Cross-Border Threats to Health: Impacts of Trade Liberalization on Nutritional Transition

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Introduction

Motivation

Trade and Health: Theory vs. Practice

- International trade improves consumer welfare by providing greater variety of products and lowering prices through efficiency gains (Melitz, 2003; Melitz and Trefler, 2012).
- In theory, cross-border food trade can ease global hunger by lowering prices and improving access to staples in poorer countries, while expanding food variety in richer ones.
- However, in practice, the cross-border flow of unhealthy food products can undermine public health.

Motivation

Trade and Health: Evidence from Samoa Island

- After World War II, the U.S. began to dump turkey tails to Samoa island which are high-fat by-product of poultry industry.
- At the same time, obesity rate in Samoa has gradually increased to 53 percent in 2010.
- Concerning about the increase in obesity rates, the Samoa government banned the turkey tail imports in 2007.
- But later lifted the ban after joining the WTO.

Research Question

Can Trade Policy Affect Nutrition, Health and Welfare?

- While the link between trade, diet change, and health seems plausible, research is scarce due to data limits and identification challenges.

- Giuntella et al. (2020, JIE): A notable exception — increased exposure to unhealthy foods induced by NAFTA increased the state-level obesity share in Mexico.

- Building on this literature, we use micro-level data and a novel structural approach to test whether trade liberalization drives unhealthy food inflows, substitutes domestic products, and shapes nutritional transitions.

What We Do

Does Trade Liberalization Trigger Nutritional Change?

- **[Trade Policy]** We exploit South Korea's two FTAs:
  1. South Korea - EU FTA (July 2011)
  2. South Korea - US FTA (March 2012)

- **[Data]** We use multiple micro-level datasets:
  1. UN Comtrade Database
  2. FTA Tariff Concession Tables
  3. Korea International Trade Association (KITA) Database
  4. NielsenIQ Korea
  5. Ministry of Food and Drug Safety Database

- **[Empirical Strategy]** We use multiple empirical techniques:
  1. Difference-in-Differences
  2. Instrumental variable regression
  3. Structural estimation

$\Rightarrow$ Examine whether the FTAs drove nutritional transitions by increasing imports and consumption of unhealthy foods in SK.

Preview

Summary of Findings

1. Using UN Comtrade, we find that imports of unhealthy food products increased after the FTAs entered into force.

2. Using KITA dataset, combined with the concession tables of two FTAs, we find complete pass-through, consistent with Fajgelbaum et al. (2020, QJE).

3. Using NielsonIQ Korea dataset, in the chocolate market, we found that import price declined by 16 percent and purchase of imported products increased by more than 100 percent.

4. Combined with the nutritional information data, we structurally estimate the chocolate market's demand–supply framework and find that higher overall consumption, and a 2.8 percent rise in national sugar intake.

Literature

Related Literature

1. **[Trade liberalization and health]**
   - Lin et al. (2018); Giuntella et al. (2020); Gracner (2021)

2. **[Tariff pass-through]**
   - Fajgelbaum et al. (2020); Flaaen et al. (2020)

3. **[Structural estimation of demand-and-supply system]**
   - Nevo (2001); Kim (2023); Grieco et al. (2024); Kim and Kim (2025)

4. **[Quantifying health costs of sugar intake]**
   - Kang et al. (2011); Imamura et al. (2015); Xi et al. (2015)

Data

Data

UNCOMTRADE dataset

- Trade data at the HS-6-digit product and country level

South Korea FTA documents

- Tariff concession tables of KOR-EU and KOR-US FTAs

Korea International Trade Association (KITA) data

- Trade data at the HS-10-digit product and country level

NielsonIQ Korea dataset

- Product-brand-manufacturer level price, quantity, weight constructed from scanner data

Ministry of Food and Drug Safety database

- Product-level nutritional contents per 100g (e.g., sugar, cholesterol, sodium) along with country of origin

Table: Wide Definition of Unhealthy Foods

HS	Product	HS	Product
0201	Beef	1806	Chocolate
0203	Pork	1902	Pasta
0401	Milk & cream	1905	Bakery products
0402	Milk & cream	2007	Jams, jellies, marmalades
0403	Fermented dairy (yogurt, kefir)	2009	Fruit & vegetable juices
0405	Butter	2101	Coffee & tea extracts/preparations
0406	Cheese	2103	Sauces & condiments
1101	Wheat or meslin flour	2104	Soups & broths
1517	Margarine; fat blends	2105	Ice cream
1601	Sausages & similar	2106	Snack foods / ready meals
1602	Prepared/preserved meats	2202	Sweetened beverages
1701	Cane/beet sugar (solid)	2203	Beer
1702	Other sugars & syrups	2204	Wine
1703	Molasses (sugar by-products)	2208	Spirits & liqueurs
1704	Sugar confectionery (sweets)	-	-

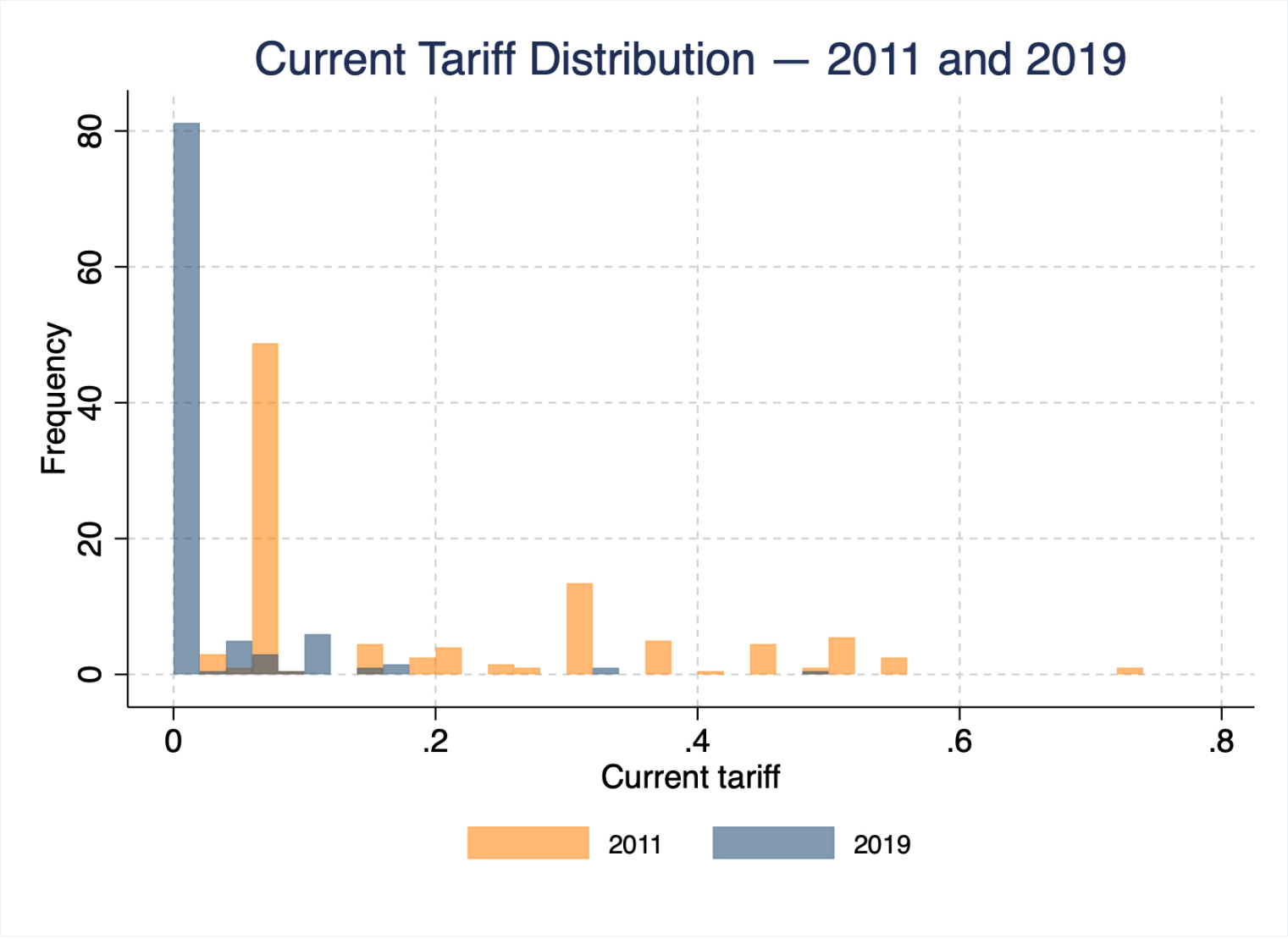
Table: Narrow Definition of Unhealthy Foods

HS	Product	HS	Product
0402	Milk & cream (powdered/condensed)	2007	Jams, jellies, marmalades
1701	Cane/beet sugar (solid)	2009	Fruit & vegetable juices
1702	Other sugars & syrups	2101	Coffee & tea extracts/preparations
1703	Molasses (sugar by-products)	2103	Sauces & condiments
1704	Sugar confectionery (sweets)	2105	Ice cream
1806	Chocolate	2106	Snack foods / ready meals
1905	Bakery products	2202	Sweetened beverages

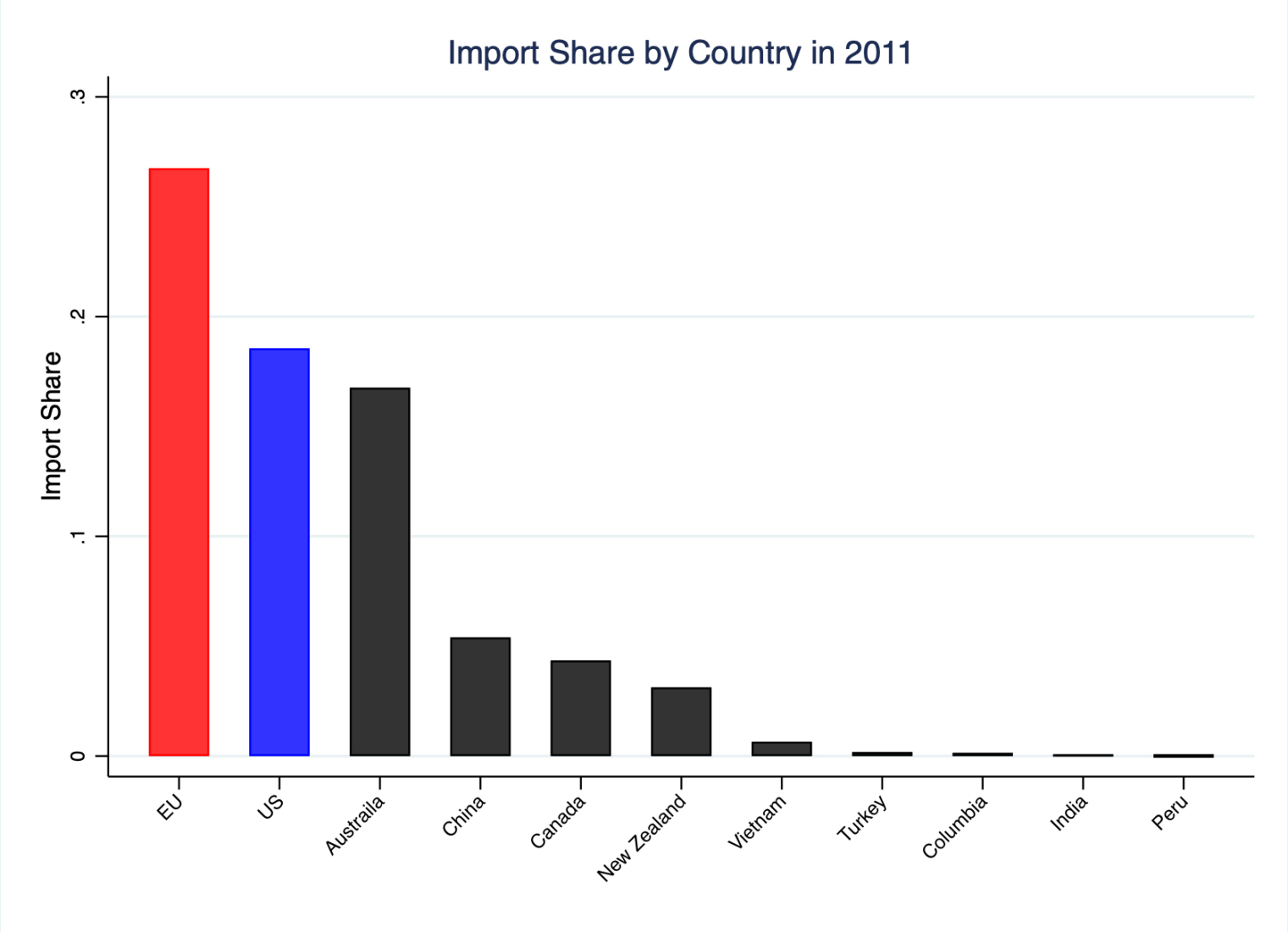
Table: Tariff Cuts by Concession Category

US Concession Category					
HSK code	Product	Year	Category	Tariff	Note
1904101000	Cereal	2011	A	5.4%	Tariff eliminated at once
1904101000	Cereal	2012	A	0%	
1904101000	Cereal	2013	A	0%	
1806201000	Chocolate	2011	C	8%	Tariff eliminated uniformly for 5 years
1806201000	Chocolate	2012	C	6.4%	
1806201000	Chocolate	2013	C	4.8%	
1806201000	Chocolate	2014	C	3.2%	
1806201000	Chocolate	2015	C	1.6%	
1806201000	Chocolate	2016	C	0%	
EU Concession Category					
HSK code	Product	Year	Category	Tariff	Note
1904101000	Cereal	2011	0	5.4%	Tariff eliminated at once
1904101000	Cereal	2012	0	0%	
1904101000	Cereal	2013	0	0%	
1806201000	Chocolate	2011	5	8%	Tariff eliminated uniformly for 6 years
1806201000	Chocolate	2012	5	6.66%	
1806201000	Chocolate	2013	5	5.33%	
1806201000	Chocolate	2014	5	4%	
1806201000	Chocolate	2015	5	2.66%	
1806201000	Chocolate	2016	5	1.33%	
1806201000	Chocolate	2017	5	0%	

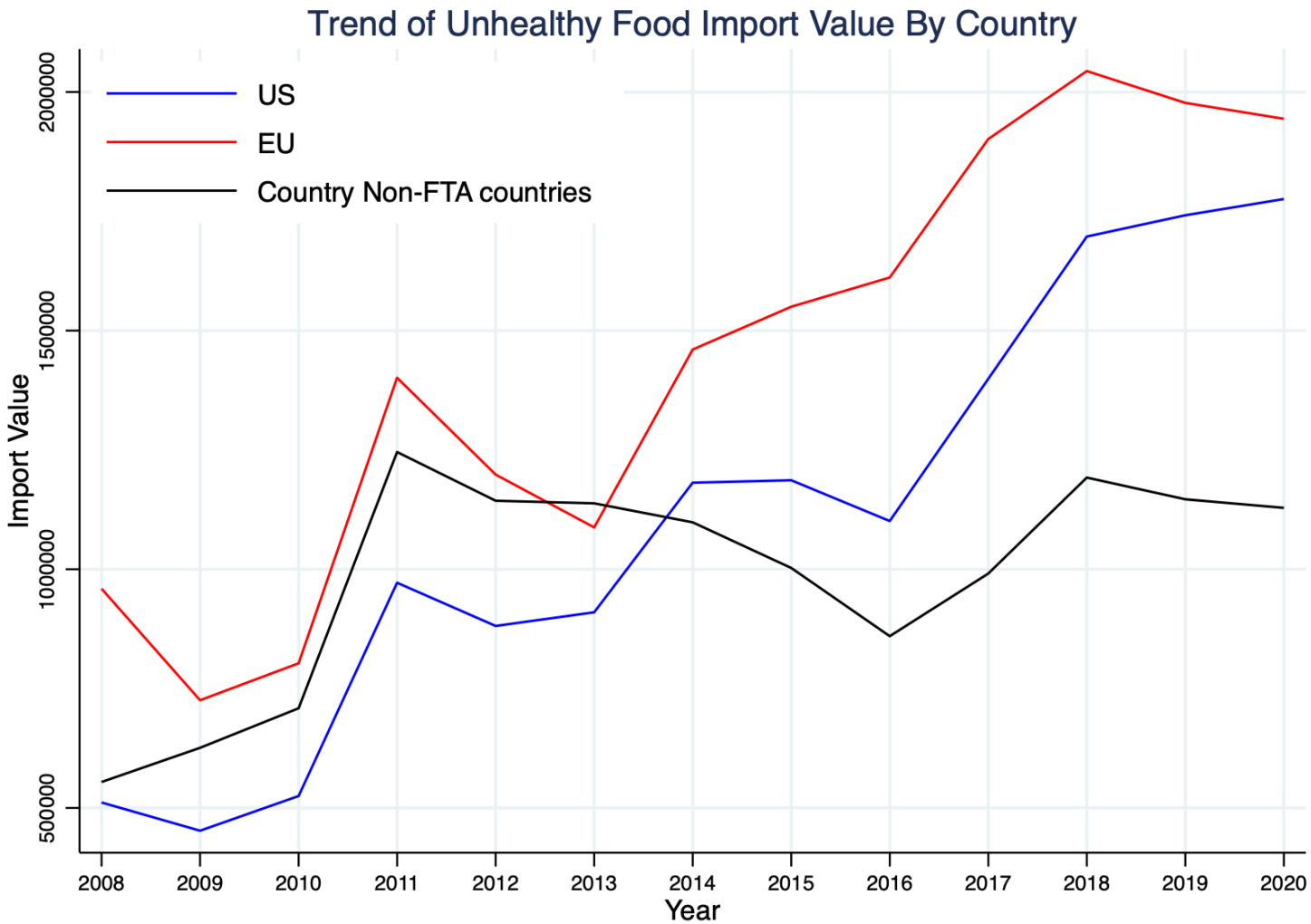
Histogram of Tariff Rates Among Unhealthy Foods



Unhealthy Food Import Share by Country



Trend of Unhealthy Food Import



Unhealthy Food Imports

Identification Strategy

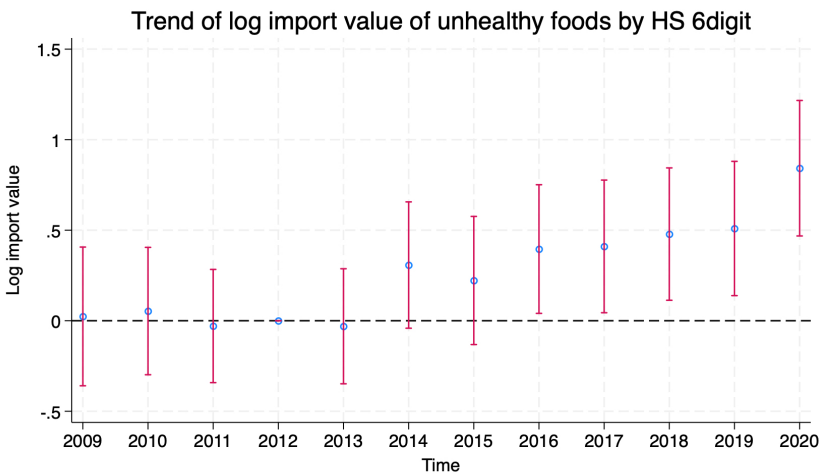
Event study regression on unhealthy foods

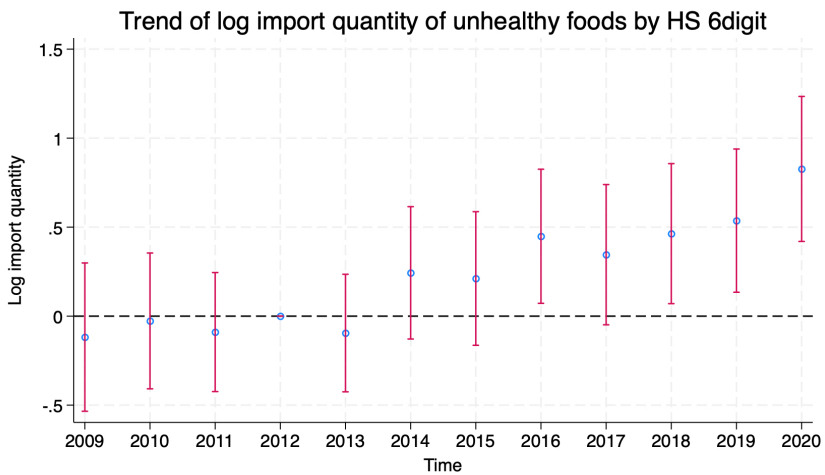
$$lny_{igt}^{SK} = \alpha_{it} + \alpha_g + \sum_{k \neq 2012} \beta_k \cdot FTA_g \mathbf{1}(t = k) + \varepsilon_{igt}$$

- lny_{igt}^{SK}: log import value, log quantity for unhealthy food i, from country g, in year t
- i: HS-6-digit code on unhealthy foods
- t: years from 2009 to 2020
- α_{it}: product x year FEs
- α_g: country FEs
- FTA_g: 1 for country belongs to the treatment group
- S.E. clustered at HS-4-digit code x country level

Estimation Results - Wide

$$lny_{igt}^{SK} = \alpha_{it} + \alpha_g + \sum_{k \neq 2012} \beta_k \cdot FTA_g \mathbf{1}(t = k) + \varepsilon_{igt},$$

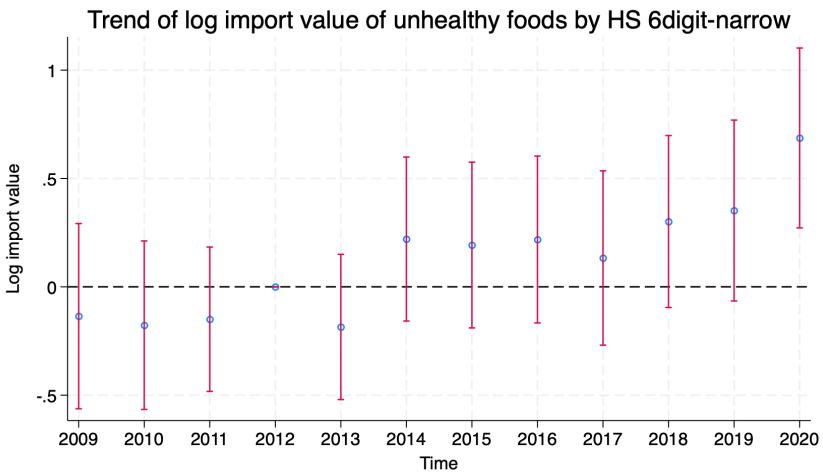


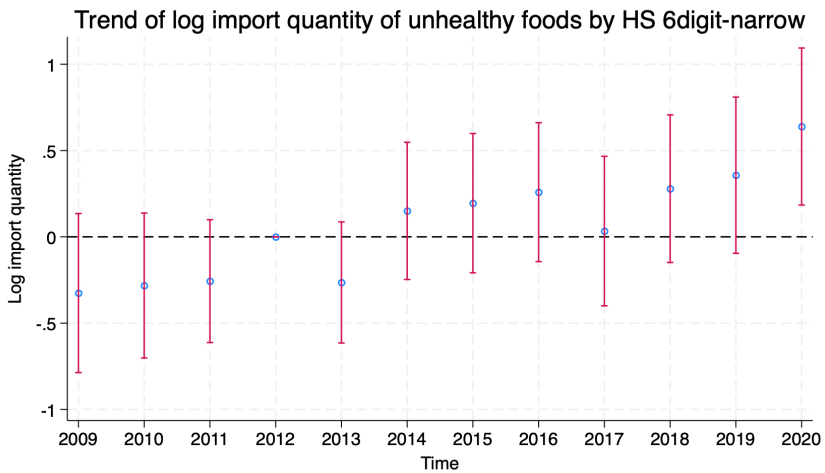


- Both the import value and the import quantity increased after the FTAs took effect relative to non-FTA countries.

Estimation Results - Narrow

$$lny_{igt}^{SK} = \alpha_{it} + \alpha_g + \sum_{k \neq 2012} \beta_k \cdot FTA_g \mathbf{1}(t = k) + \varepsilon_{igt},$$





- Increasing trend remains in the narrower definition of unhealthy products
- **Stacked estimation design** with more FTA countries better shows the statistical significance

Tariff Pass-through

Identification Strategy

Pass-through regression

$$\Delta ln y_{igt} = \alpha_{ig} + \alpha_{gt} + \alpha_{it} + \beta \Delta ln(1 + \tau_{igt}) + \varepsilon_{igt}$$

- i: HS-6-digit code in the food sector
- g: U.S. and EU 19 countries (UK excluded)
- t: years from 2009 to 2019
- α_{ig}: product x country FEs
- α_{gt}: country x year FEs
- α_{it}: product x year FEs
- $\Delta ln(1 + \tau_{igt})$: log difference of tariff rate of product i from country g in year t
- Data is aggregated to HS-6-digit HS code
- S.E. clustered at HS-4-digit code x country level

Tariff Pass-through Results

$$\Delta ln(1 + y_{igt}) = \alpha_{ig} + \alpha_{gt} + \alpha_{it} + \beta \Delta ln(1 + \tau_{igt}) + \varepsilon_{igt},$$

	$\Delta ln(1 + p^*_{igt} m_{igt})$	$\Delta ln(1 + m_{igt})$	$\Delta ln(1 + p^*_{igt})$	$\Delta ln(1 + p_{igt})$
Δln$(1+\tau_{igt})$	-3.9909***	-3.3004***	0.2951	0.9327***
Product x Country FE	Yes	Yes	Yes	Yes
Country x Year FE	Yes	Yes	Yes	Yes
Product x Year FE	Yes	Yes	Yes	Yes
Obs	15,741	15,741	15,741	15,741

- $p^*_{igt} m_{igt}$: import value in dollars
- m_{igt}: import quantity in kilograms
- p^*_{igt}: before-duty unit price
- $p_{igt} = (1 + \tau_{igt}) p^*_{igt}$: duty-inclusive unit price

Tariff Pass-through Results

$$\Delta ln(1+y_{igt}) = \alpha_{ig} + \alpha_{gt} + \alpha_{it} + \beta \Delta ln(1+\tau_{igt}) + \varepsilon_{igt},$$

	$\Delta ln(1+p^*_{igt}m_{igt})$	$\Delta ln(1+m_{igt})$	$\Delta ln(1+p^*_{igt})$	$\Delta ln(1+p_{ig})$
Δln(1+τ_{it})	-3.9909***	-3.3004***	0.2951	0.9327***
Product x Country FE	Yes	Yes	Yes	Yes
Country x Year FE	Yes	Yes	Yes	Yes
Product x Year FE	Yes	Yes	Yes	Yes
Obs	15,741	15,741	15,741	15,741

- The duty-inclusive unit price (i.e., domestic price) decreased by the tariff cut, however, the before-duty unit price (i.e., exporter price) did not change.

$\Rightarrow$ Evidence of complete pass-through consistent with Fajgelbaum et al.(2020,QJE).

Placebo Test

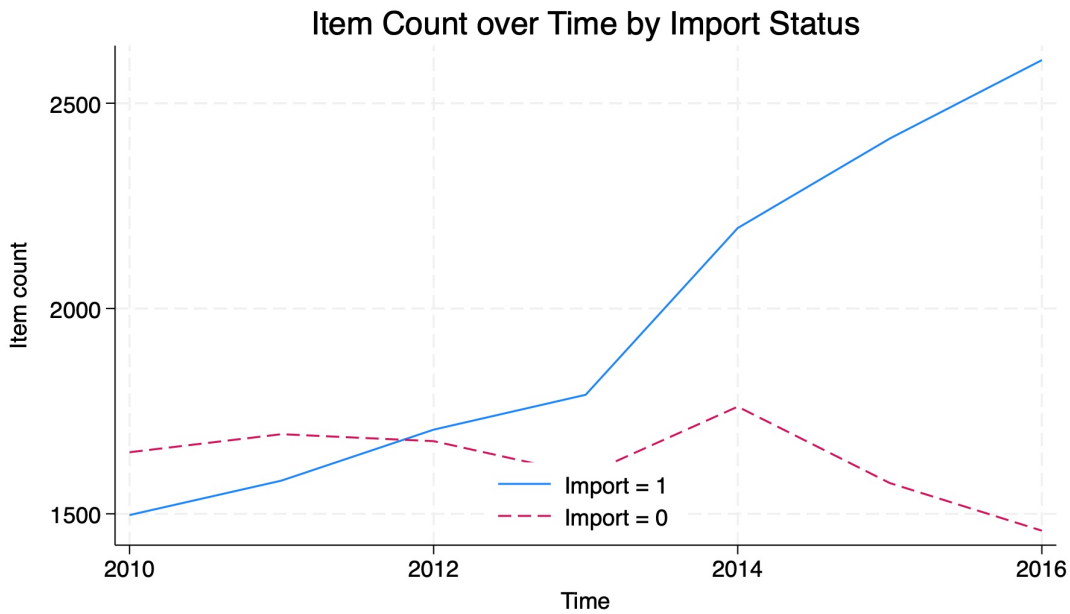
$$\Delta ln y_{ig,09-11} = \alpha_{k(i),g} + \alpha_i + \beta \Delta ln(1 + \tau_{ig,11-19}) + \varepsilon_{ig},$$

	$\Delta ln(1+p^*_{ig}m_{ig})$	$\Delta ln(1+m_{ig})$	$\Delta ln(1+p^*_{ig})$	$\Delta ln(1+p_{ig})$
Δ ln(1+$\tau_{ig,11-19}$)	2.6321	3.1855	-0.5849	-0.6274
Sector x Country FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
Obs	890	890	890	890

- $k(i)$ denotes HS-4-digit HS sector
- S.E. clustered at HS-4-digit code x country level
- Results are robust to the 08-11 outcome
- Pre-trend did not exist

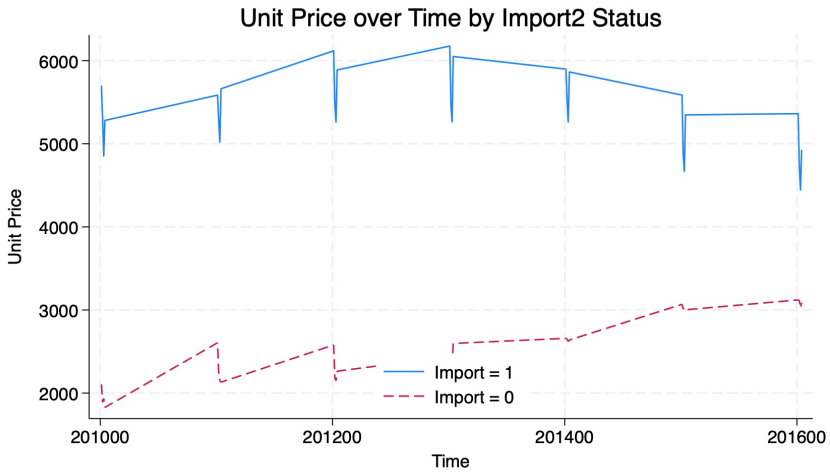
Chocolate Market

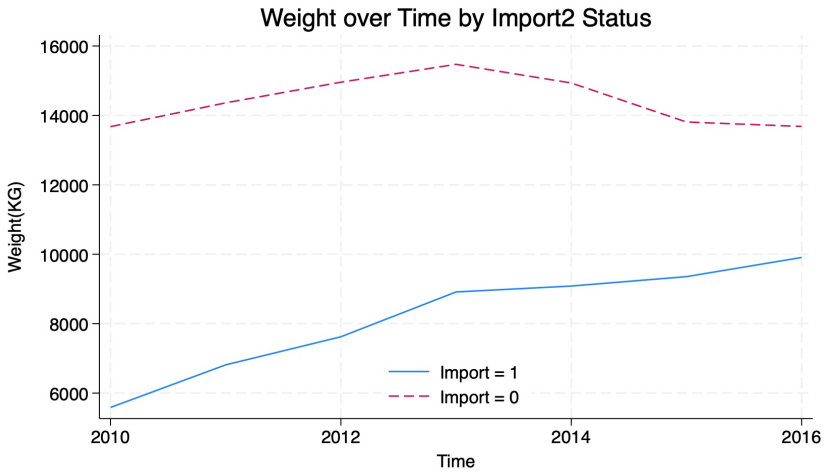
Focusing on Chocolate market



- The number of unique items for imported chocolate products in South Korea increased over time, especially after the two FTAs (i.e., extensive margin).

Focusing on Chocolate market





- The unit price of imported chocolate declined and the quantity purchase of imported chocolate increased
- The sugar content is higher in imported chocolates: Ministry of Food and Drug Safety database shows that the average of sugar(g) content per 100g is 36.97g for domestic products, and 46.44g for U.S. import, and 41.68g for EU import

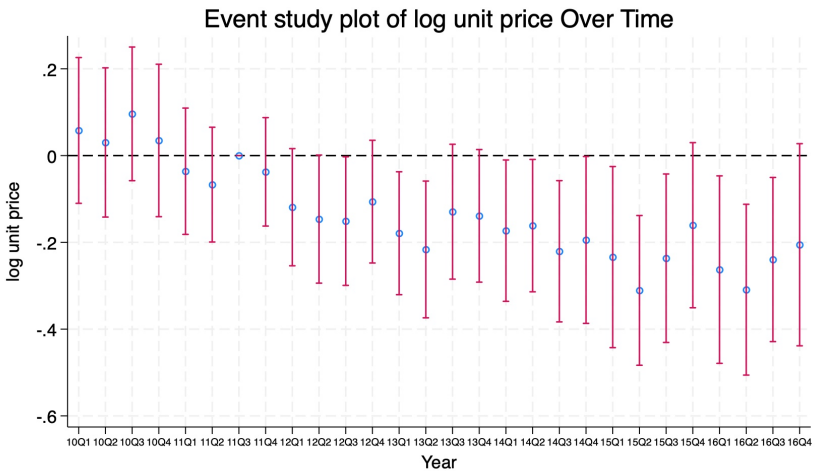
Identification Strategy

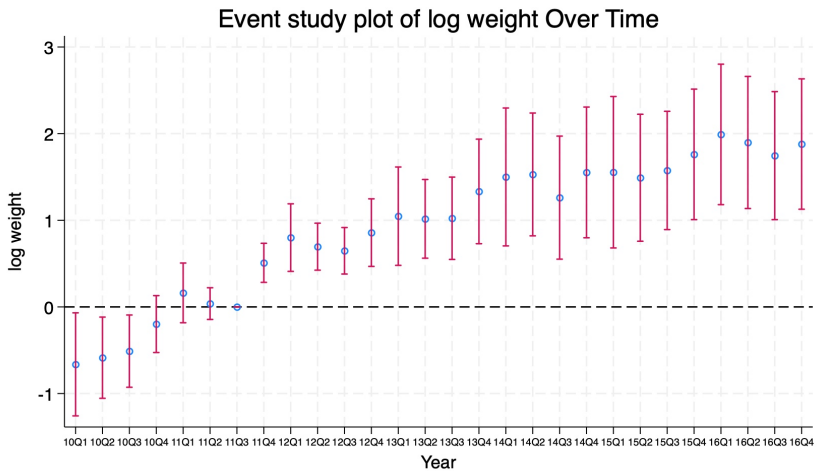
Event Study Regression in the Chocolate Market

$$lny_{it}^{SK} = \alpha_i + \alpha_t + \sum_{k \neq 2011Q3} \beta_k \cdot Import_i \cdot \mathbf{1}(t = k) + \varepsilon_{it}$$

- lny_{it}^{SK} : log unit price, log quantity of chocolate item i purchased in year-quarter t
- i: chocolate item (e.g., M&M's Milk Chocolate 357.2G)
- t: year-quarter from 2010Q1 to 2016Q4
- $Import_i$: 1 for imported goods, defined at the brand–manufacturer level
- S.E. clustered at the brand level

Focusing on Chocolate market





- The unit price decreased and the quantity purchased increased for imported products

Structural Estimation

Identification Strategy

Mixed Logit Approach in the Chocolate Market

- A widely used approach in Industrial Organization to estimate the demand system in a market
- The mixed logit model introduces a consumer preference with randomness to allow price sensitivity and disutility to be heterogeneous across consumers
- It incorporates cross-product elasticities and provides a counterfactual scenario capturing a substitution pattern between domestic and imported products

Identification Strategy

Consumer i's utility from consuming a chocolate product j in market m:

$$u_{ijm} = \alpha_{im} p_{jm} + \beta_{im} \mathbf{x}_j + \xi_{jm} + \varepsilon_{ijm}$$

- p_{jm}: product j's price in market m
- $\mathbf{x}_j$: a vector of product j's observed characteristics
- ξ_{jm}: unobservable characteristics that vary at the product x market level
- Market is defined as the region-year-quarter combination

Identification Strategy

Introducing heterogeneity across consumers:

$$\alpha_{im} = \alpha + \sum_h \alpha_h D_{im}^h + \sigma_1 v_{im}$$

$$\beta_{ikm} = \beta + \sum_h \beta_{kh} D_{im}^h + \sigma_k v_{ikm}$$

$$\xi_{jm} = \xi_j + \xi_m + \tilde{\xi}_{jm}$$

- The first and second equation assume the marginal utility of price and observed product characteristics depend on observed individual demographics D_{im} and unobserved demographics v_{im}
- The third equation shows the unobserved product characteristics ξ_{jm} is decomposed into three terms: (i) product and (ii) marekt fixed effects, and (iii) product-market specific component $\tilde{\xi}_{jm}$

Identification Strategy

The predicted market share can be expressed as:

$$s_{jm} = \int_i \frac{\exp(\beta_{im}\mathbf{x}_j + \alpha_{im}p_{jm} + \xi_{jm})}{\exp(\gamma_m) + \sum_{l=1}^{J} \exp(\beta_{im}\mathbf{x}_l + \alpha_{im}p_{lm} + \xi_{lm})} dF(i)$$

- Then, with the contraction mapping theorem, the mean utility term δ_{jm} from the equation $\delta_{jm}^{I+1} = \delta_{jm}^{I} + ln(s_{jm}^{obs}) - ln(s_{jm}^{pred})$ can be backed out.
- Then, from the mean utility equation $\delta_{jm} = \alpha p_{jm} + \mathbf{x}_j\beta + \xi_j + \xi_m + \tilde{\xi}_{jm}$, the coefficient α can be identified with the instrument for price
- With the moment condition, $E[\tilde{\xi}_{jm} \mid Z_{jm}] = 0$, the parameters are identified with GMM

Identification Strategy

Incorporating the Supply side:

$$\Pi_{fm} = \sum_{j \in J_{fm}} \left(p_{jm} - mc_{jm}\right) s_{jm}(\mathbf{p}_m) \; - \; FC_f,$$

$$\Omega_{jk,m} = \begin{cases} -\dfrac{\partial s_{km}(\mathbf{p}_m)}{\partial p_{jm}} & \text{if } \exists\, f : \{k, j\} \subset J_{fm}, \\ 0 & \text{otherwise,} \end{cases}$$

$$\underbrace{\mathbf{p}_m - \mathbf{mc}_m}_{\text{markups}} = \Omega_m^{-1} \; s(\mathbf{p}_m)$$

- The first equation describes the profit function of firm f in market m. With the first order condition and the ownership elasticity matrix $\Omega_{jr,m}$, the markup equation can be written as in the third equation

Identification Strategy

Incorporating the Supply side:

$$mc_{jm} = \gamma\, \tau_{jt} \;+\; \eta_j \;+\; \zeta_m \;+\; \omega_{jm}$$

- The equation describes the marginal cost equation. We include τ_{jt} on the right side that varies by product (import status) and year within a market, reflecting the tariff cut schedules of the US and EU FTAs
- From the marginal cost backed out from the demand side, we stack the demand and supply side and resolve the simultaneous equation using GMM-IV and moment conditions.
- From the estimated marginal cost, we switch off the tariff and recompute the equilibrium price and market share

Coefficient Estimates

			Demographic interactions			
	β	σ	Constant	Income	Inc. sq.	Education
Demand Side						
Price	-1.31***	0.0277	-0.976***	0.172***	-0.00038**	-
	(0.114)	(0.700)	(0.114)	(0.0331)	(0.00018)	
Sodium	0.577***	5.76	-	-	-	-10.21**
	(0.010)	(8.30)				(4.21)
Kcal	0.456***	7.78	-	-	-	-38.7***
	(0.011)	(4.42)				(8.00)
	γ					
Supply Side						
Tariff	3.41***	-	-	-	-	-
	(0.320)	-				-

Counterfactual Analysis

Panel A. Domestic vs. Imported

Percent of total (%) : Composition Change

Import status	Baseline	Counterfactual	Change (pp)
Domestic	65.03	70.54	-5.51pp
Imported	34.97	29.46	$+5.51$pp

Consumption (thousand kg)

Import status	Baseline	Counterfactual	% Change
Domestic	60,554	64,346	-5.89%
Imported	32,577	26,867	$+21.25\%$

Panel B. National totals and net changes

Consumption (thousand kg)

National-level	Baseline	Counterfactual	Net change	Net change (% of base)
	93,131	91,214	1,917	$+2.10\%$

Sugar intake (thousand kg)

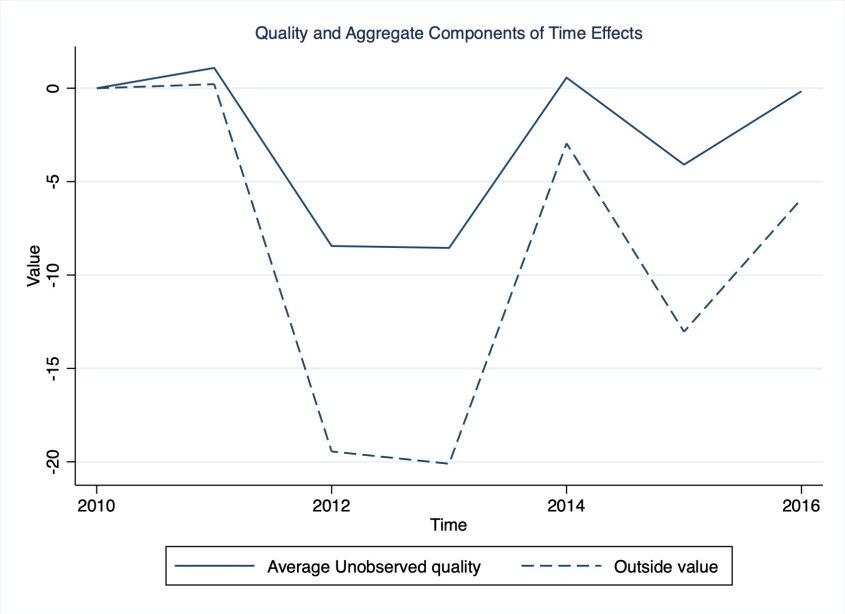
National-level	Baseline	Counterfactual	Net change	Net change (% of base)
	42,057	40,923	1,133	$+2.77\%$

Decomposition of time effects

$$\forall\, j \in \mathcal{C}_t^r, \quad : \quad \mathbb{E}\Big[\xi_{j,t}^r - \xi_{j,t-1}^r\Big] = \mathbb{E}\Big[(\tau_t^r - \tau_{t-1}^r) + (\tilde{\xi}_{j,t}^r - \tilde{\xi}_{j,t-1}^r)\Big] = 0.$$

- We extend the assumption in Grieco et al.(2024,QJE) to region-level and assume that innovations in continuing product characteristics ξ_{jt} are mean zero across year–quarters within a region and are independent across regions
- This equation separately identifies the fluctuating outside value γ_m in each market

Decomposition of time effects



- The decomposition of time effects shows that the value of the outside good is more volatile than average unobserved quality, consistent with Grieco et al.(2024,QJE)
- We interpret this large negative swing in outside value starting from 2012 as the effect of FTA tariff cuts, which increase market variety and reduce the relative prices of imported chocolate products compared to domestic ones.

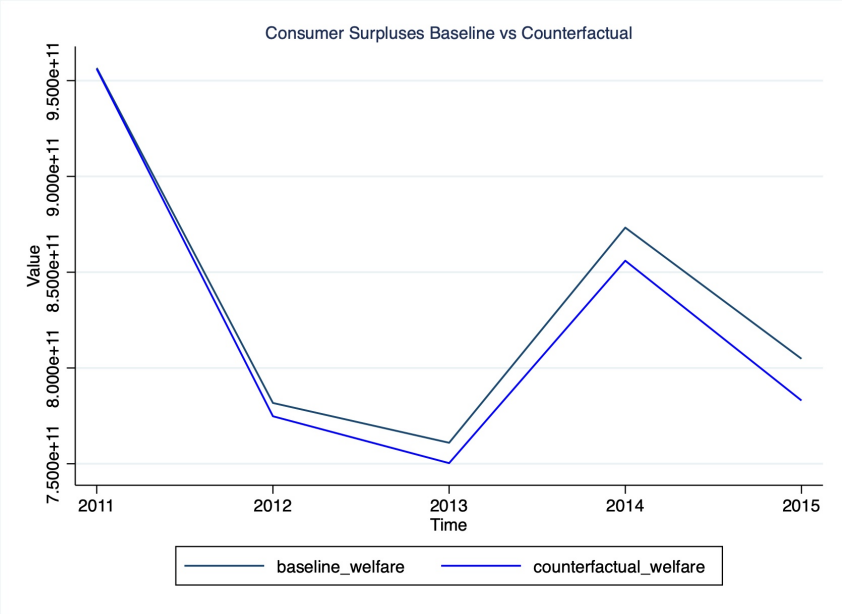
Consumer Surplus

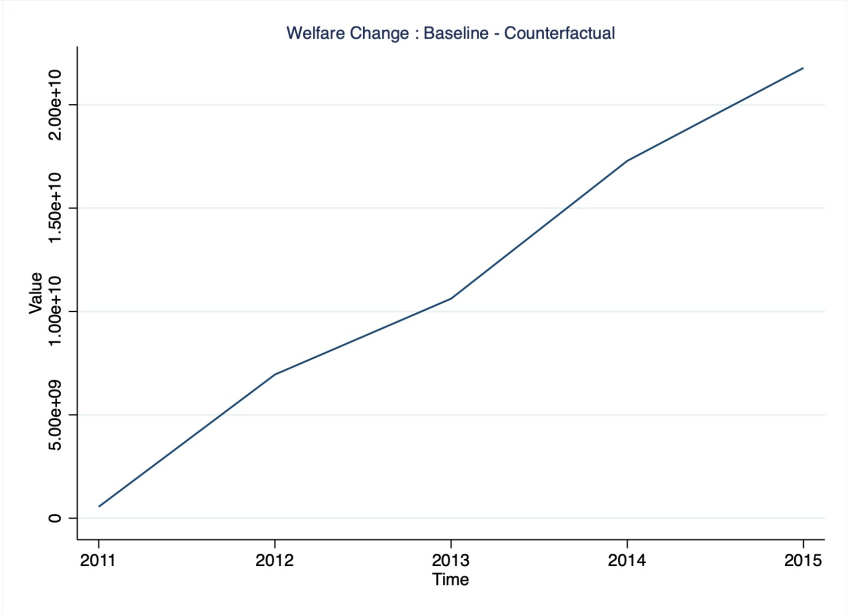
$$CS_m(\gamma) = \int_i \frac{1}{\alpha_{im}} \left[\log\left(\exp(\gamma) + \sum_{l=1}^{J} \exp(\beta_{im}\mathbf{x}_l + \alpha_{im}p_{lm}^{(\gamma)} + \xi_{lm}) \right) - \gamma \right] dF_m(i).$$

$$\widetilde{CS}_m = \frac{1}{M} \sum_{\nu=0}^{M} CS_m(\gamma_\nu)$$

- As noted above, the outside value varies across markets, so this relative compensating variation can depend on fluctuations in γ
- To address this, following Grieco et al.(2024,QJE), the second equation computes consumer surplus in each market m by evaluating it at every γ_v from other markets and then averaging across these values to obtain a measure that is invariant to variation in γ.

Consumer Surplus





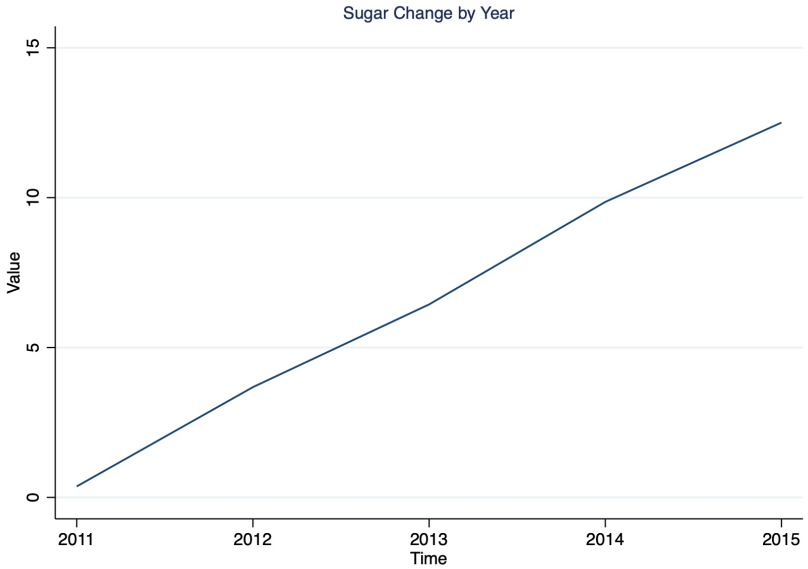
- The left graph plots consumer surplus for the baseline and counterfactual cases and the right graph plots their differences
- The counterfactual uses predicted marginal costs under the assumption that tariffs were not reduced.

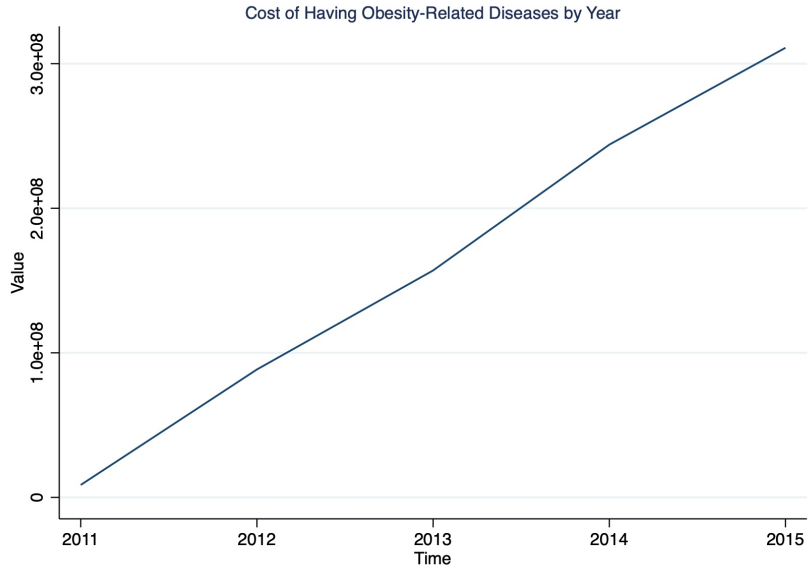
Social Health Cost

$$\Delta C_{\text{year}} = \left(RR_{\text{per g, disease}}^{\Delta s_{\text{year}}} - 1\right) C_{\text{year,disease}}$$

- $RR_{\text{per g, disease}}$ is the per-gram increase in disease risk associated with higher sugar intake estimated from Imamura et al.(2015) and Xi et al.(2015)
- Δs is the average annual increase in per-capita sugar intake estimated in our data
- $C_{\text{year,disease}}$ denotes the total social cost of each disease in South Korea, estimated from Kang et al.(2011)

Social Health Cost





- Annual change in per-capita sugar intake and the total health cost implied by the health cost equation
- Both the per-capita sugar increase and the induced health cost rise steadily over the sample period, highlighting the latent social costs attributable to increased sugar intake that can be linked to FTA-driven changes in the chocolate market.

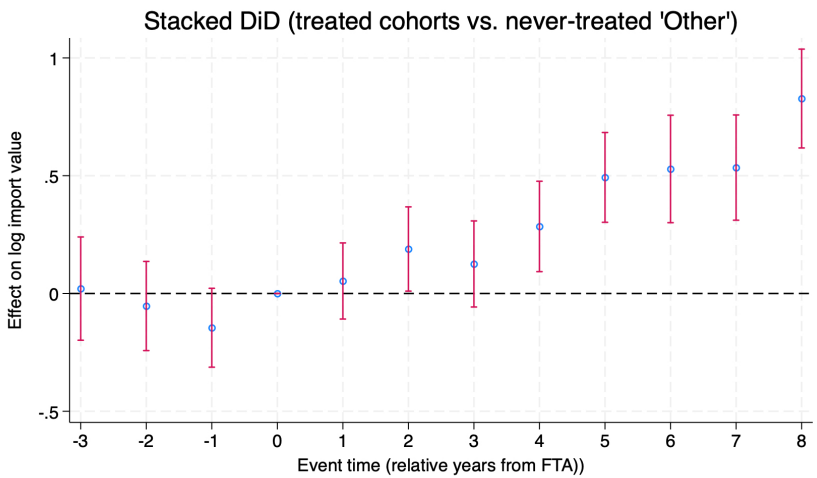
Conclusion

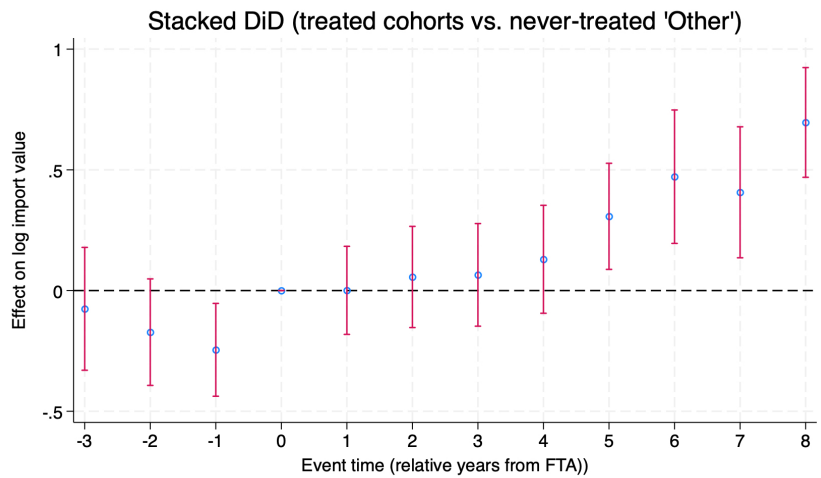
Conclusion

- Korea's FTAs with the EU and the US lowered tariffs, making imported chocolate cheaper and increasing import demand.
- Scanner data and a structural model show increased imports, chocolate consumption, and a 2.8% rise in sugar intake.
- Without tariff cuts, both consumption and sugar intake would have been lower.
- Trade policy can have unintended health impacts through dietary shifts.
- Policy implication: Excluding unhealthy products from preferential tariff treatment may help limit negative health effects. (e.g., Nauru's sugar levy and Fiji's import duties)

Stacked Estimation Results - Wide

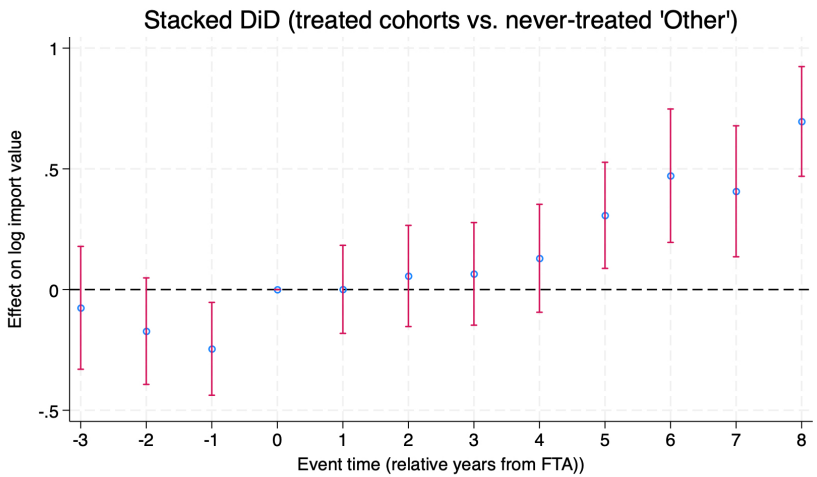
$$lny_{igct} = \sum_{k \neq 0} \beta_k \, \mathbf{1}\{t - c = k\} \cdot \mathbf{1}\{g \in \mathcal{G}_c\} \; + \; \alpha_{itc} \; + \; \gamma_{gc} \; + \; \varepsilon_{igct}$$

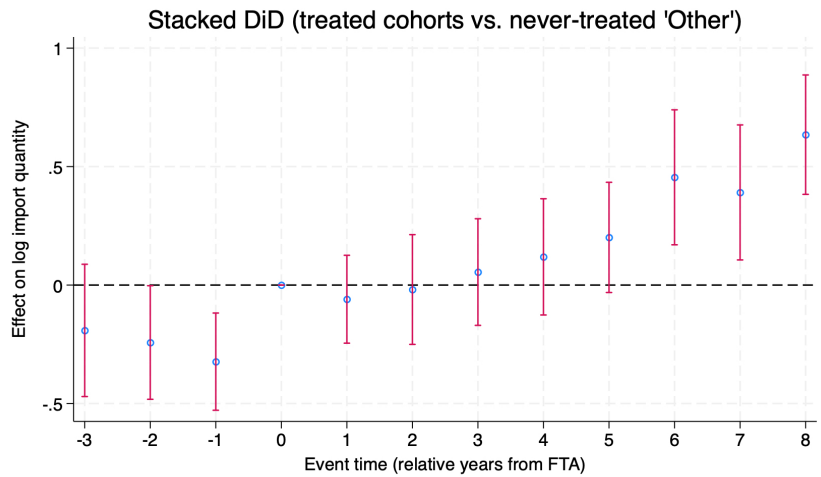




Stacked Estimation Results - Narrow

$$lny_{igct} = \sum_{k \neq 0} \beta_k \, \mathbf{1}\{t - c = k\} \cdot \mathbf{1}\{g \in \mathcal{G}_c\} \; + \; \alpha_{itc} \; + \; \gamma_{gc} \; + \; \varepsilon_{igct}$$





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