substantial and heterogeneous along the farm size

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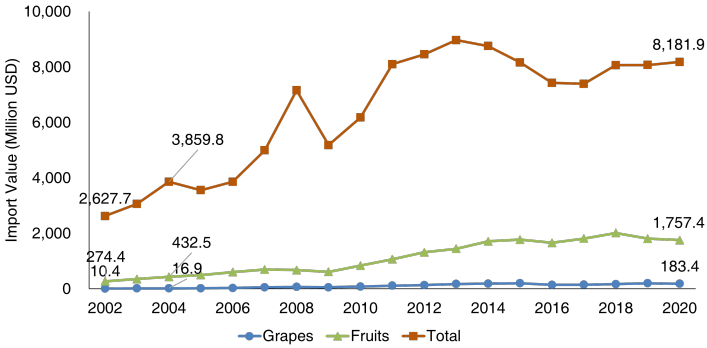
Appendix

Annual agricultural imports from the world



Appendix

Estimation of UQR

Using the recentered influence function (RIF), the effect of import exposure on the marginal (unconditional) quantiles of the dependent variable can be captured by estimating the following equation:

$$RIF(y_{it}; q_\tau, F_y) = \beta_0 + \beta_1 Import\ Shock_{it}^{Chile} + u_i + v_t + \epsilon_{it}$$

where y_{it} are the crop revenue, farm profit, and labor cost, q_τ is the τ-th quantile of y, F_y is the cumulative density function of y, and

$$RIF(y_{it}; q_\tau, F_y) = q_\tau + \frac{\tau - I\{y \leq q_\tau\}}{f_y(q_\tau)}$$

with $I\{y \leq q_\tau\}$ is dummy variable that indicates 1 if the value of y is less than the value of y at q_τ, and $f_y(q_\tau)$ is the probability density function of y evaluated q_τ. We can estimate the effect of import exposure on the unconditional quantiles implementing an OLS regression with the assumption that $Pr[Y > q_\tau | X = x]$ is linear in x.

Appendix

Effects of Import Exposure from Chile on Farm Economy at Different Quantiles

VARIABLES	(1) $\tau = .25$	(2) $\tau = .50$	(3) $\tau = .75$
Depend. variable: Crop Revenue			
F & V Import – Chile	0.0146***	0.0042	-0.0969***
	(0.0047)	(0.0065)	(0.0311)
Depend. variable: Farm Profit			
F & V Import – Chile	-0.0021	-0.0178	-0.1203***
	(0.0078)	(0.0110)	(0.0276)
Depend. variable: Labor Cost			
F & V Import – Chile	0.0001	0.0000	-0.0045**
	(0.0002)	(0.0002)	(0.0021)

Observations are 4,864. All regressions include a constant, control variables, farm and province-by-year fixed effects.

Appendix

UQR Estimates of the Effect of Imports from Chile on the F & V Share