

# The Rwanda-Uganda border closure

## Impacts and Adaptation through Production Networks

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# Introduction

- Production Networks: Key to understand micro-to-macro and macro-to-micro shocks to an economy.
- **This Project**
  - How resilient are production networks in developing economies?
  - Focus on firm-to-firm connections
  - Production networks from two East African countries (Rwanda and Uganda)
- **Identification**
  - Large exogenous shock to RW-UG trade
  - Compare firms trading with Uganda with those who did not (Diff-in-diff)

# Administrative firm-level data

## Rwanda

- Firm-level outcomes
  - Personal Income Tax *08-21*
  - Corporate Income Tax *08-21*
  - VAT *08-21*
  - Pay-As-You-Earn firm records *08-21*
- International Trade
  - Imports & Exports *08-21*
- Domestic Trade
  - Monthly b-to-b transactions *13-21*

## Uganda

- Firm-level outcomes
  - Corporate Income Tax *10-21*
  - Pay-As-You-Earn firm records *08-21*
- International Trade
  - Imports & Exports *10-20*
- Domestic Trade
  - Monthly b-to-b transactions *10-21*

# The Shock: Background

- March 2019 to January 2022
- Unilateral closure of RW-UG trade by Rwanda
- Caused by political tensions
- UG:
  - 4<sup>th</sup> origin country of Rwandan imports (after TZ, CN & UAE)
  - 8% of all RW imports in 2018

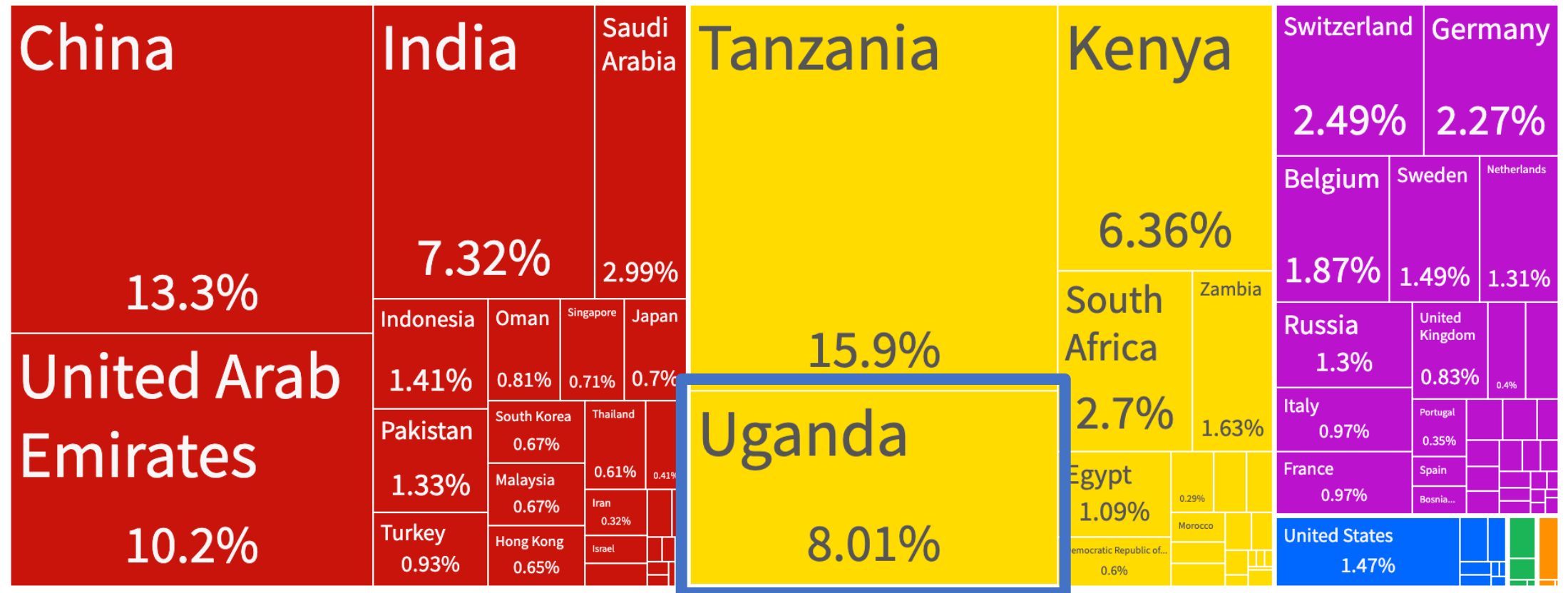


Credits: [VOAnews](#)

# Where does Rwanda import from? (2018)

Before closure

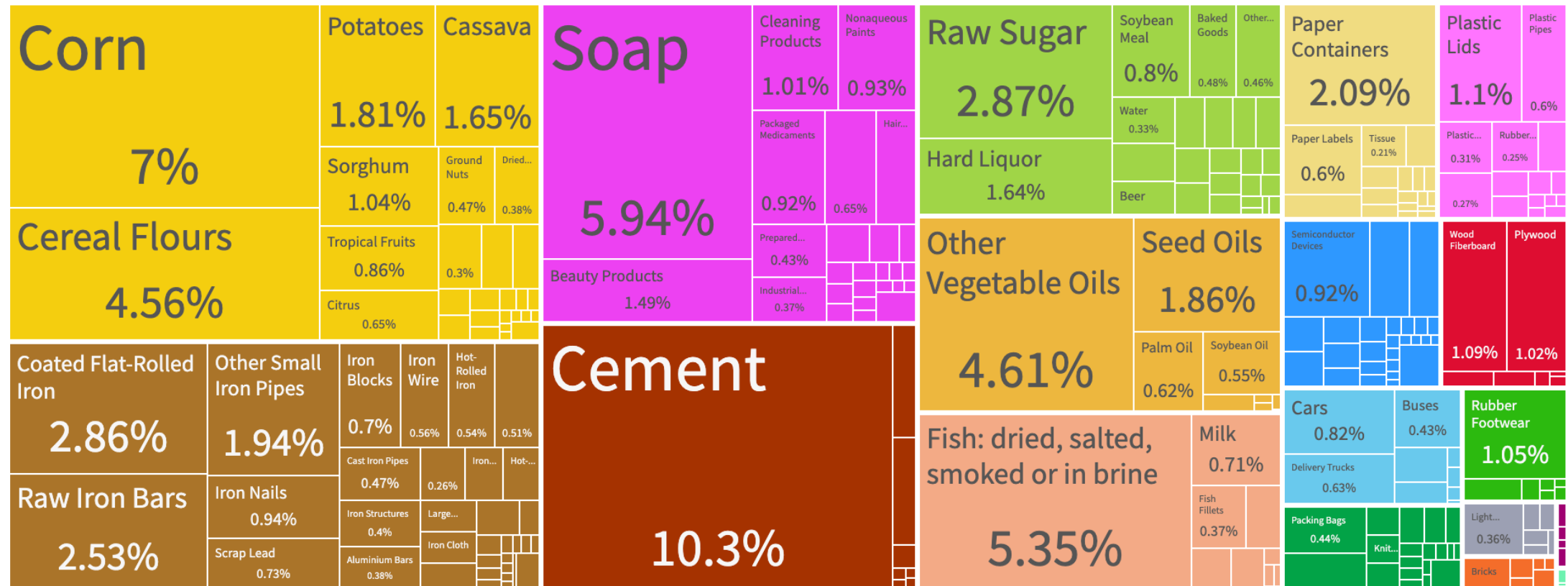
Total: \$2.87B



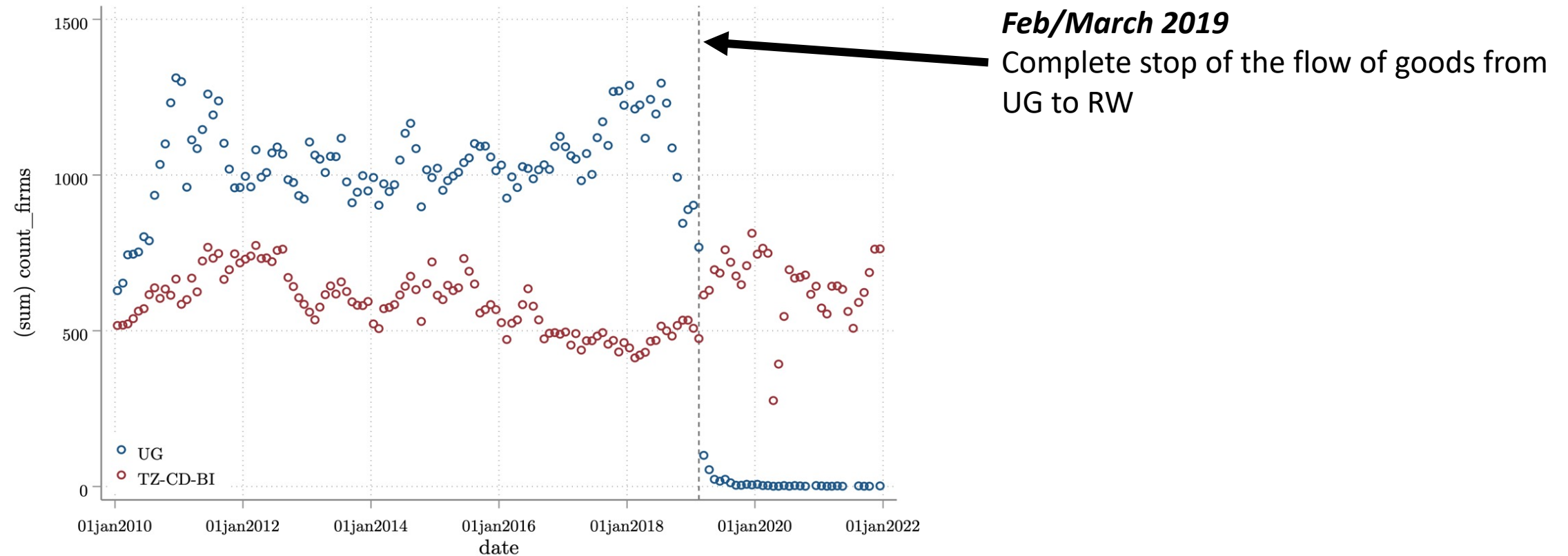
# What does Rwanda import from UG? (2018)

Before closure

Total: \$230M



# Number of firms transacting between Rwanda and Uganda



Monthly number of Rwandan firms importing from Uganda (blue time series) and from other countries bordering Rwanda (red time series)

# Specification (Difference-in-Differences)

- Treatment ~ 1284 firms
  - RW firms importing from UG in 2017-18
- Control ~ 2790 firms
  - RW firms importing from anywhere except UG in 2017-18
- Sample selection:
  - Firms with sales data observed throughout
    - (this conditions on survival)



# Specification (Difference-in-Differences)

- Outcome variables: sales, employment, imports, exports, domestic purchases and sales
- **Treated**: Firms importing from Uganda in 2017 or 2018
- Firm Fixed Effects (what we report)

$$Y_{it} = \alpha_i + \sum_{t=2015}^{2021} \beta_t \times treated_i \times \mathbf{1}[t] + \gamma \times treated_i + \varepsilon_{it}$$

- District Fixed Effects (similar results – not reported)
- District  $\times$  year Fixed Effects (similar results – not reported)

# Preview of results

- Among surviving firms, no detectable effect on sales, employment or wage bill
  1. Large increase in imports from neighboring and non-neighboring countries
  2. Weak response of the domestic production network
  3. Exports to Uganda decrease
- Firms are more likely to exit if they were previously importing from Uganda
- Other side of the border: UG firms largely unaffected
  - [results not reported in this presentation]

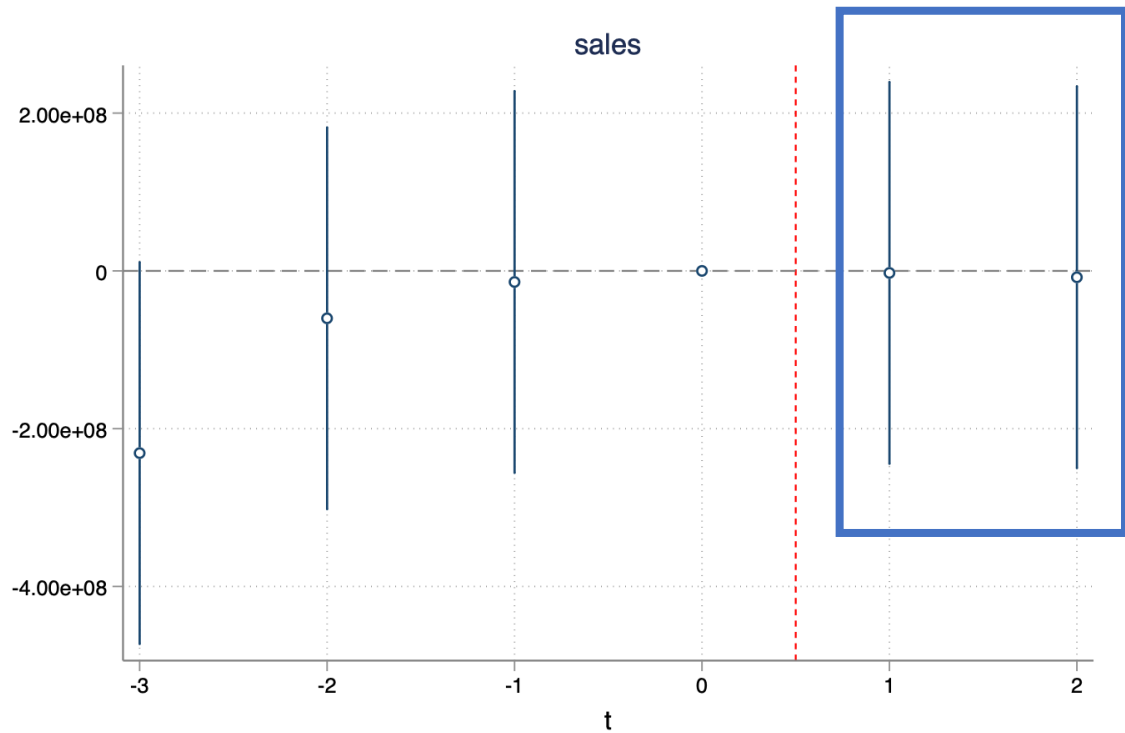
# Rwandan firms largely unaffected by the shock, why?

## Prospective Hypotheses:

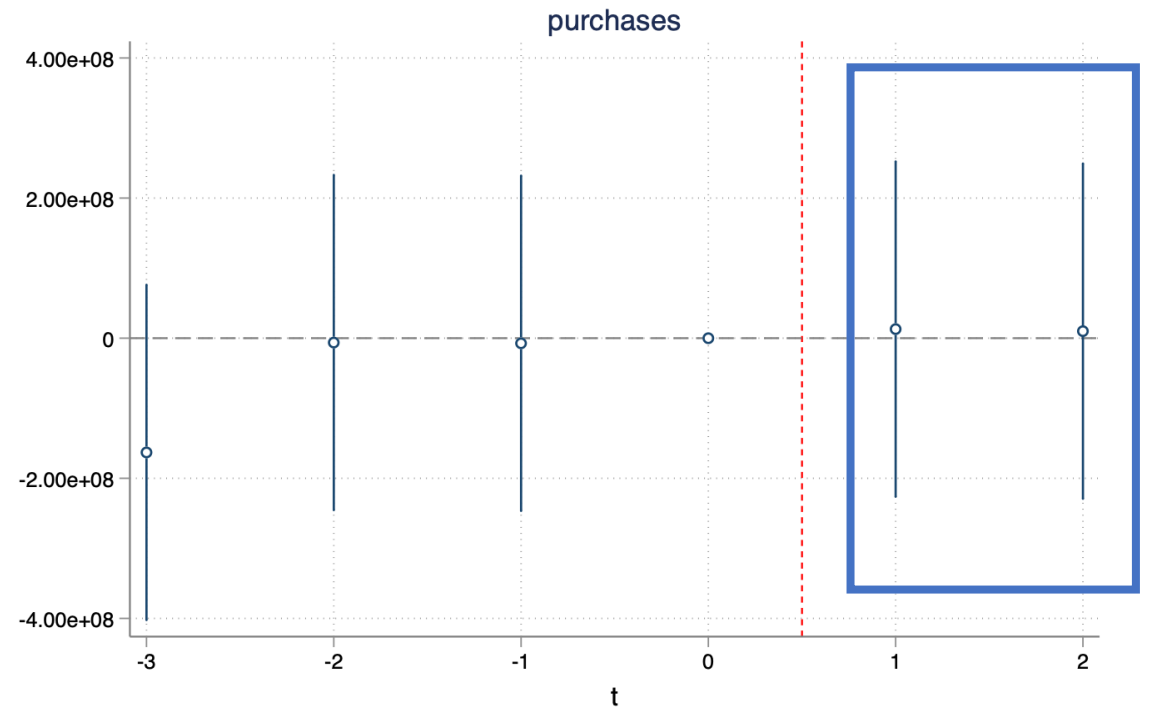
1. Uganda accounts for a small share of imports by Rwandan firms
2. Treated firms are big firms
3. Easy Substitutability of imported goods
4. Survival Bias – Some evidence that firms importing from UG before the closure are less likely to survive

# 0. DiD results

# Domestic Sales and Purchases



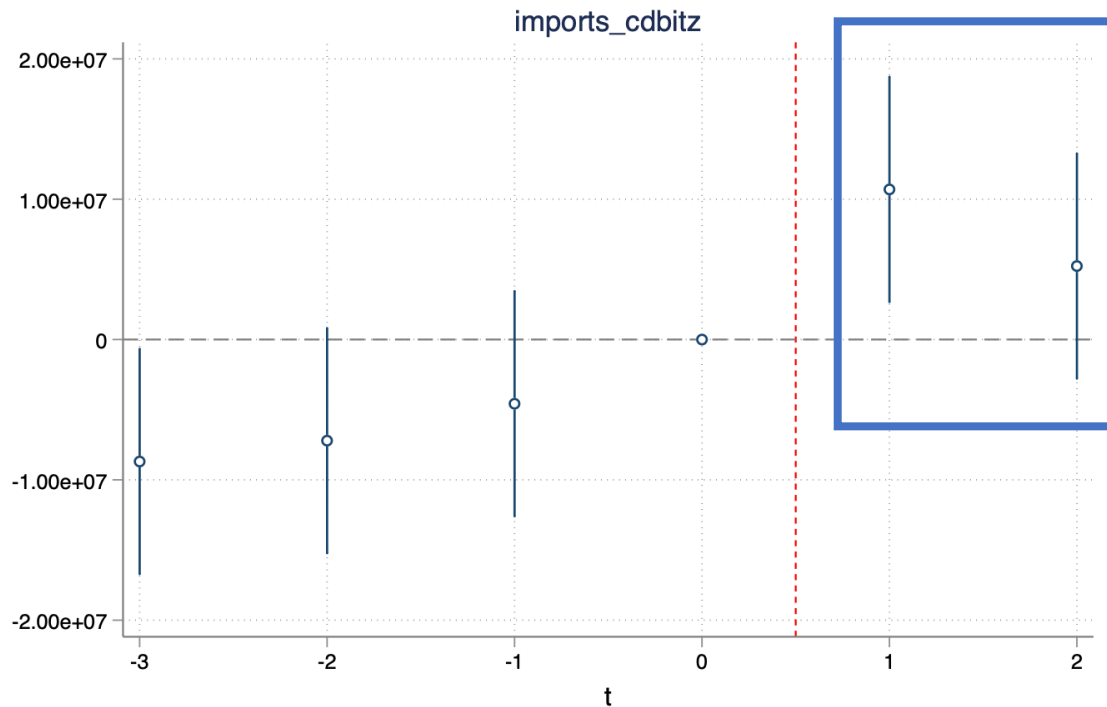
Domestic Sales



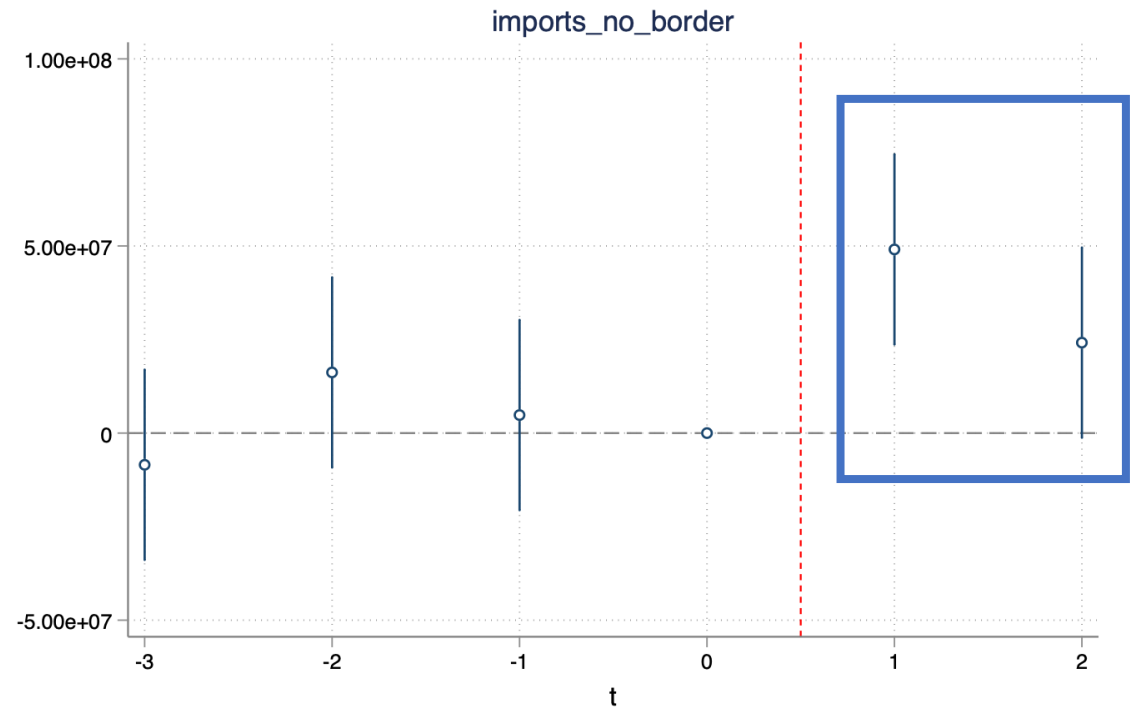
Domestic Purchases

No impact on domestic sales or purchases  
No impact on employment and turnover (see appendix)

# Imports from countries except UG



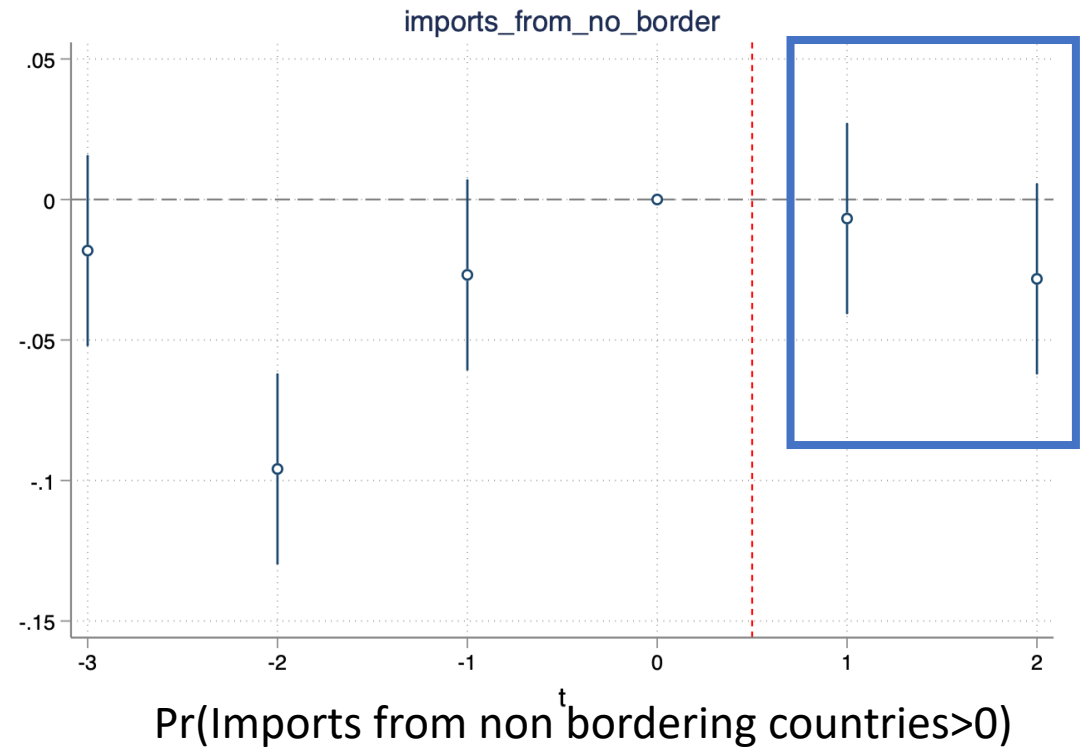
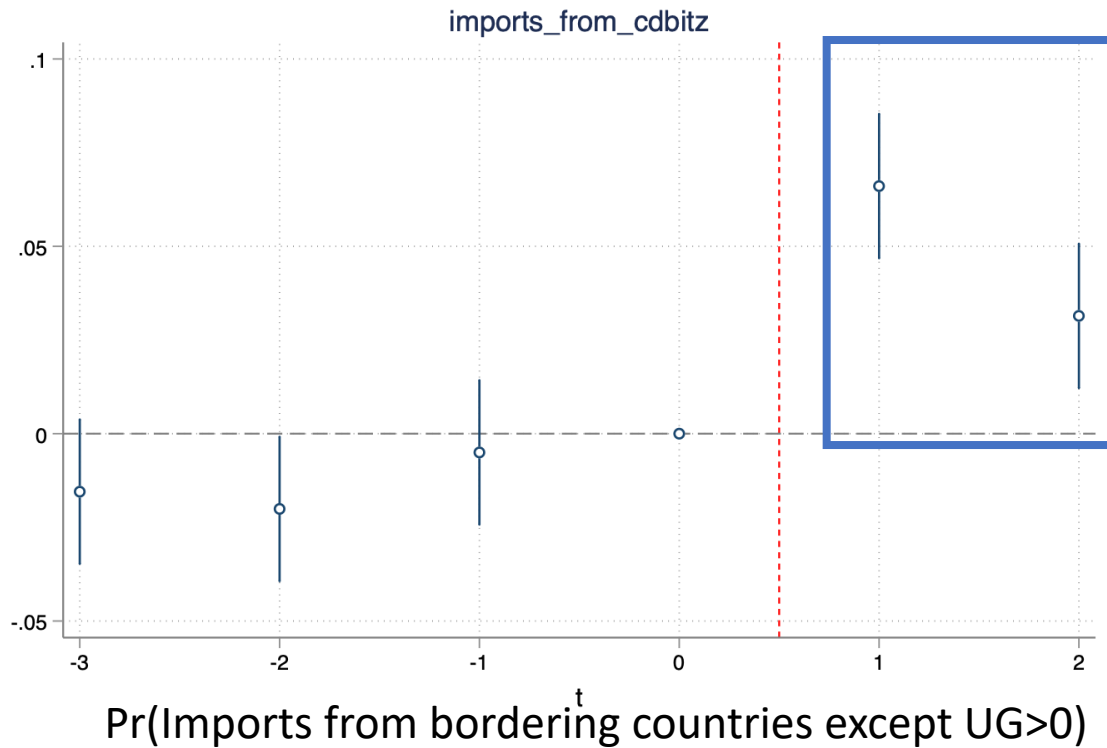
Imports from bordering countries except UG



Imports from non bordering countries

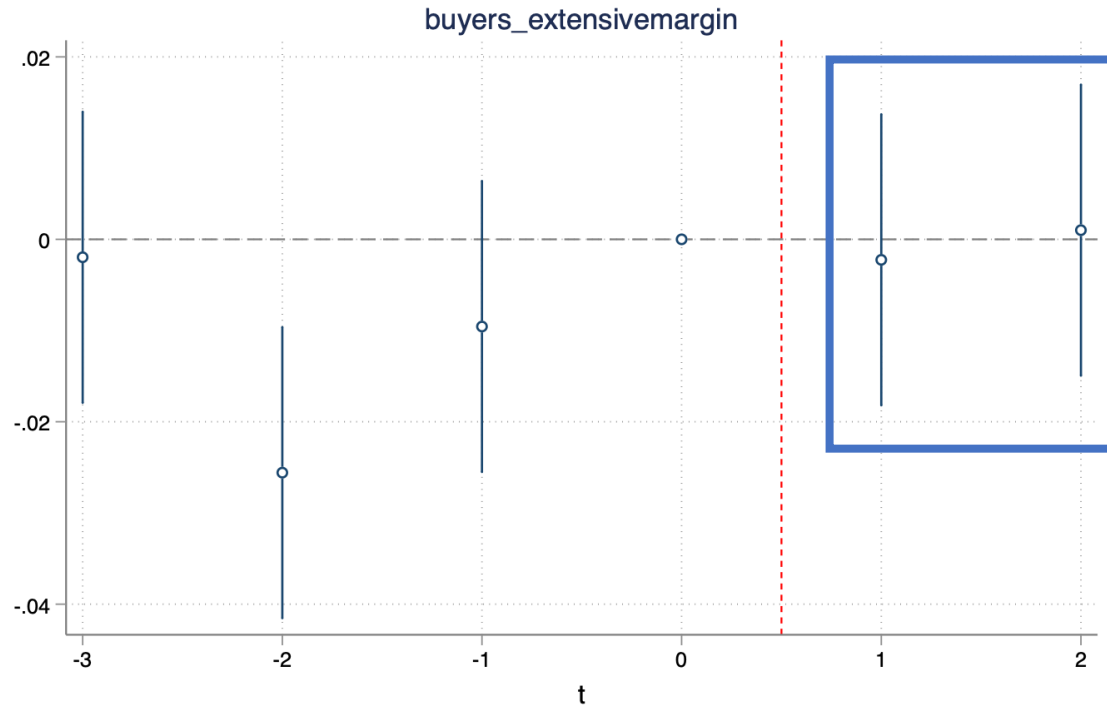
Increase in imports from neighbouring and non-neighbouring countries

# Pr(Imports) from countries except UG

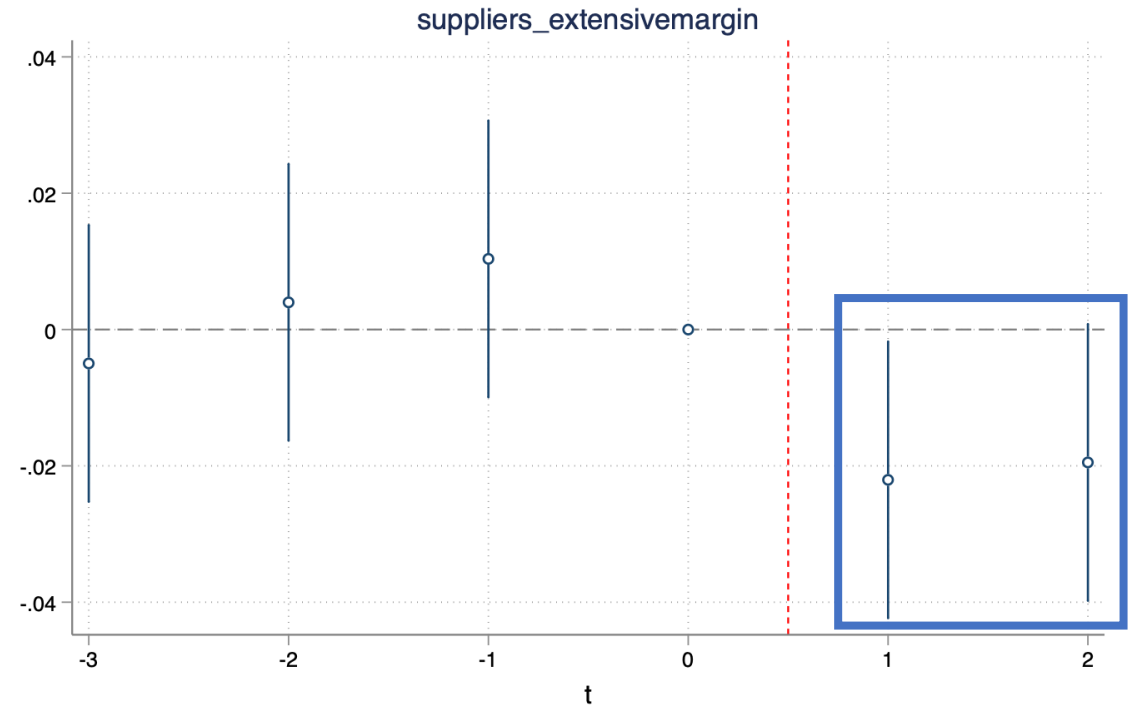


Increase in probability to import from neighbouring countries  
No such increase for non-neighbouring countries

# Buyers/Suppliers Extensive Margin



Pr(Domestic Customers>0)



Pr(Domestic Suppliers>0)

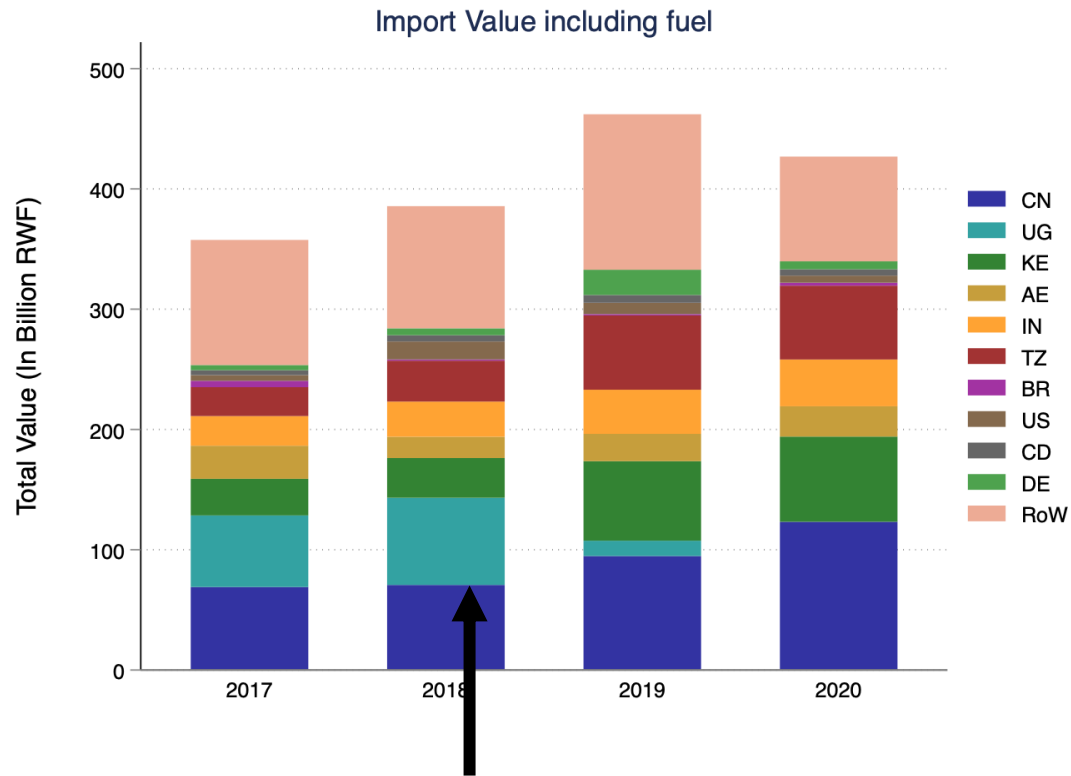
No change in the probability to sell to RW firms  
Decrease in the probability to source from the RW network (puzzle?)



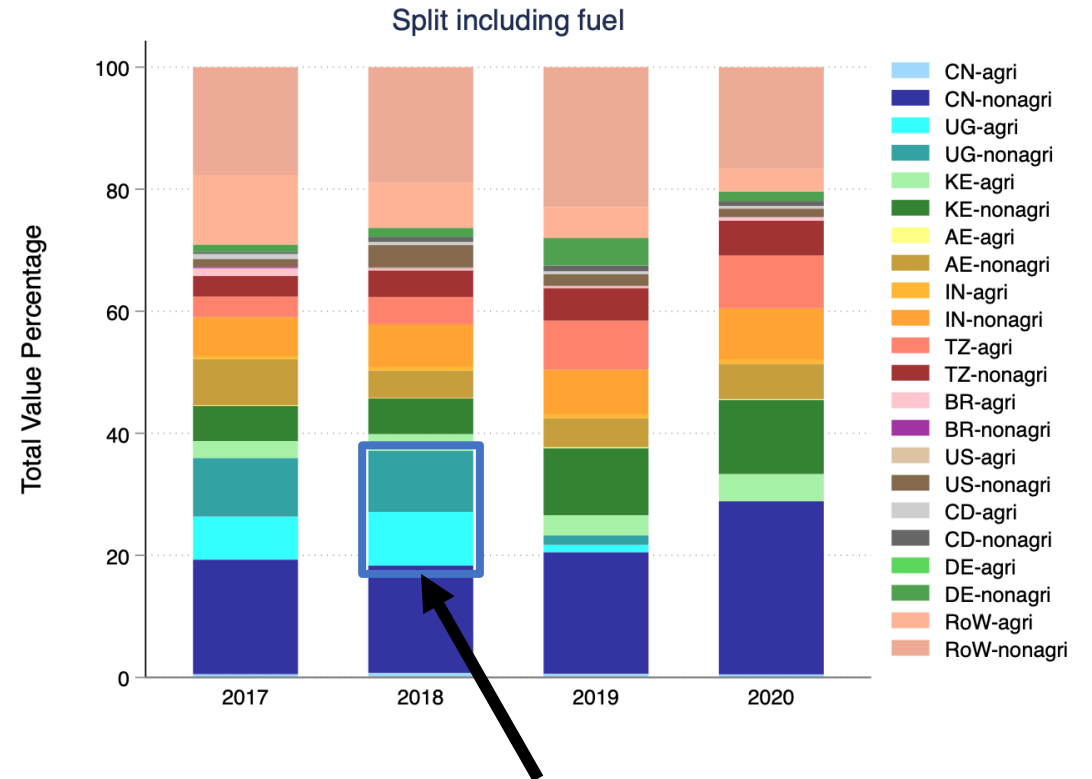
1. Uganda accounts for a small share of imports by Rwandan firms

# Import Value - agri/food vs the rest

*(treated firms only)*

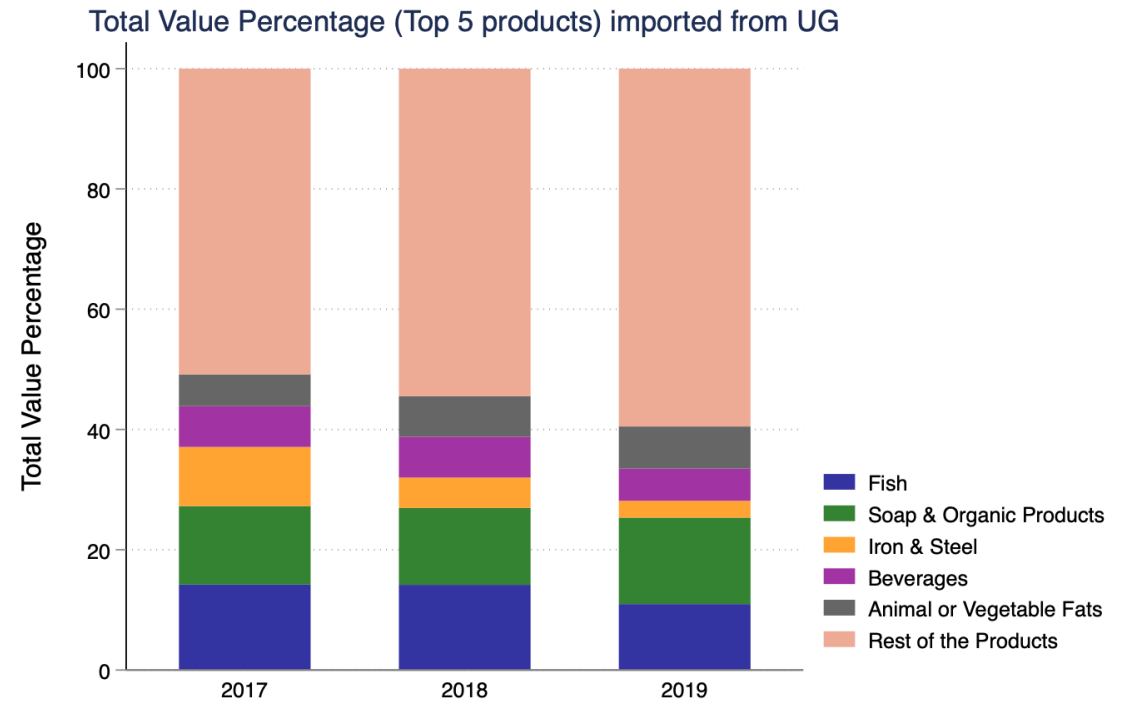
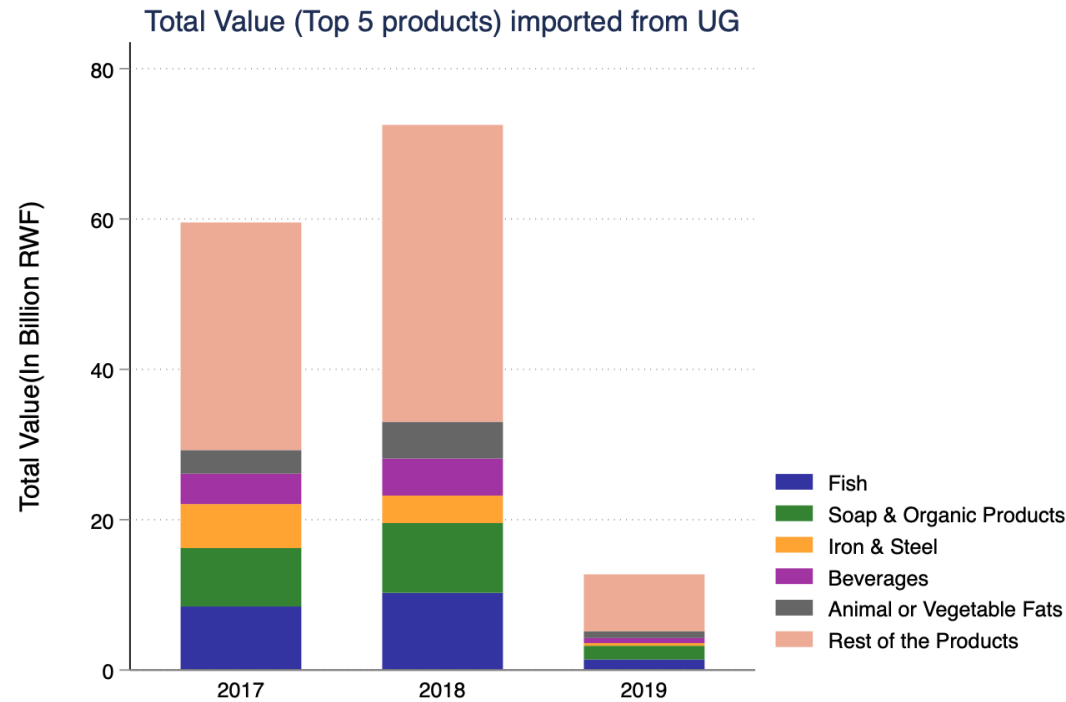


20% of imports by treated firms come from UG



Slightly less than half of these imports are agri/food imports

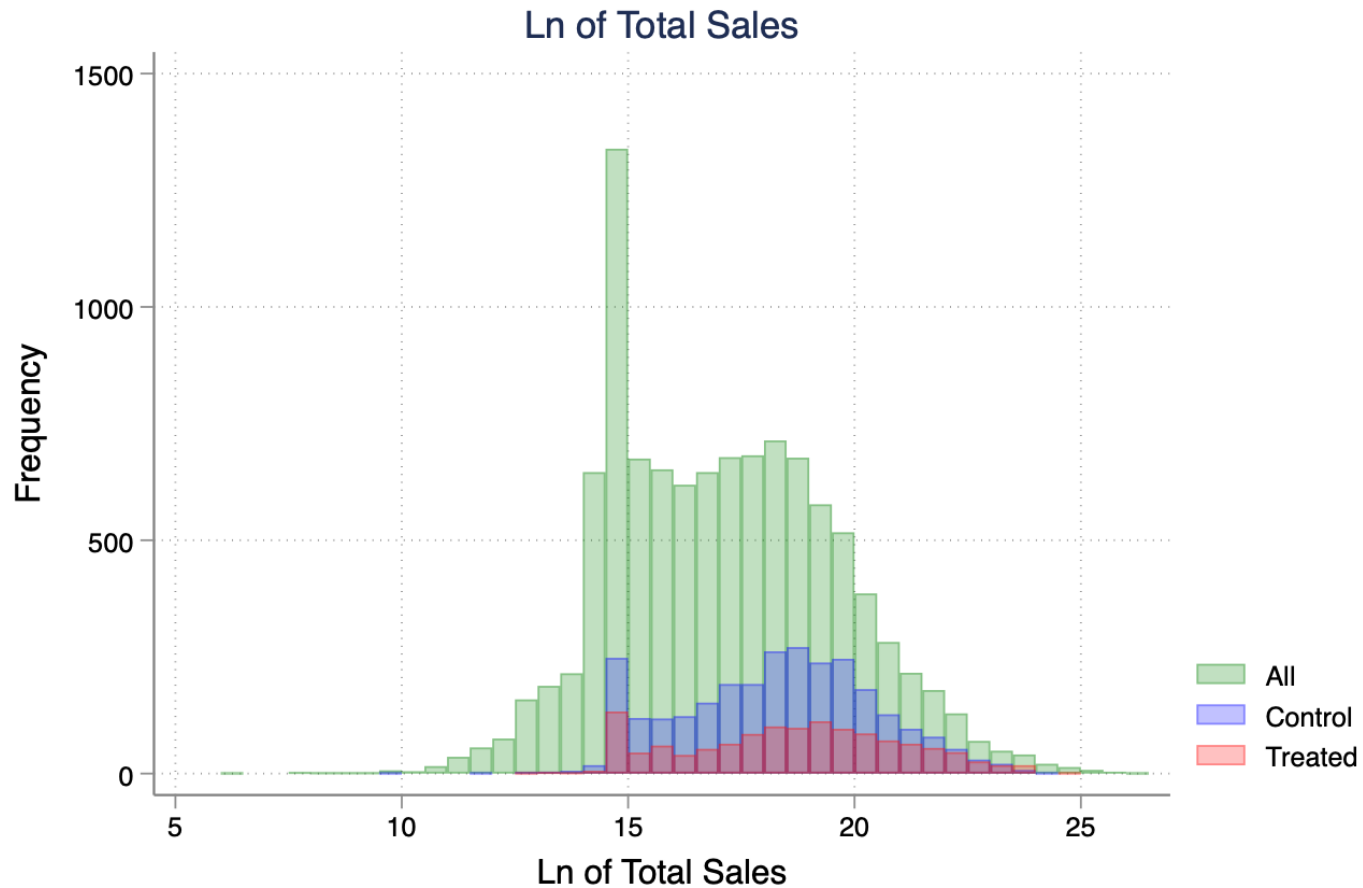
# Import Value/ Percentage of goods imported from Uganda split according to top 5, 2-digit hs codes (Treated firms only)



The top 5 goods (in terms of import value) make up 50% of the goods imported from Uganda

## 2. Treated Firms are Big Firms

# Histograms – General Population, Treatment and Control(17-18)



Treatment:

Mean: **USD 1,417,154** (Levels)

Mean: 18.61; p10: 14.92; p90: 21.79

Control:

Mean: **USD 759,059** (Levels)

Mean: 18.27; p10: 14.98; p90: 21.03

All Firms:

Mean: **USD 309,210** (Levels)

Mean: 17.09; p10: 14.13; p90: 20.42

# 3. Substitution of Imports

## Probabilities of Substitution (Unit: FirmX2-digit hs code pairs)

- **“Double sourcing”**: **58%** of goods imported from UG before the closure were also imported from another country *before* the closure
- **Easy substitutability**: **50%** of goods imported from UG before the closure were imported from another country *after* the closure
  - Breakdown: 54% non-agri, 35% agri
- **Role of TZ and CD**: Of the successful substitutions, **15%** were toward TZ and CD
  - Breakdown: 12% non-agri, 31% agri

# Sector wise substitution probabilities

hscode2	succ_shift	succ_shift_TZCD	Total_value_imported	hsdesc
3	0.56	0.89	18723447953	Fish and other aquatic invertebrates.
34	0.58	0.31	17048930496	Soap, organic surface-active agents
72	0.62	0.19	9510602030	Iron and steel
22	0.18	0.50	8966768129	Beverages, spirits and vinegar.
15	0.41	0.20	8032347875	Animal or vegetable fats and oils and other products
10	0.29	0.87	7160081461	Cereals.
39	0.59	0.15	6116456973	Plastics and articles thereof
44	0.40	0.21	5940446203	Wood and articles of wood
17	0.52	0.07	5039963953	Sugars and sugar confectionery.
30	0.67	0.17	4427006390	Pharmaceutical products
48	0.56	0.12	3907601794	Paper and paperboard; articles of paper pulp
32	0.57	0.10	3430435286	Tanning or dyeing extracts
76	0.34	0.14	3286160325	Aluminium and articles thereof
73	0.57	0.06	3188613609	Articles of iron or steel
64	0.38	0.19	2451118619	Footwear, gaiters and the like
23	0.46	0.67	2401110588	Residues and waste from the food industries
85	0.73	0.13	2080341913	Electrical machinery and equipment
12	0.09	0.50	1992586026	Oil seeds and oleaginous fruits; miscellaneous grains
78	1.00	0.00	1732329145	Lead and articles thereof
11	0.07	0.25	1717900372	Products of the milling industry; malt; starches
25	0.40	0.42	1514756134	Salt; sulphur; earths and stone; plastering materials
55	0.62	0.10	1205066612	Man-made staple fibres
4	0.31	0.30	1107257674	birds' eggs; natural honey; edible products of animal
38	0.57	0.08	993872962	Miscellaneous chemical products
7	0.15	1.00	916589913	vegetables and certain roots and tubers.

Agricultural goods (hscode2 < 25) are more likely to be substituted by Tanzania or Congo.

succ\_shifts – The probability of treated firms who are importing from UG also importing the same good from another country before the closure

succ\_shift\_TZCD – Of the successful substitutions, probability of finding a substitute from TZ/CD



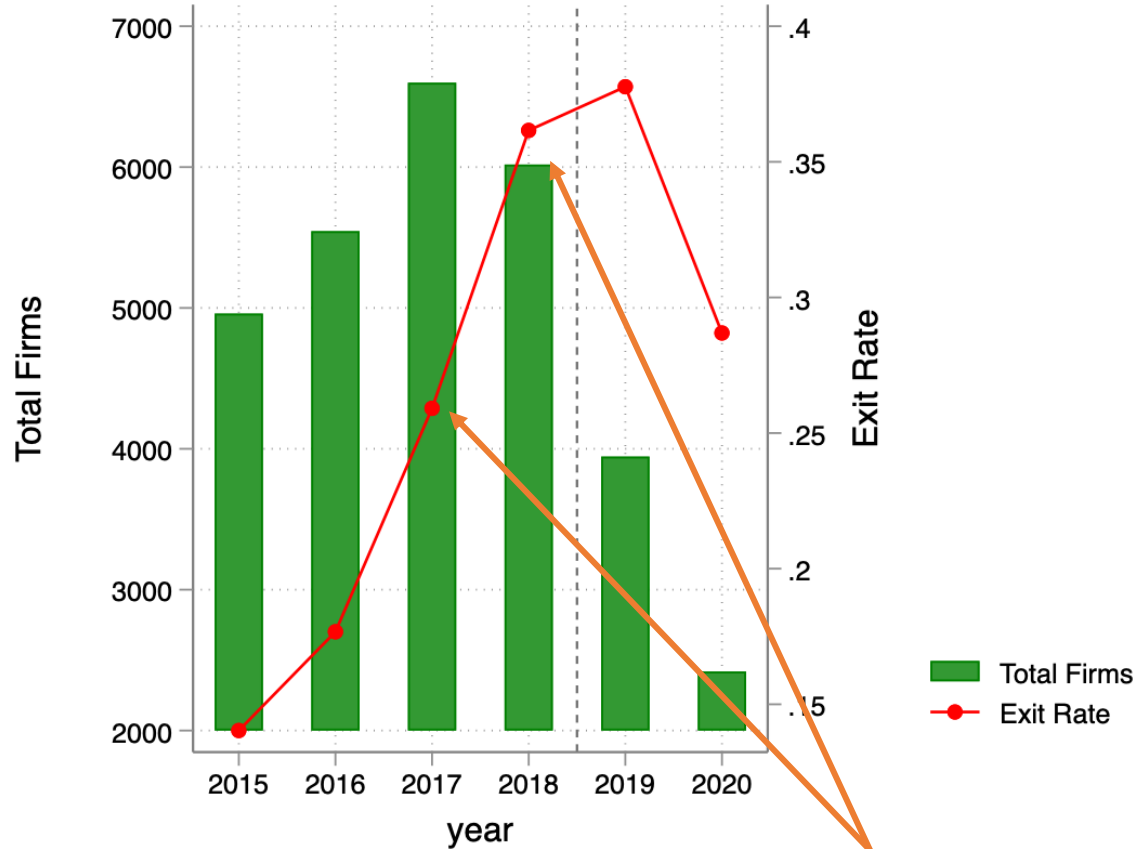
# 4. Firm dynamics

# Average Exit Rates

Firms importing from UG before the closure are more likely to exit

### Firms importing from UG (15-18)

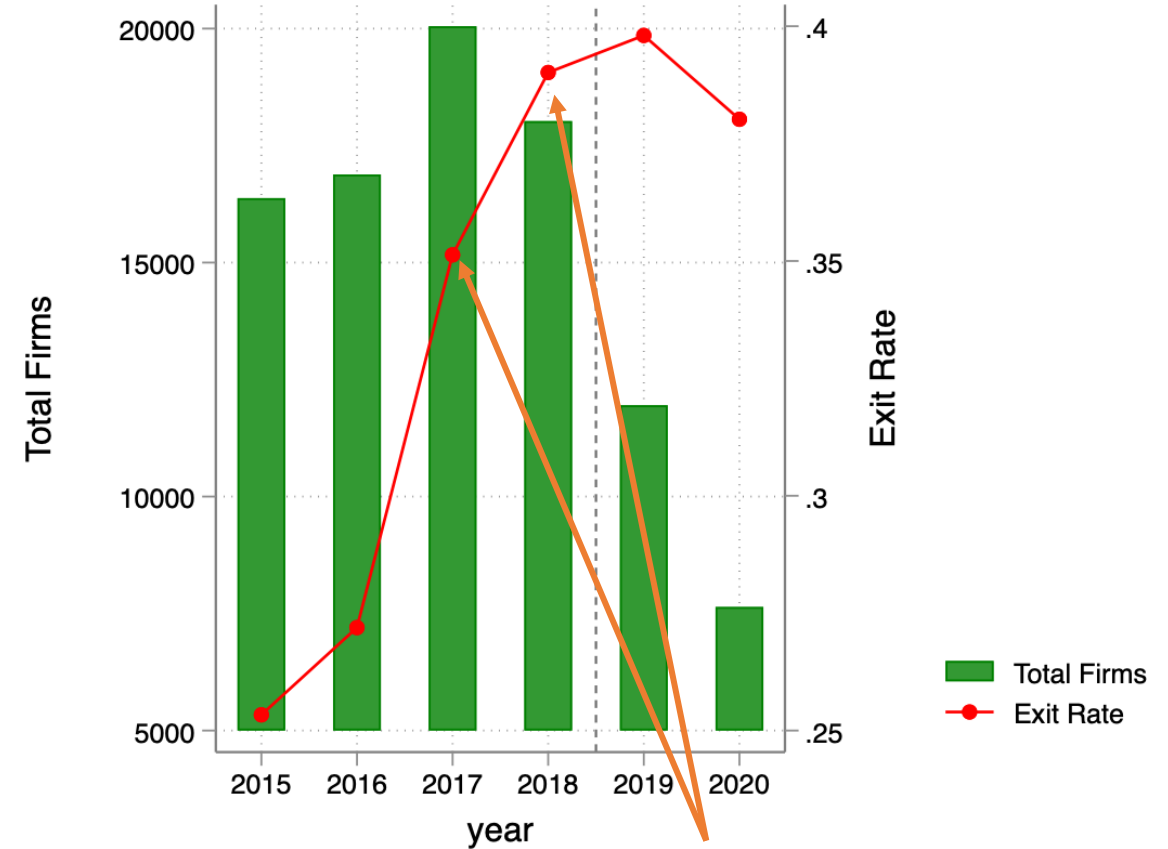
#### Average Exit Rate - UG



+10pp increase in exit rate among firms importing from UG

### Firms importing from any country (15-18)

#### Average Exit Rate - Any Country



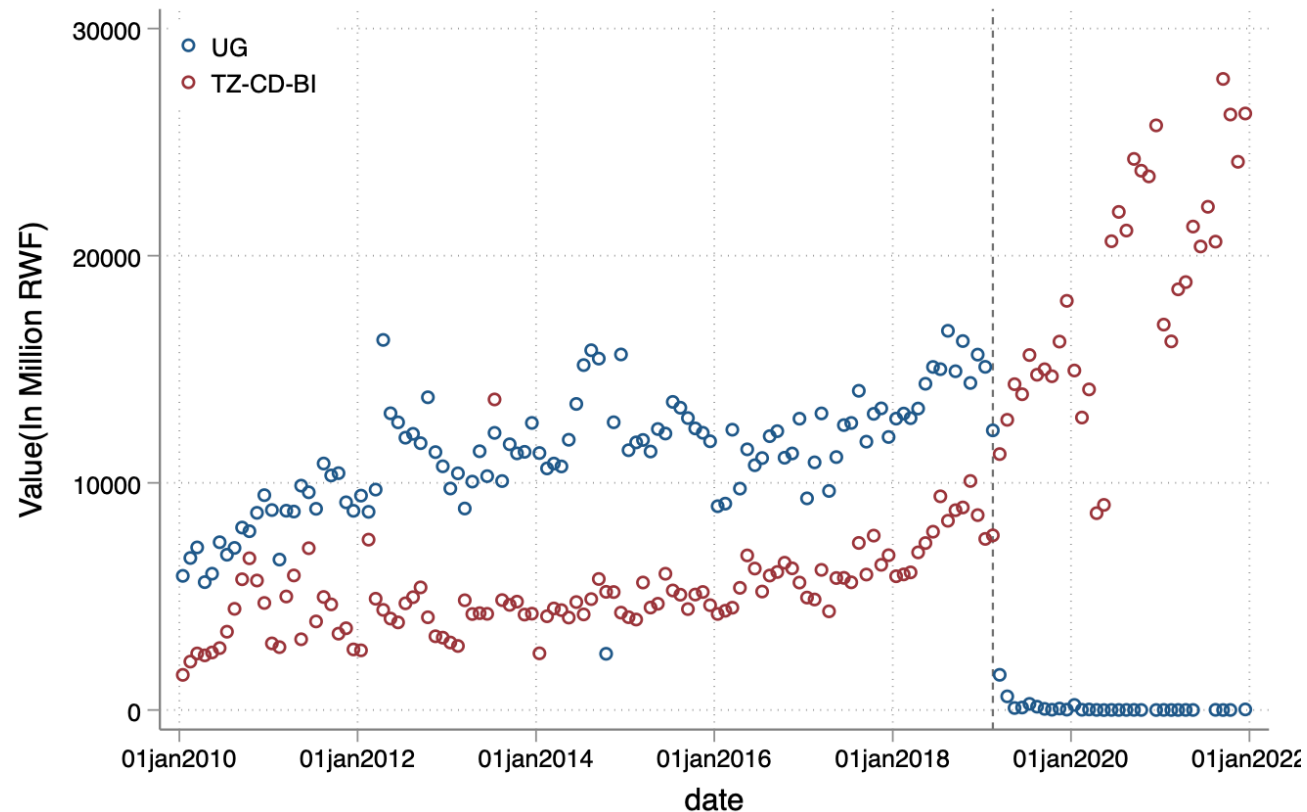
+4pp increase in exit rate among importing firms

# Conclusion

- This project: studies the RW-UG 2019 border closure at the firm level
  - Evidence that firms importing from UG are more likely to exit (+6pp)
  - But surviving firms largely unaffected
    - UG not so important for RW firms
    - Easy substitution toward Kenya, Tanzania, DRC mainly for agricultural goods
    - Importers from UG are large firms – More able to recover from shocks
  - Ugandan exporters largely unaffected as well

# Appendix

# Value of Transactions between Rwanda and Uganda



Monthly value of Rwandan firms importing from Uganda (blue time series) and from other countries bordering Rwanda (red time series)

*10 bn Rwf ~ 10mn USD in early 2019*

# Specification (Difference-in-Differences)

- Firm Fixed Effects (what we report)

$$Y_{it} = \alpha_i + \sum_{t=2015}^{2021} \beta_t \times treated_i \times \mathbf{1}[t] + \gamma \times treated_i + \varepsilon_{it}$$

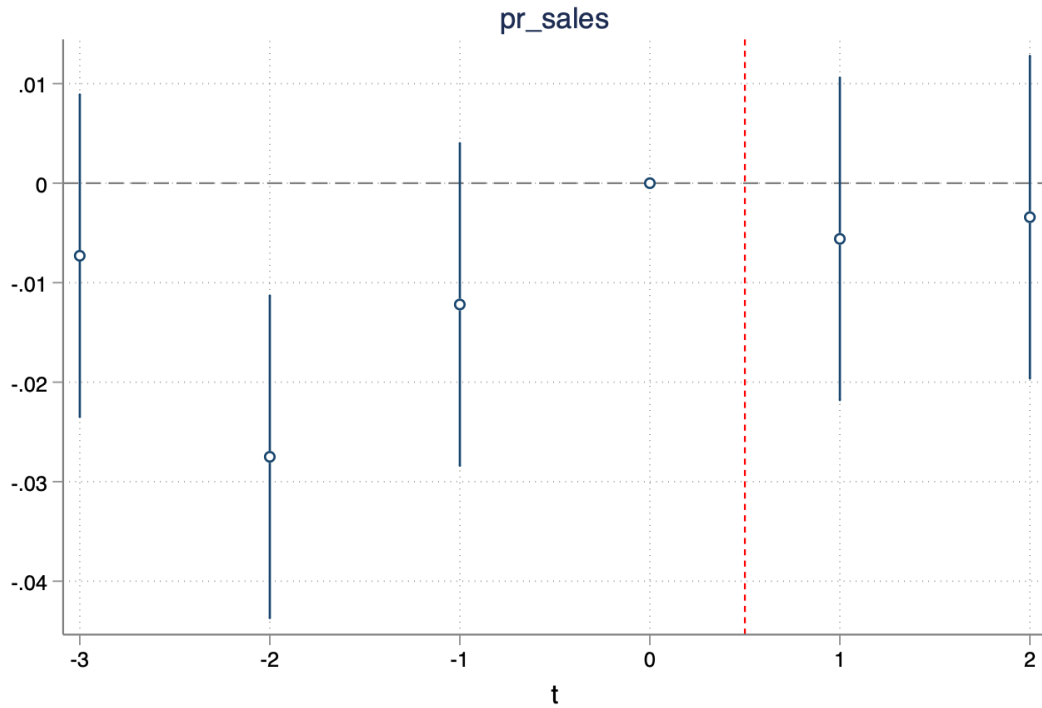
- District Fixed Effects (similar results – not reported)

$$Y_{it} = \alpha + \sum_{t=2015}^{2021} \beta_t \times treated_i \times \mathbf{1}[t] + \gamma \times treated_i + dist_{d(i)} + \varepsilon_{it}$$

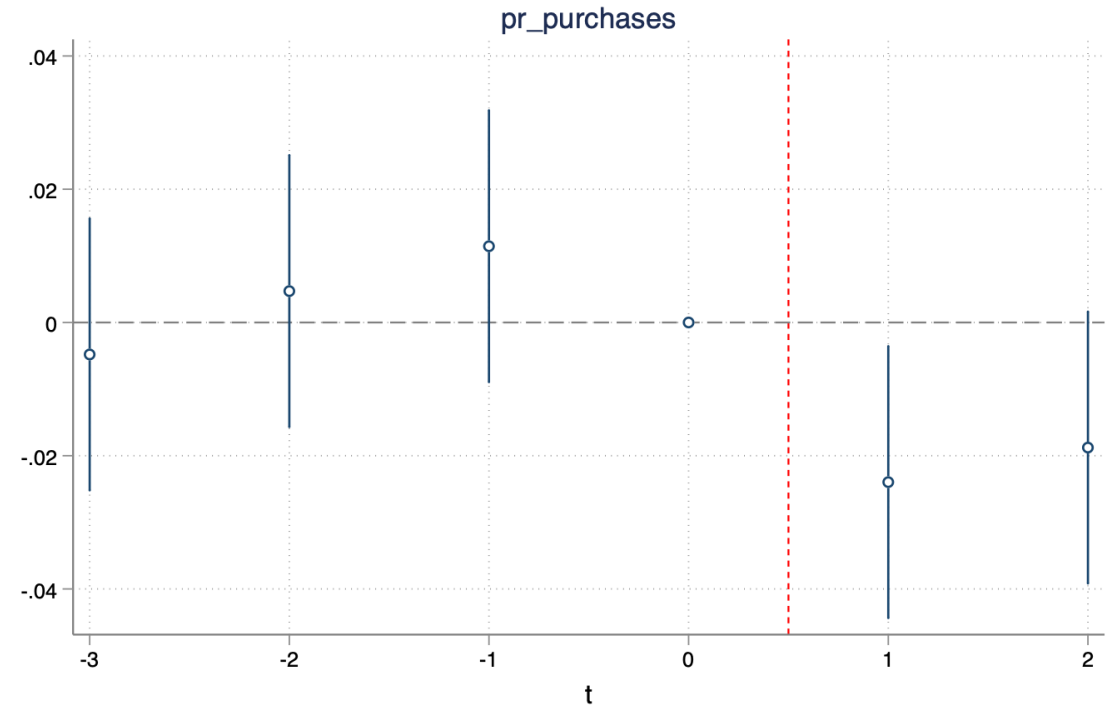
- District  $\times$  year Fixed Effects (similar results – not reported)

$$Y_{it} = \alpha + \sum_{t=2015}^{2021} \beta_t \times treated_i \times \mathbf{1}[t] + \gamma \times treated_i + dist \& year_{d(i)t} + \varepsilon_{it}$$

# $\Pr(\text{Domestic Sales} > 0)$ and $\Pr(\text{Domestic Purchases} > 0)$

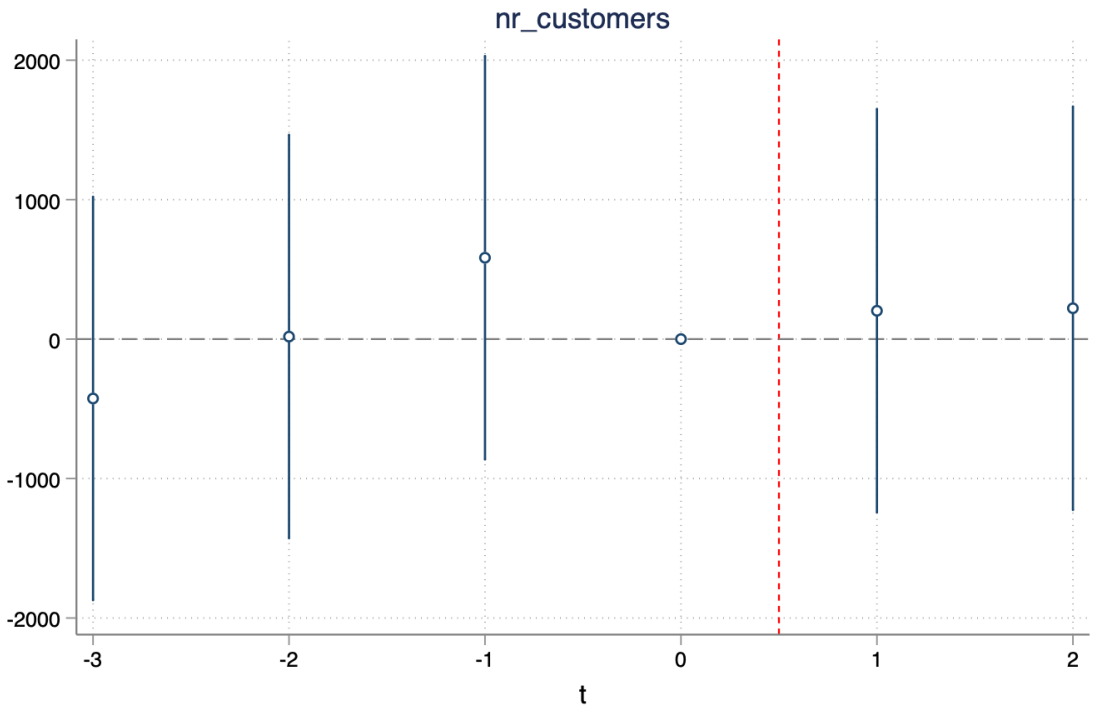


$\Pr(\text{Domestic Sales} > 0)$

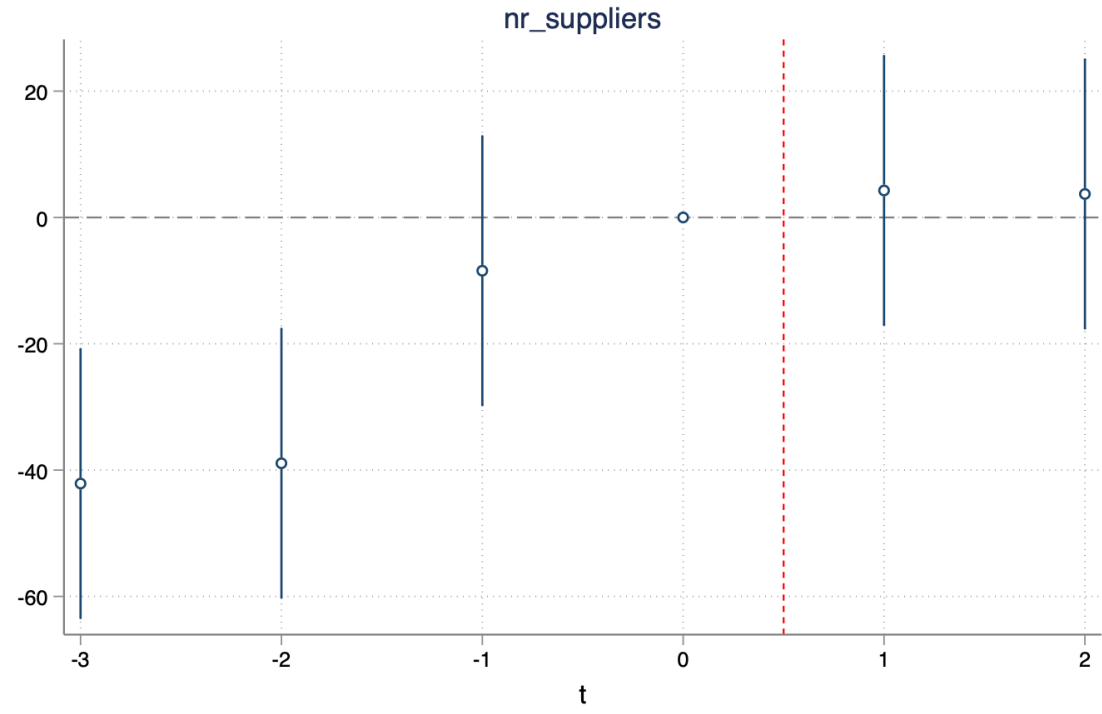


$\Pr(\text{Domestic Purchases} > 0)$

# Domestic Customers and Suppliers



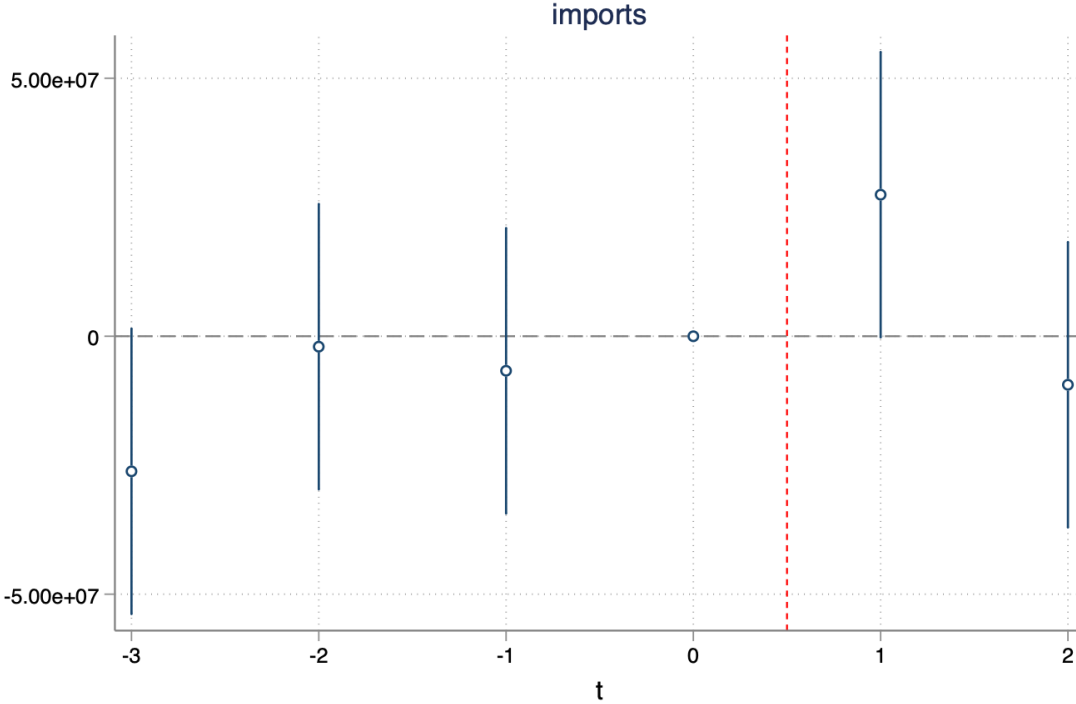
Domestic Customers



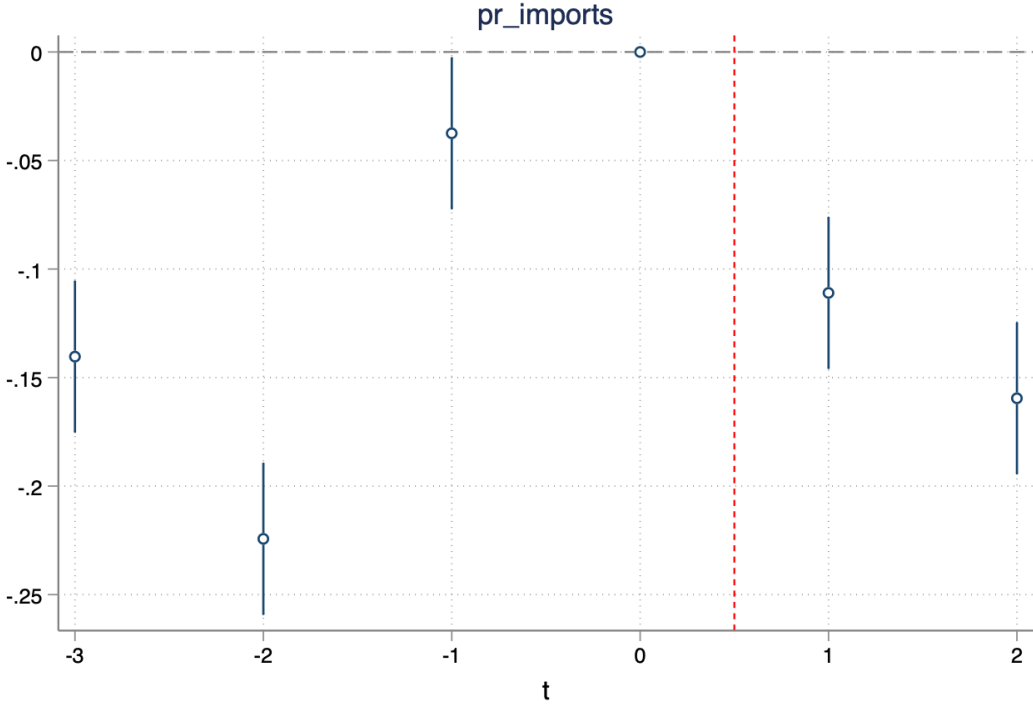
Domestic Suppliers



# Imports

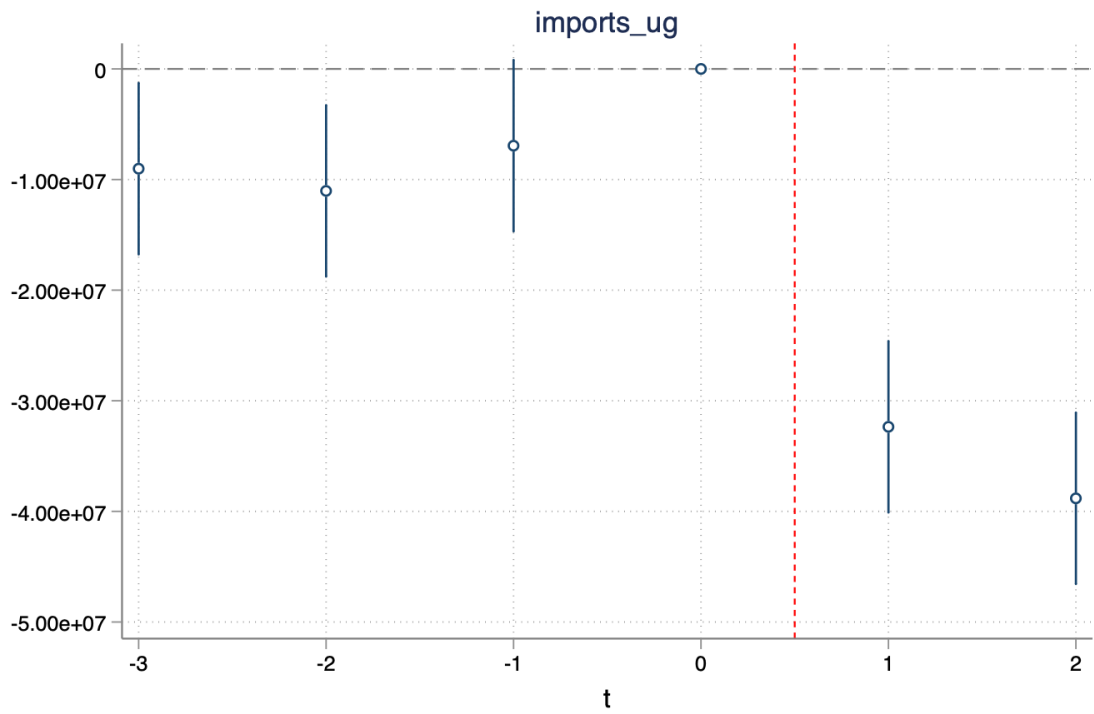


Imports

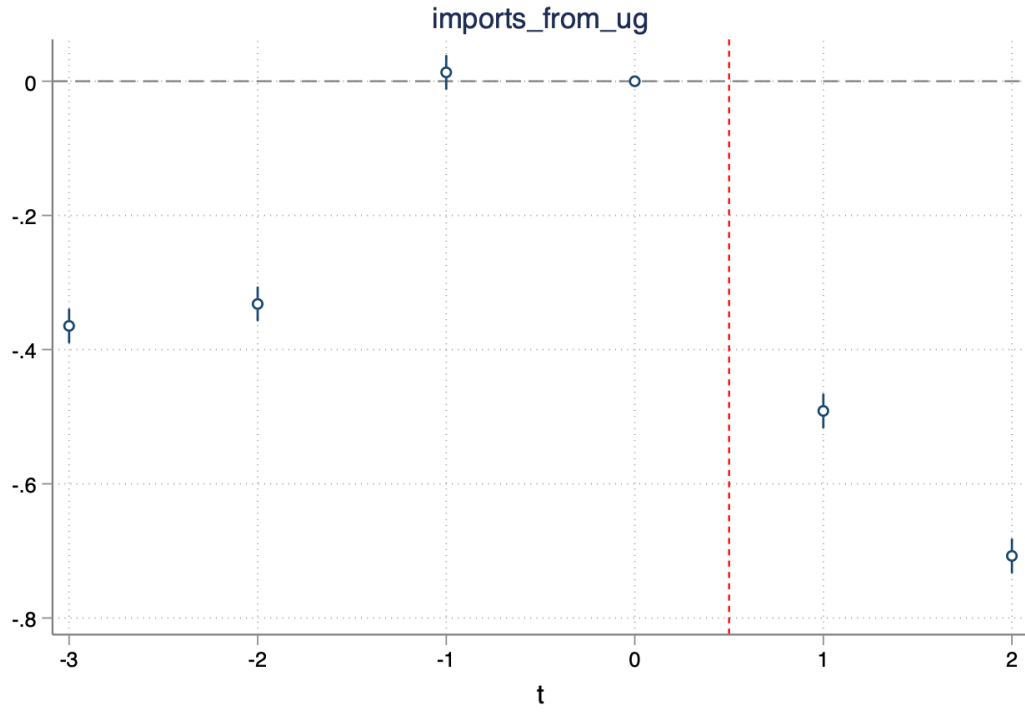


$\Pr(\text{Imports} > 0)$

# Imports from UG

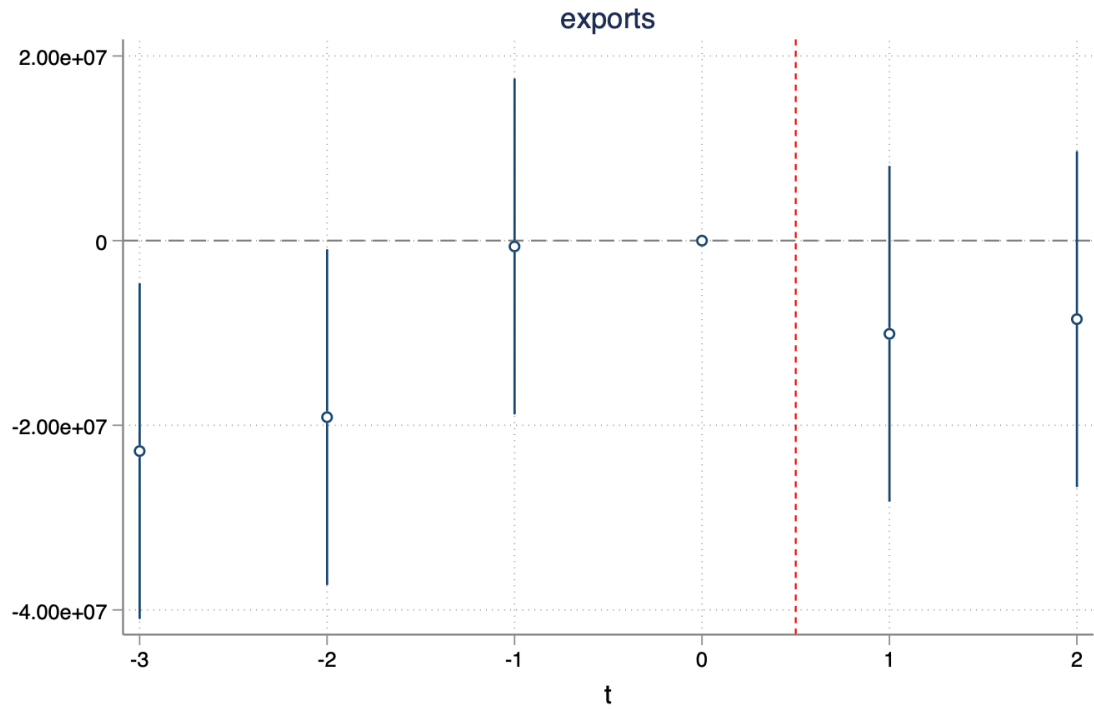


Imports from UG

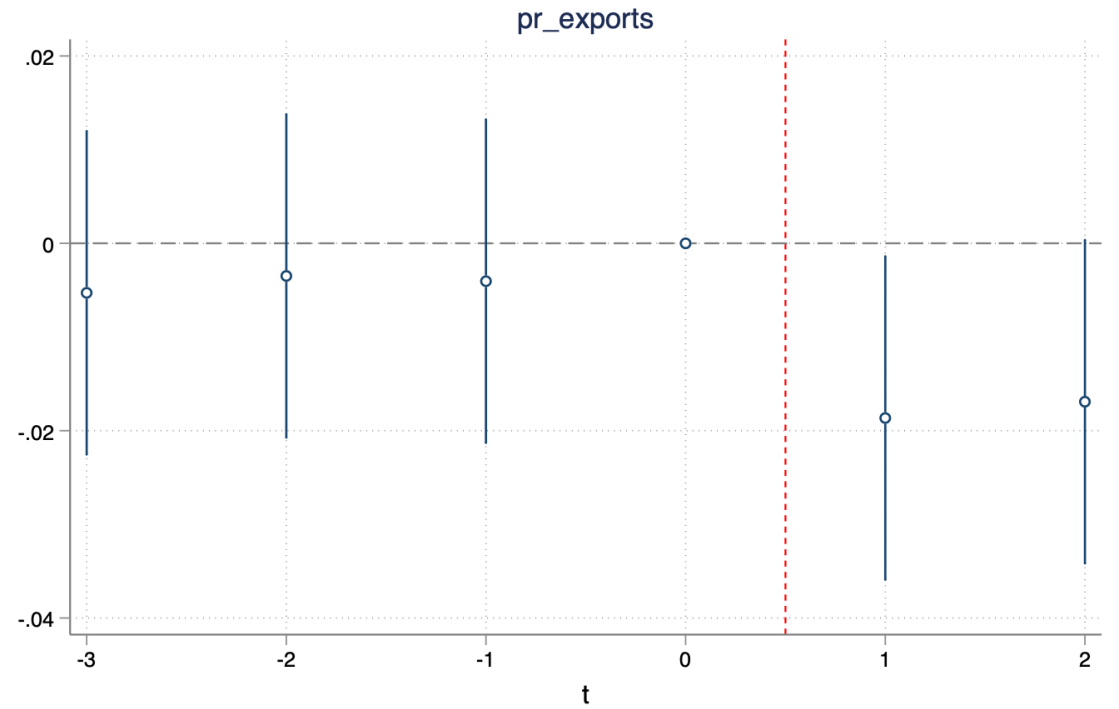


$\Pr(\text{Imports from UG} > 0)$

# Exports

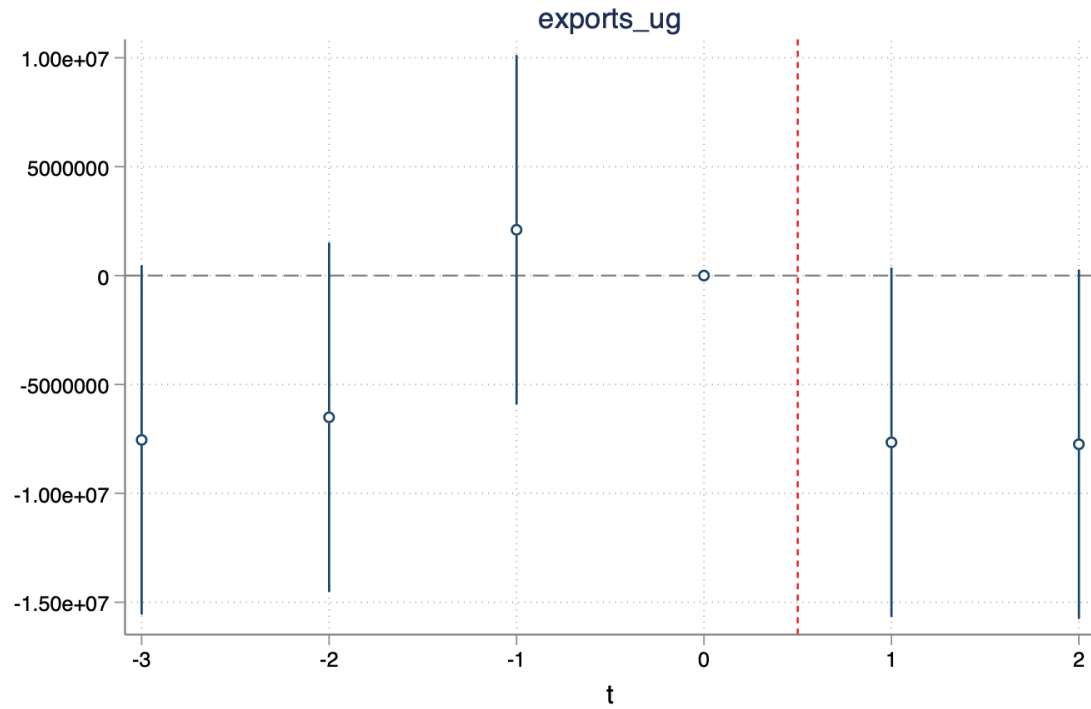


Exports

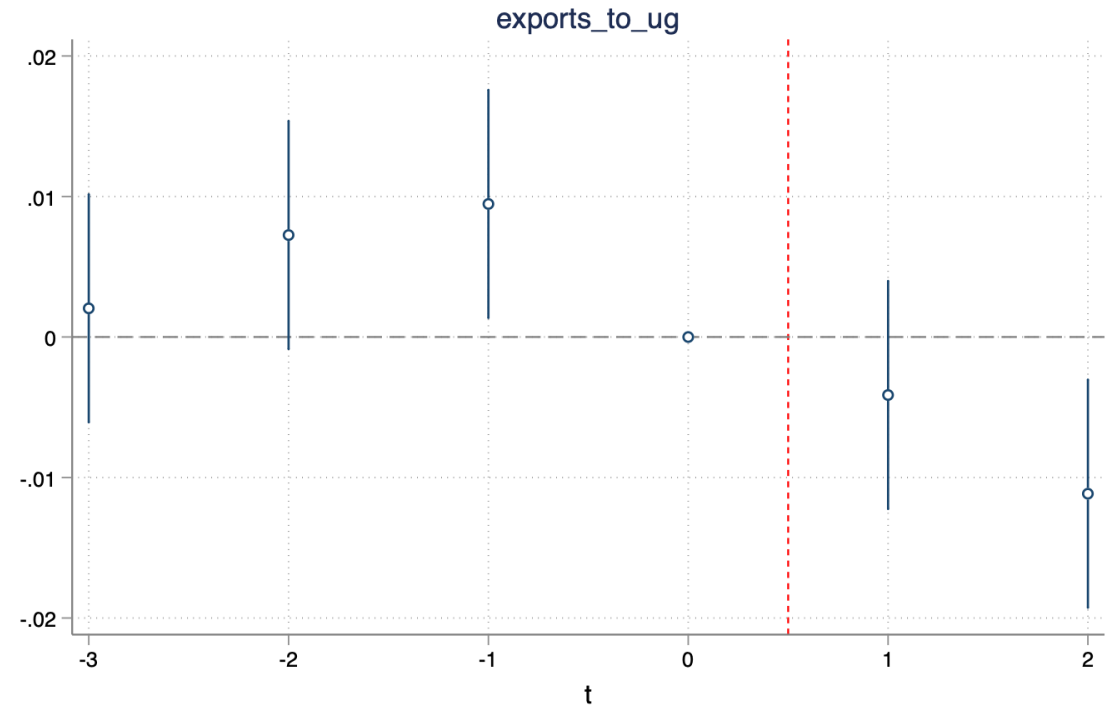


$\Pr(\text{Exports} > 0)$

# Exports to UG

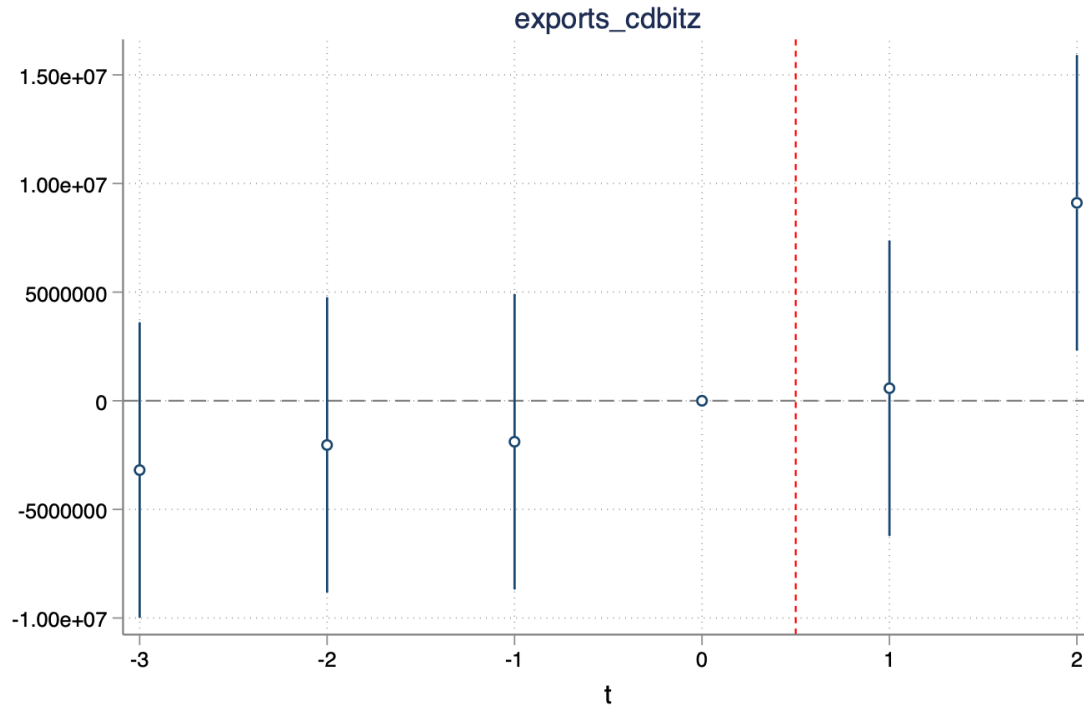


Exports to UG

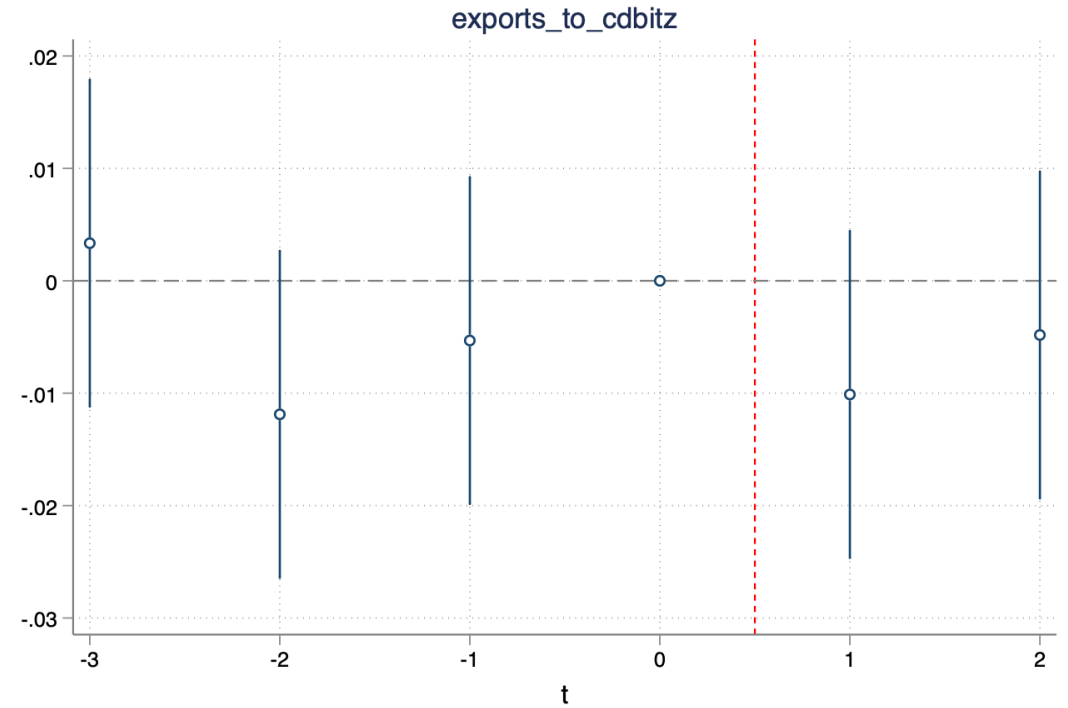


Pr(Exports to UG > 0)

# Exports to bordering countries except UG

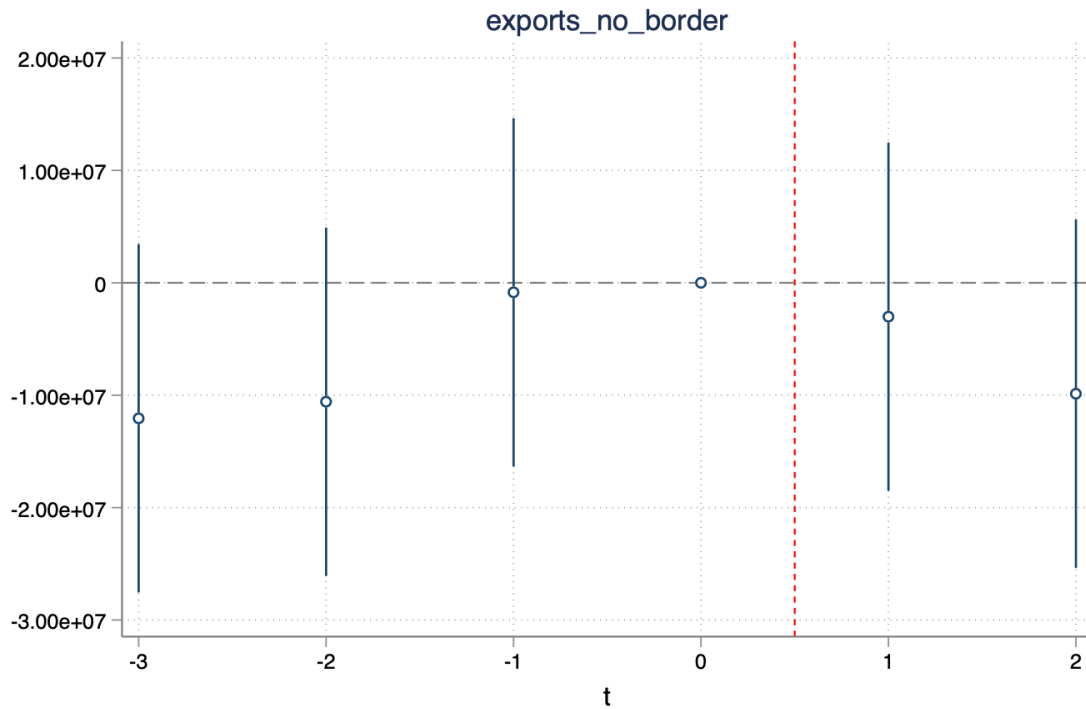


Exports to other bordering countries except UG

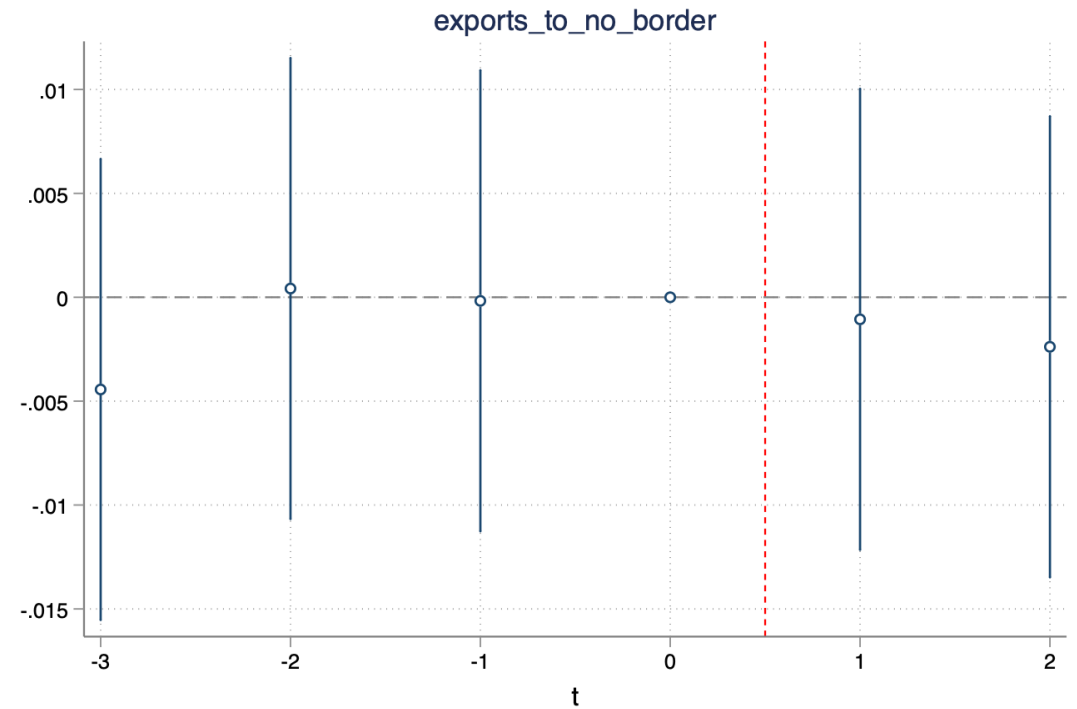


Pr(Exports to other bordering countries except UG > 0)

# Exports to non-bordering countries

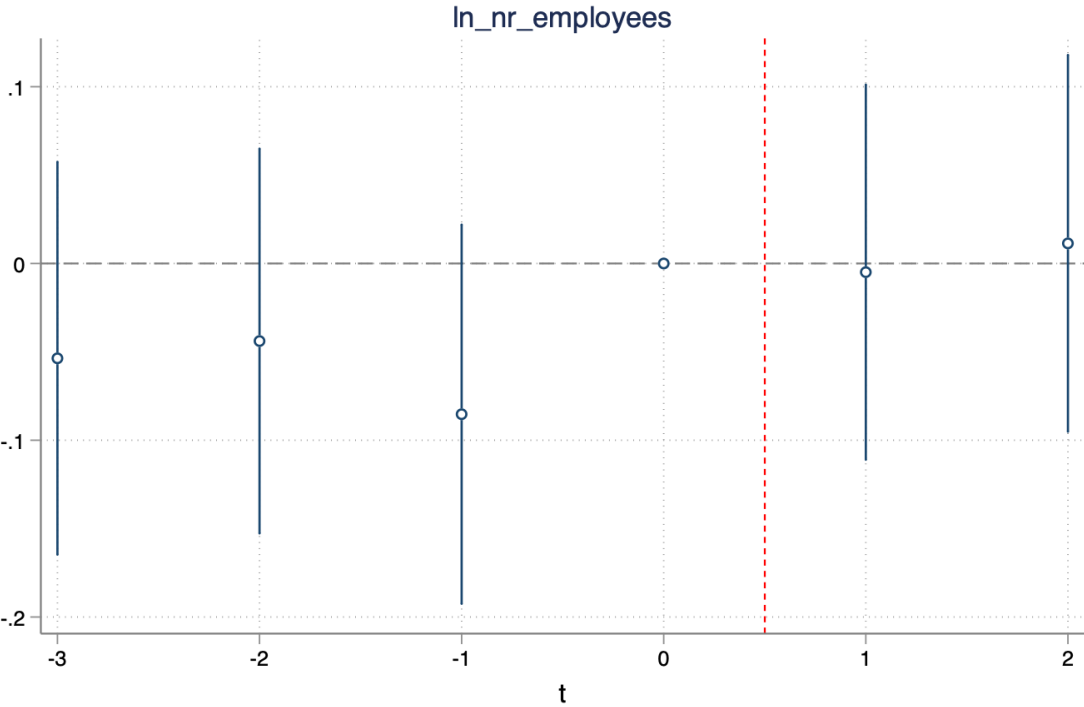


Exports to non-bordering countries

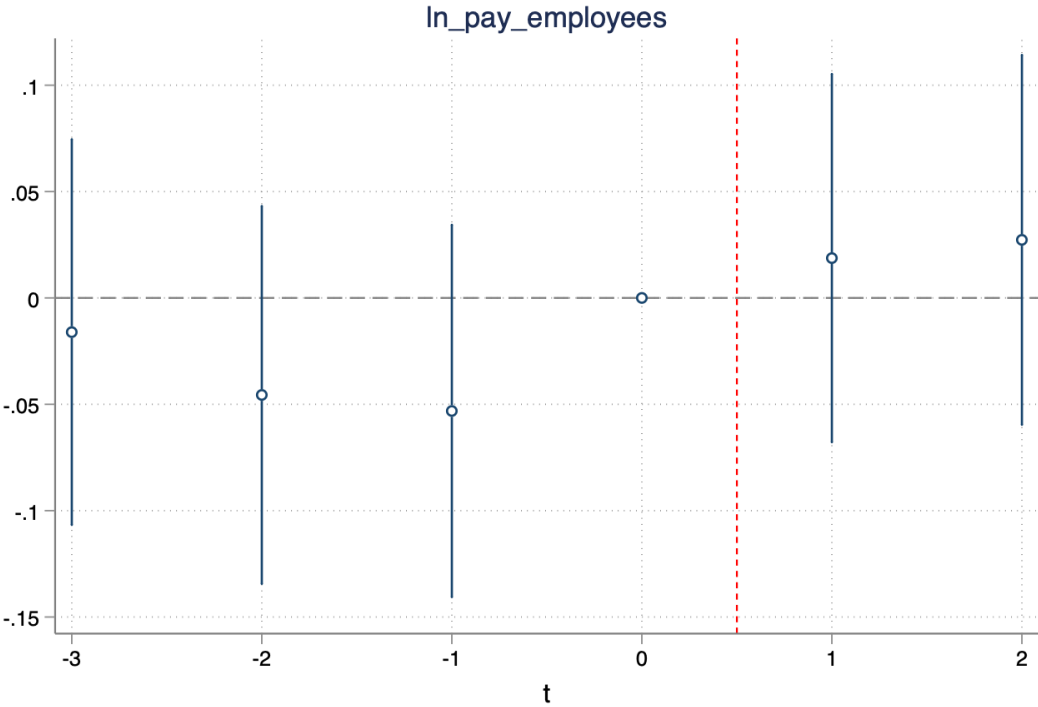


$\Pr(\text{Exports to non-bordering countries} > 0)$

# Employment

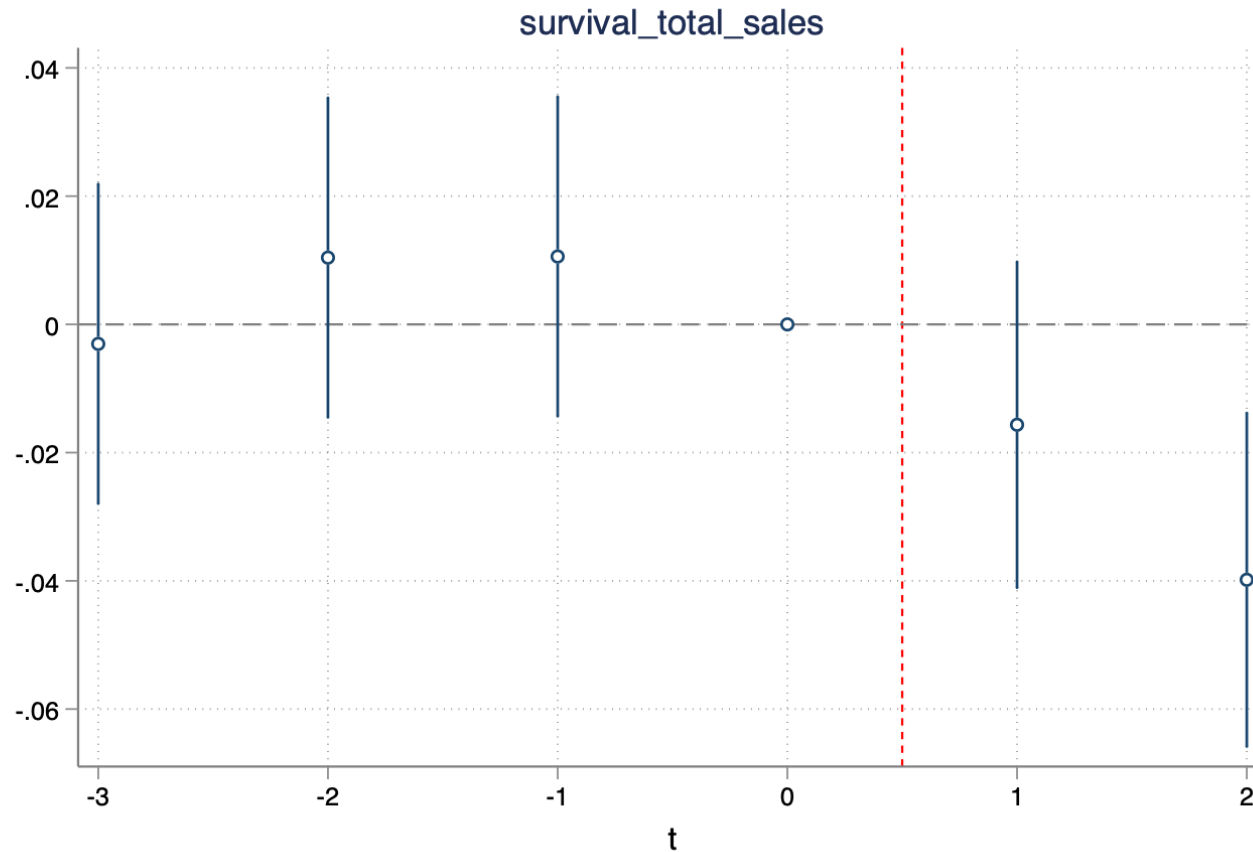


ln(Number of Employees)



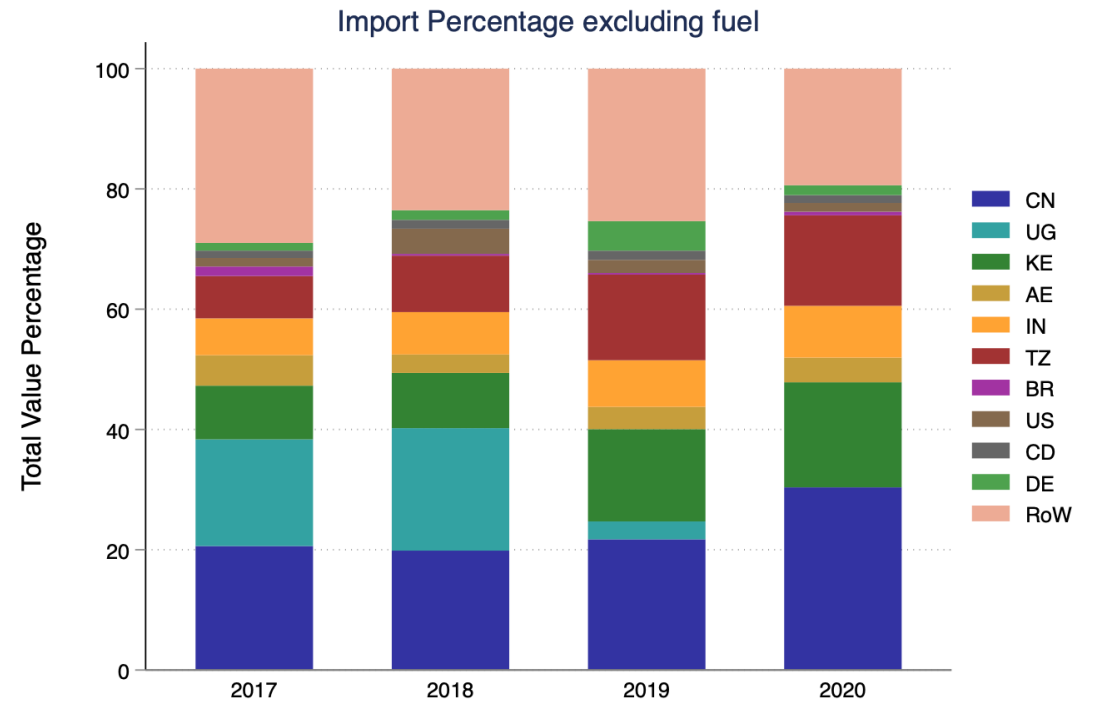
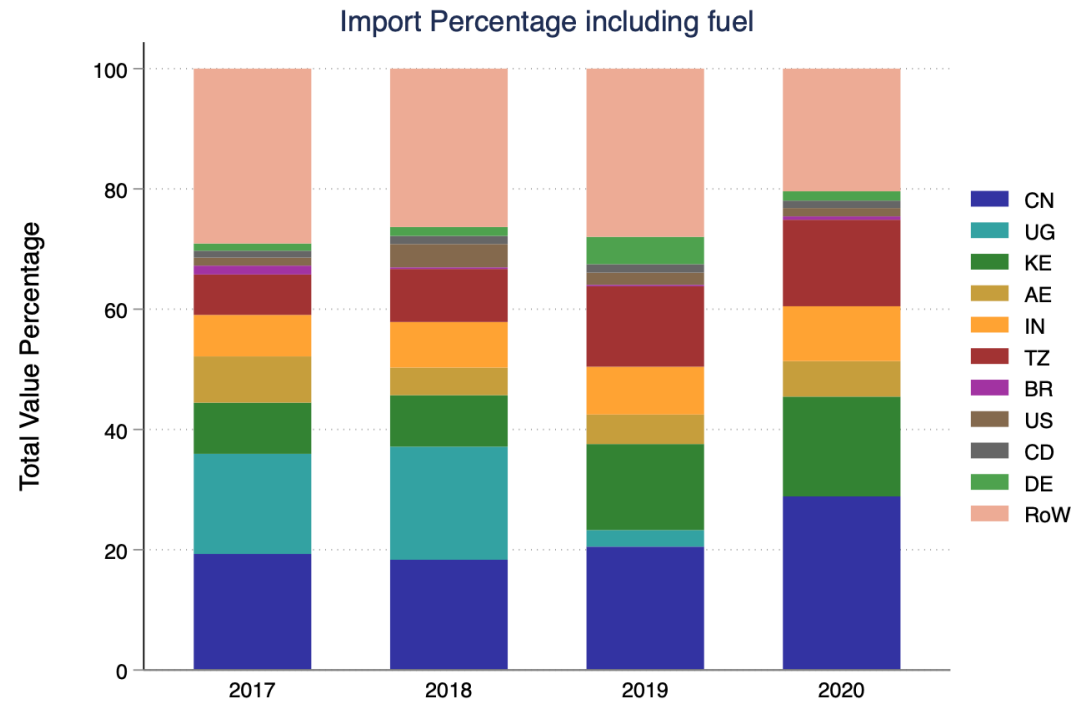
ln(Pay of Employees)

$\Pr(\text{Survival})$  (firm total sales non-zero and present in  $t$  and in  $t+1$ ) retaining firms with non-zero imports in 15, 16, 17 or 18

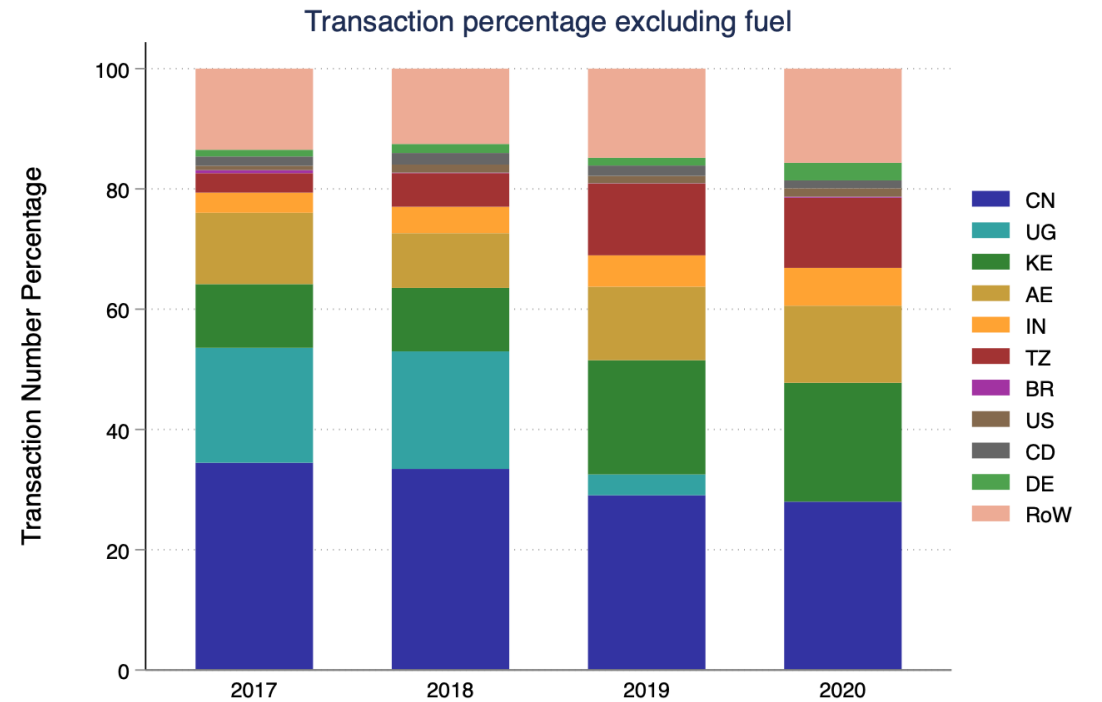
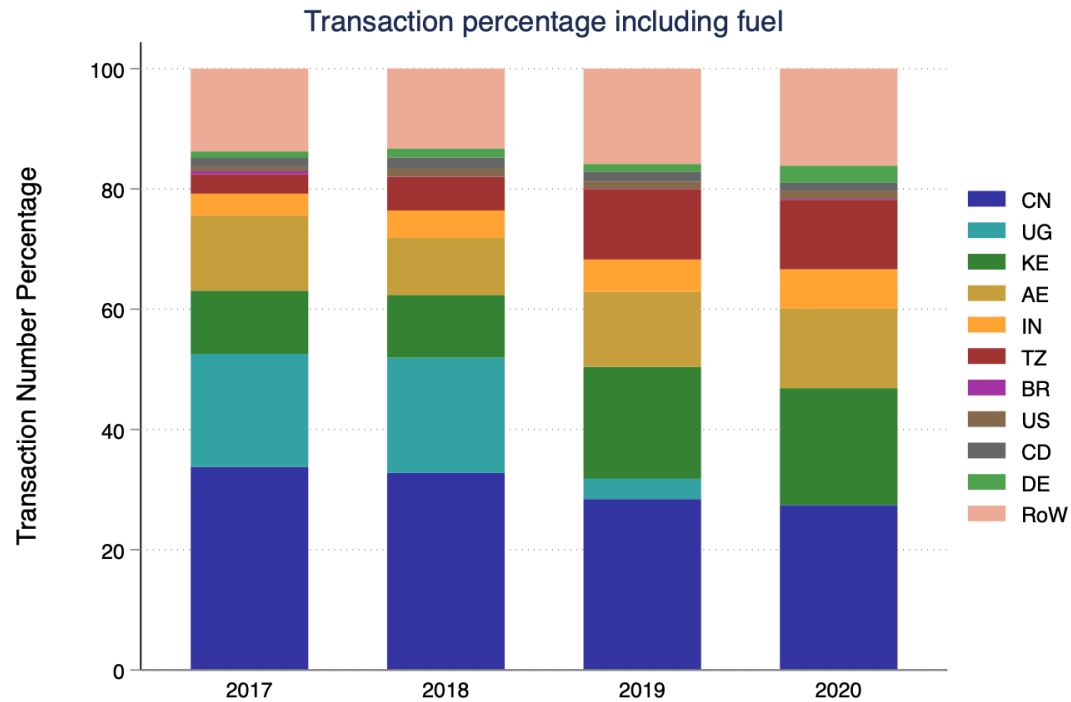




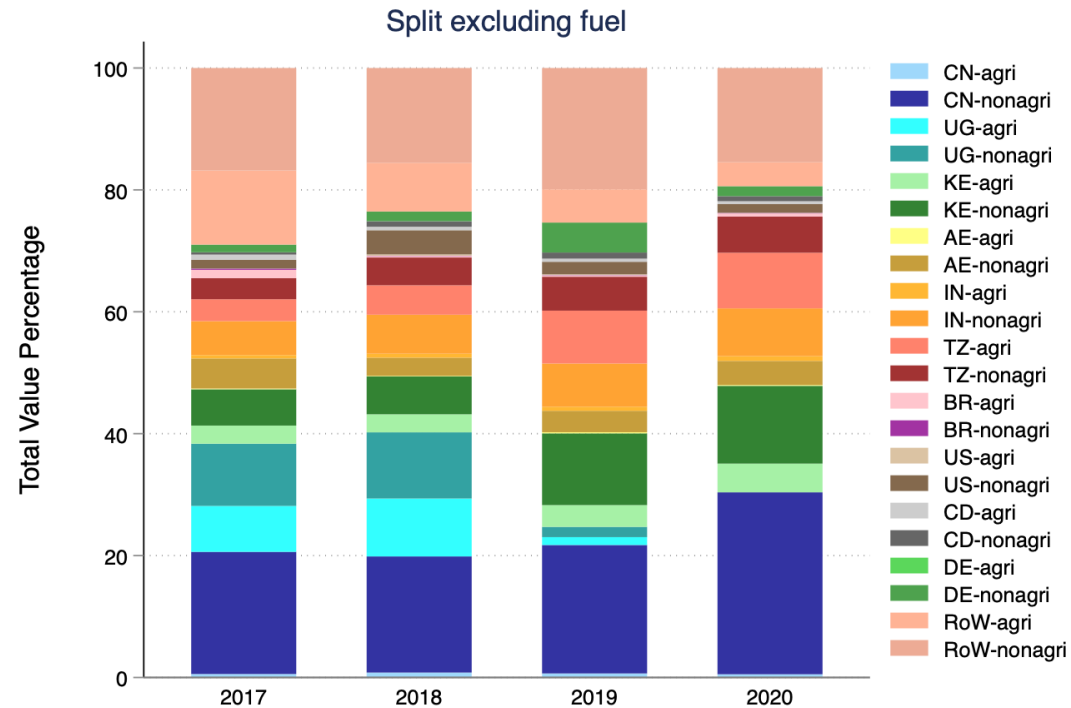
# Import Percentage



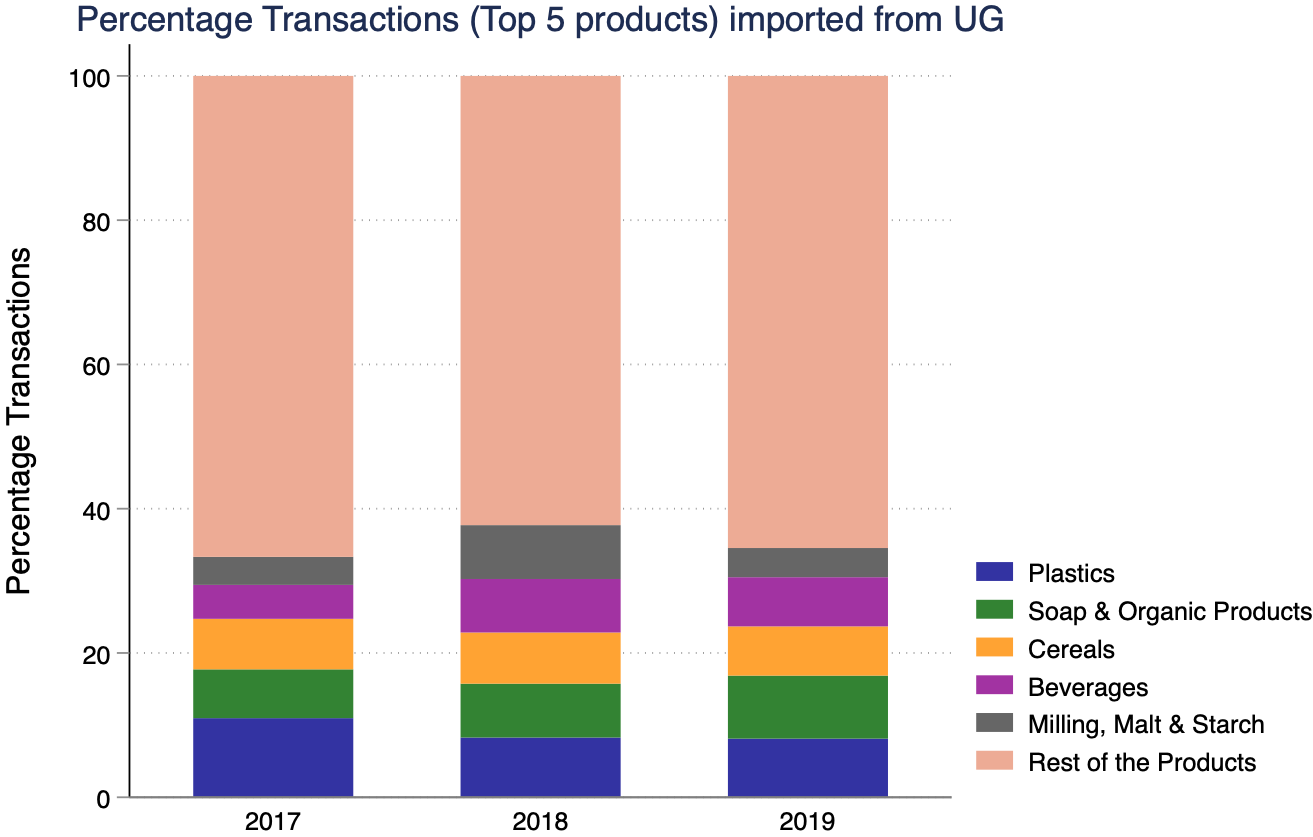
# Number of Transactions Percentage



# Import Percentage split according to agriculture/non-agriculture



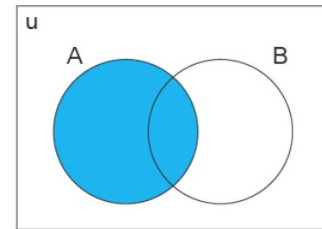
# Percentage of number of Transactions of goods imported from Uganda split according to top 5 hs codes(Total Import Value 17/18)



# Firm- all digits HScode pair

- Probability of shifting successfully =  $1531/5027 = 0.3$  ( $243/888 = 0.27$  Agri;  $1288/4139 = 0.31$  Non - Agri)
- Probability of shifting to TZ/CD conditional on shifting successfully =  $185/1531 = 0.12$  ( $64/243 = 0.26$  Agri;  $121/1288 = 0.09$  Non-Agri)
- Compared to non-agricultural products, agricultural products can be substituted easily by the bordering countries of Tanzania and Congo
- The above probability is  $A/A \cup B$ , where TZ/CD is A and B is other countries.  $A \cup B$  is the set of successful shifting

\*Here shifting successfully refers to firms which are initially importing from UG in 2017/18 successfully finding a firm-hscode pair importing from another country in 2019/20



## Probabilities of Substitution (Using Firm - 2-digit hs code pairs)

- The probability of treated firms who are importing from UG also importing the same good from another country before the closure =  $1893/3252 = 0.58$
- Probability of successfully finding a substitute for Ugandan goods from other countries post closure =  $1637/3252 = 0.5$  ( $238/677 = 0.35$  Agri;  $1399/2575 = 0.54$  Non - Agri)
- Of the successful substitutions, probability of finding a substitute from Tanzania/Congo =  $245/1637 = 0.15$  ( $73/238 = 0.31$  Agri;  $172/1399 = 0.12$  Non-Agri)
- Conclusion: In comparison, agricultural products are more likely to be substituted by the bordering countries of Tanzania and Congo

## Firm – 2-digit HScode pairs – control

- Of the control firms importing from TZ/CD before the closure, what is the probability of importing the same hscore2 product from any country after the closure =  $234/433 = 0.54$
- Of the control firms importing from TZ/CD before the closure and successfully importing the same hscore2 product from any country after the border closure, what is the probability of them importing from TZ/CD =  $174/234 = 0.74$
- Out of the control firms that survived the border closure, the probability of them importing the same hscore2 product =  $8217/15467 = 0.53$
- Of the control firms surviving the border closure and importing the same hscore2 product, the probability of them importing from the same country =  $7167/8217 = 0.87$ . (e.g., If a firm imports a good from Uganda and India before the border closure and the same good from China and India after the closure, it will be considered as a firm importing from the same country)

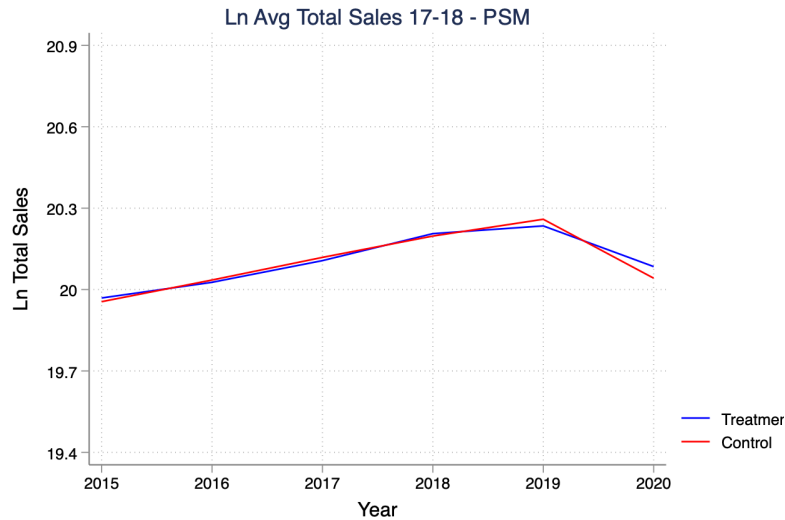
## Alternate Robustness Checks

- We observed that the treatment and control differ significantly in the logarithm of average total sales.
- Hence, we run the same DiD analysis on three specifications mentioned in the next slide correcting for the difference.
- We however observe that the results do not differ with the no matching case.



# DiD Analysis - Comparison of Ln(Avg Total Sales 17-18)

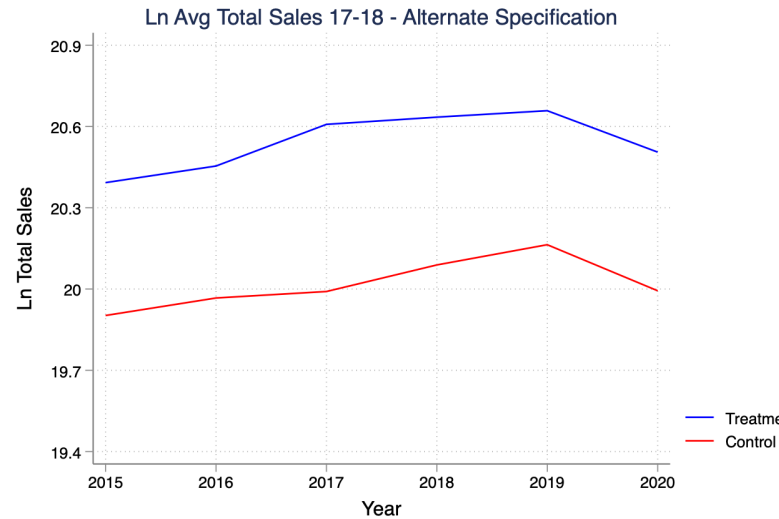
PSM



(1283 Treated, 854 Control)

1. Remove firms in the top 1% of average sales in 17-18
2. Take 1 nearest neighbor using PSM (with replacement)
3. Keep duplicates (one control firm can be the nearest neighbour of several treated firms)

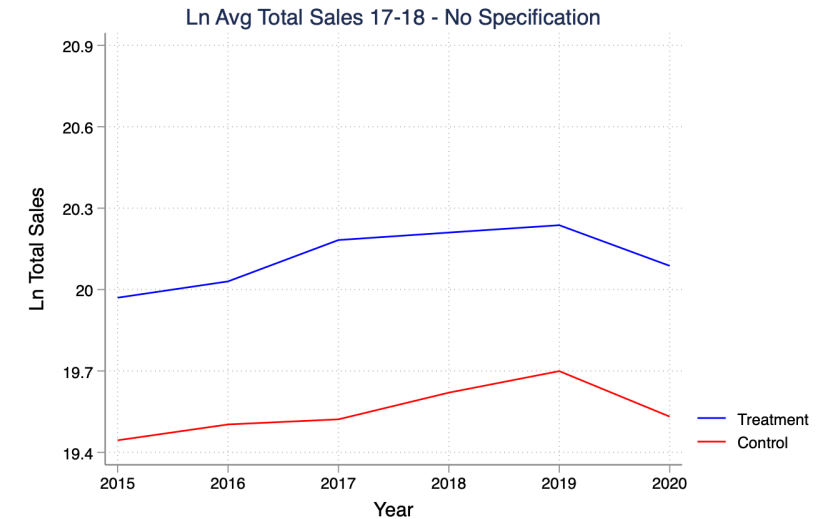
Alternative-“unsophisticated matching”  
Keeping firms above size threshold



(836 Treated, 1730 Control)

1. Remove top 1% firms
2. Keep firms with  $\ln(\text{sales}) \geq 17$  (explained in the next slide)

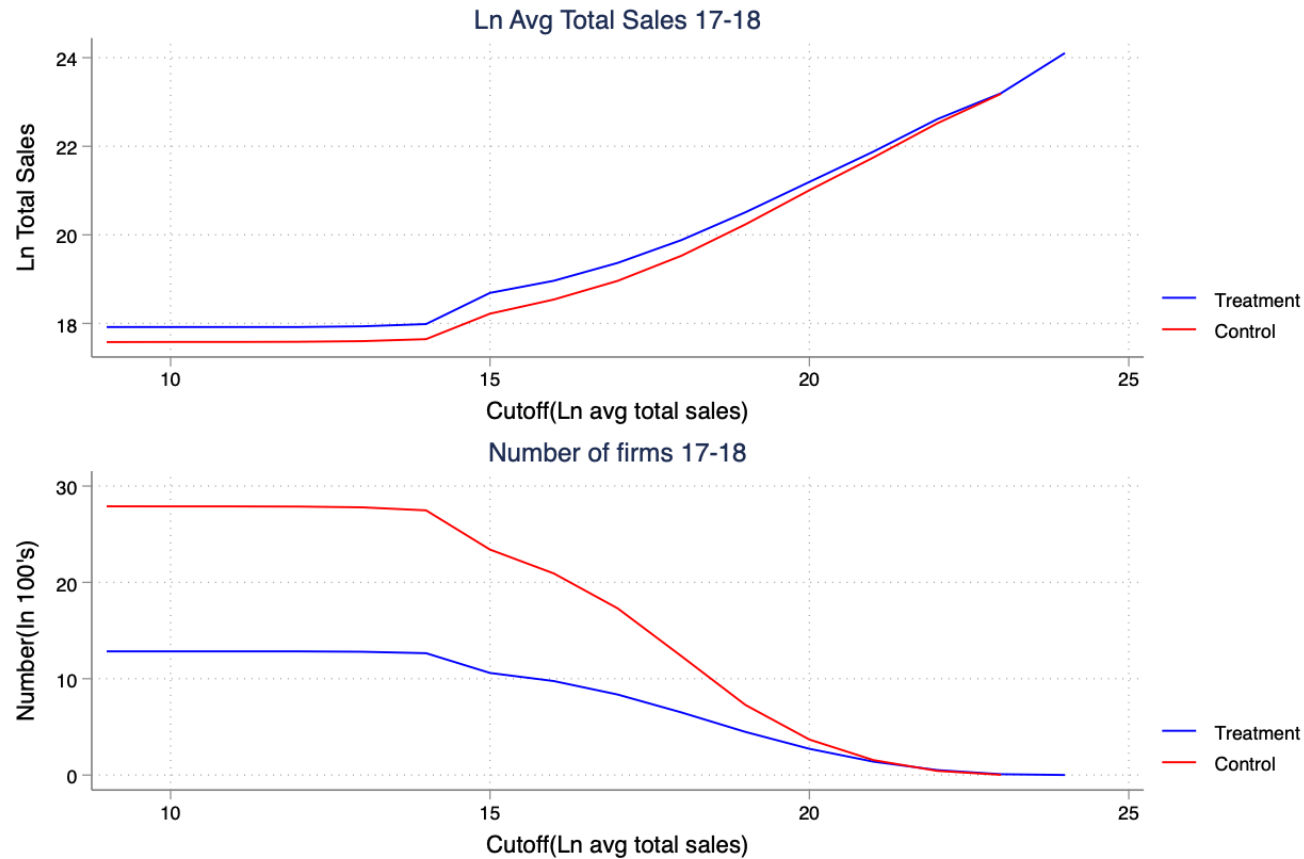
No matching



(1284 Treated, 2790 Control)

1. Remove top 1% firms

# For Alternate Specification – Unsophisticated Matching



Here Cutoff is chosen as 17 to generate DiD graphs

The difference in firm sizes between treatment and control firms does not shrink rapidly as we increase the lower bound of sales.

# Probabilities (PSM Analysis)

- Of the firms importing from Uganda at least once in 2017/18, the Probability of survival(from 2015-20) – treatment =  $2720/6587 = 0.41$ .
- Of the firms that did not import from Uganda even once in 2017/18, the Probability of survival(from 2015-20) – control =  $9490/24504 = 0.38$
- Of the firms that survived all the years and that imported from Uganda at least once in 2017/18, the Probability of making it to the final PSM cut–treatment =  $1283/2720 = 0.47$ , the Probability of making it to the final PSM cut–control =  $854/9490 = 0.09$

Orig\_tr~1718 – Atleast one import from UG 17/18

Tot\_bi – Dummy for survival throughout (15-20)

Treated – Final firms treated dummy

	orig_tr~1718	tot_bi	treated	tot
1	0	0	.	15014
2	0	1	0	854
3	0	1	.	8636
4	1	0	.	3867
5	1	1	1	1283
6	1	1	.	1437

# DiD Results

Sno	Y Variable	OLS - No Speci	FE - No Specifi	OLS - PSM	FE - PSM	OLS - Alternate	FE - Alternate
Intensive Margin							
1	Domestic Sales						
2	Ln(Domestic Sales)						
3	Domestic Purchases						
4	Ln(Domestic Purchases)						
5	Count of Customers						
6	Ln(Count of Customers)						
7	Count of Suppliers						
8	Ln(Count of Suppliers)				X		
9	Import Value		X				
10	Ln(Import Value)		X		X		X
11	Import Value from UG	X	X	X	X	X	X
12	Ln(Import Value from UG)		X		X		X
13	Import Value from bordering countries except UG		X				X
14	Ln(Import Value from bordering countries except UG)			X	X		
15	Import Value from non-bordering countries		X		X		X
16	Ln(Import Value from non-bordering countries)						
17	Export Value						
18	Ln(Export Value)				X		
19	Export Value to UG						
20	Ln(Export Value to UG)						X
21	Export Value to bordering countries except UG	X	X			X	X
22	Ln(Export Value to bordering countries except UG)			X			
23	Export Value to non-bordering countries						
24	Ln(Export Value to non-bordering countries)						
25	Ln(Number of Employees)						
26	Ln(Pay of Employees)						
27	Ln(Total Sales)						

Here X refers to significant outcomes

# DiD Results

Sno	Y Variable	OLS - No Speci	FE - No Specifi	OLS - PSM	FE - PSM	OLS - Alternate	FE - Alternate
Extensive Margin							
28	Has at least one domestic supplier		X		X		
29	Has at least one domestic buyer						
30	Pr(Imports from UG)	X	X	X	X	X	X
31	Pr(Imports from TZ)	X	X	X	X	X	X
32	Pr(Imports from CD)	X	X	X	X		X
33	Pr(Imports from BI)						
34	Pr(Imports from bordering countries except UG)	X	X	X	X	X	X
35	Pr(Imports from non bordering countries)			X	X		
36	Pr(Imports from RoW except UG)						
37	Pr(Exports to UG)	X	X				X
38	Pr(Exports to TZ)						
39	Pr(Exports to CD)						
40	Pr(Exports to BI)	X	X			X	X
41	Pr(Exports to bordering countries except UG)						
42	Pr(Exports to non bordering countries)						
43	Pr(Exports to RoW except UG)		X				

Here X refers to significant outcomes

## firm-hs code pair (Context) – Substitutability year wise

- From 2017 to 2018, Probability of successful shifting =  $808/3077 = 0.26$  (agri  $81/523 = 0.15$ , non-agri  $727/2554 = 0.28$ ). Of the successful shifts, percentage shift to TZ/CD =  $49/808 = 0.06$  (agri  $21/81 = 0.26$ , non-agri  $28/727 = 0.04$ )
- From 2018 to 2019, Probability of successful shifting =  $213/2893 = 0.07$  (agri  $32/583 = 0.05$ , non-agri  $181/2310 = 0.08$ ). Of the successful shifts, percentage shift to TZ/CD =  $11/213 = 0.05$  (agri  $7/32 = 0.22$ , non-agri  $4/181 = 0.02$ )
- From 2019 to 2020, Probability of successful shifting =  $4/697 = 0.01$  (agri  $2/175 = 0.01$ , non-agri  $2/522 = 0$ ). Of the successful shifts, percentage shift to TZ/CD =  $2/4 = 0.5$  (agri  $2/2 = 1$ , non-agri  $0/2 = 0$ )