Unequal Expenditure Switching: Evidence from the 2015 Swiss Franc Appreciation

By Raphael Auer, Ariel Burstein, Sarah Lein, Jonathan Vogel

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Questions

- How do consumers adjust expenditures in response to exchange rate movements?
  - Margins of adjustment:
    - Imports vs. domestic goods
    - Cross-border shopping vs. domestic shopping

- And how does this response vary across the population?
  - Dimensions of heterogeneity:
    - Household income (and size)
    - Household distance to cross-border shopping

- What are the implications for (e.g.)
  - welfare
  - local employment
Jan. 2015 Swiss Franc Appreciation

- **Sept. 6, 2011**: After sharp appreciation of the Swiss franc (CHF), Swiss National Bank (SNB) introduced a min. exchange rate of 1.20 CHF per EUR
- **Late 2014, early 2015**: Foreign developments (e.g., anticipation of large QE program in the euro area) raised perceived cost of sustaining CHF policy
- **Jan. 15, 2015**: SNB unexpectedly abandons minimum exchange rate
  - ⇒ Large and sudden appreciation of the CHF

Subsequent appreciation episode is unique in a number of ways

1. Followed a period of remarkable exchange rate stability
   - EUR/CHF fluctuated in range of 1.2-1.25 while minimum rate was in place...
   - ... and 1.2-1.22 in the last six months before January 15, 2015

2. Exchange rate movement was large in magnitude
   - EUR/CHF appreciated more than 20% on day of policy change
   - 14.0% and 10.6% by the end of Mar. and Dec. 2015

3. Appreciation occurred against the backdrop of a stable Swiss economy
   - reflected a policy response to foreign events
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Heterogeneous price implications

Change in prices of imports, domestic goods, and cross-border goods...

border prices from ABL(2020)
CB price gap

Price gap for identical goods bought by Swiss in Switzerland and abroad
Adjustments in import and cross-border expenditure shares

- $X_m^s$: total expenditure by source $s$ btw January and month $m$ in each year

Import relative to domestic expenditures
\[ X_m^{imp} / X_m^{dom} \]

Cross border relative to (imports + domestic) expenditures
\[ X_m^{cb} / X_m^{imp+dom} \]
Heterogeneous expenditure-side effects

Identify heterogeneous effects of exchange rate shock across agents arising from:

- initial exposure (initial expenditure shares on imports, CB shopping)
- responsiveness (elasticities of substitution btw import, domestic, CB)

associated to differences in:

- income (e.g. non-homotheticity)
- distance to the border

Using detailed Swiss non-durable consumption data

Heterogeneity in initial exposure in 2014

<table>
<thead>
<tr>
<th></th>
<th>CB expenditure share</th>
<th>M expenditure share</th>
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<tr>
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Heterogeneity in responsiveness 2014-2015

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<td>– / 0</td>
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Two implications

Empirically identify retail employment effects of CHF appreciation by distance to the border

- Retail employment falls in regions that are more exposed to CB shopping

Quantify differential welfare effects (from differences in consumption prices) across agents within a country

- Estimate differences in trade elasticities by income
- Counterfactual changes in consumption price by
  1. income
     * Low income households substitute more between imports and domestic goods ⇒ they benefit more (or lose less) from large changes in relative prices due to e.g. exchange rate or trade cost changes
  2. distance to the border
     * Those near CB shopping have higher CB shares ⇒ they benefit more (or lose more) from changes in relative prices due to e.g. exchange rate or trade cost changes in CB prices
Relation to literature

Differential price effect across income groups of international shocks
- Typically, do not observe trade shares by income group, so fill gaps in data by
  - structural model to infer shares from aggregate trade flows (Fajgelbaum-Khandelwal, 2016)
  - common trade shares and elasticities w/in “sector,” diffs in expenditure across
    (Cravino and Levchenko 17; Jaravel and Sager, 19; Borusyak and Jaravel, 18; Caroll and Hur, 19; Hottman and Monarch, 20)
  - price indices by group using S-V weights — assume no demand shocks of any
    form over time, project on (non-group specific) China shock (Bai and Stumpner, 2019)
- We observe import shares and estimate import elasticities by income group
- Limitation: Data on a small set of goods (supermarkets and drugstores)

Price sensitivity and income
- We estimate differences in import price sensitivities using large exchange rate shock

Expenditure switching and income effects
- Bems and Di Giovanni (2016)
- We focus on heterogeneous expenditure switching across income groups rather than
  on expenditure switching driven by aggregate changes in income

Cross border shopping and exchange rate movements
- Retail employment and proximity to the border in response to exchange rate
- We observe CB expenditures by household and region and a large xrate shock
Baseline Nested Armington Framework

- Utility of each household $h$ in region $r$ w/ income $i$ aggregates CB, local purchases

$$C_{ht} = \left( C_{ht}^{OT} \right)^{\xi} \left[ \mu_{ht}^{\frac{1}{\sigma_h}} \left( C_{ht}^{CB} \right)^{\frac{\sigma_h - 1}{\sigma_h}} + (1 - \mu_{ht})^{\frac{1}{\sigma_h}} \left( C_{ht}^{DM} \right)^{\frac{\sigma_h - 1}{\sigma_h}} \right]^{\frac{\sigma_h}{\sigma_h - 1}} (1 - \xi)$$

where $C_{ht}^{DM}$ is a CES aggregator across domestic and imported varieties

$$C_{ht}^{DM} = \left( \zeta_{ht}^{\frac{1}{\eta_h}} \left( C_{ht}^{M} \right)^{\frac{\eta_h - 1}{\eta_h}} + (1 - \zeta_{ht})^{\frac{1}{\eta_h}} \left( C_{ht}^{D} \right)^{\frac{\eta_h - 1}{\eta_h}} \right)^{\frac{\eta_h}{\eta_h - 1}}$$

- To be done: introduce non-homotheticities explicitly
- Abstract from product categories in baseline because
  - Not sufficient cross-border shopping data
  - For nest combining imports and domestically-produced:
    - Changes in import shares almost all from reallocation w/in product categories
    - Investigate within product categories in robustness
Data requirements and sources

Data requirements

- Household income (and size)
- Household-level panel data on expenditures by product & country of purchase
- Product-country-of-purchase-specific panel on prices
- For products purchased in Switzerland, data on production location

Data sources

- AC Nielsen homescan: Retail prices and expenditures
  - Covers a demographically, regionally representative sample of ≈ 3,000 households in Switzerland January 2012 - June 2016
    - 7 income bins, 9 size bins
    - Participating households record purchases in supermarkets and drugstores (food, beverages, personal and household items)
  - Observation is a transaction:
    - household ID, barcode (European Article Number, or EAN) of product, quantity, price (net of good-specific discounts), date of purchase, name of retailer
    - whether purchase occurred in Switzerland or abroad
Data requirements and sources

**Data requirements**

- Household income (and size)
- Household-level panel data on expenditures by product & country of purchase
- Product-country-of-purchase-specific panel on prices
- For products purchased in Switzerland, data on production location

**Data sources**

- codecheck.info: info on country of production for a subset of goods
  - 63% of goods, 72% of exp. in Nielsen in 36 months surrounding appreciation
  - Import share in expenditures 27% in 2014, similar to total import share in consumption reported in in SFSO (2014)
Data requirements and sources

Data requirements

- Household income (and size)
- Household-level panel data on expenditures by product & country of purchase
- Product-country-of-purchase-specific panel on prices
- For products purchased in Switzerland, data on production location

Additional details

- Small share of transactions abroad
  - This guides our more restrictive assumptions on CB shopping
- M vs. D: Construct expenditure shares using transactions for which
  - goods purchased in Switzerland (not CB), we know imports or domestic produced
- CB vs. MD: Construct expenditure shares using transactions for which
  - goods purchased abroad or in Switzerland, with or without country of production
Household income and size

Share of households by income (Top) and size (Bottom)

- **Annual wages in 2014 by percentile (Swiss Earnings Structure Survey):**
  - $20^{th}$ 29.3$K$, $50^{th}$ 52.8$K$, $80^{th}$ 75.8$K$

- **Annual disposable income in 2014 by percentile (Federal Statistical Office):**
  - $25^{th}$ 35.8$K$, $50^{th}$ 49.2$K$, $75^{th}$ 67.5$K$, $90^{th}$ 91.2$K$
• Shares in total consumption expenditures decreasing in household income
  ▶ Good expenditures
  ▶ Food, beverages, personal care and household items expenditures
Average expenditure by income group

(weighted by number of HHs)
Income and expenditure at the HH level

\[
\ln(\text{exp}_{ht}) = \alpha_t + \beta_t \ln(\text{inc}_h) + \varepsilon_{ht}
\]

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<td>1.227***</td>
<td>1.180***</td>
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<td></td>
<td>(0.111)</td>
<td>(0.111)</td>
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<tr>
<td>Constant</td>
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<td>2,189***</td>
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<td></td>
<td>(8.182)</td>
<td>(7.984)</td>
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<td>R-squared</td>
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<td>Robust standard errors in parentheses</td>
<td>*** p&lt;0.01, ** p&lt;0.05, * p&lt;0.1</td>
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Roadmap

1. **Initial exposure**: Show that $X_{ht}^{CB}/X_{ht}^{DM}$ is higher closer to border
   - $X_{ht}^j$ denotes expenditure on $j \in \{CB, D, M, DM\}$

2. **Responsiveness**: Show that $X_{ht}^M/X_{ht}^D$ rises by less for high income households between 2014-15

3. **Heterogeneous elasticities**: Estimate how import elasticities vary with income

4. **Retail employment effects**

5. **Heterogeneous welfare implications**
Step I: Initial Exposure
Initial exposure: M vs D
No differences in import shares by income or distance

$$X^M_{ht} / X^D_{ht} = \alpha_t + \beta_{1t} \ln(inc_h) + \beta_{2t} \ln(size_h) + \beta_{3t} \ln(drive_h) + \varepsilon_{ht}$$

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<td>-0.002</td>
<td>-0.040*</td>
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<td>[0.026]</td>
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<td>-0.099**</td>
<td>-0.083***</td>
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<td>weighted</td>
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<td>Y</td>
<td>N</td>
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(weighing h share of expenditure w/in (income, size) × # of h in (income, size))
Initial exposure: M vs D

No differences in import shares by income or distance

\[ X_{ht}^M / X_{ht}^D = \alpha_t + \beta_{1t} \ln(inc_h) + \beta_{2t} \ln(size_h) + \beta_{3t} \ln(drive_h) + \epsilon_{ht} \]

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(weighing \( h \) share of expenditure w/in \((income, size) \times \# of \( h \) in \((income, size)\))

- Income insignificant when import share calculated by product category, aggregating at the income \( \times \) size level
Initial exposure: CB vs DM

Higher expenditure shares on CB closer to CB shopping (by 2-digit zip code)

(a) CB Share 2014

(b) ln(driving time)

- Driving time measurement for each 2-digit zip code, \( z \)
  - Identify supermarkets close to Swiss border in Germany, France, Italy, Austria
  - Identify the largest town by population in each \( z \), \( t_z \)
  - Use viamichelin.ch (similar to google maps) to measure min. driving time to and from \( t_z \) to foreign supermarkets, keeping only minimum

- We often refer to drive time as “distance”
Initial exposure: CB vs DM
Higher expenditure shares on CB closer to CB shopping

CB relative to DM expenditure by 2-digit zip code, 2014

(weighing 2-digit zip codes by total expenditure; same results hold weighting by number of households)
Initial exposure: CB vs DM

Higher expenditure shares on CB closer to the border

\[ y_{ht} = \alpha_t + \beta_{1t} \ln(inc_h) + \beta_{2t} \ln(size_h) + \beta_{3t} \ln(drive_h) + \varepsilon_{ht} \]

where \( y_{ht} = \frac{X_{ht}^{CB}}{X_{ht}^{DM}} \) or \( y_{ht} = I_{X_{ht}^{CB} > 0} \)

<table>
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<th>( \mathbb{1}<em>{X</em>{ht}^{CB} &gt; 0} )</th>
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(weighing \( h \) share of expenditure w/in \( income, size \) \( \times \) \# of \( h \) in \( income, size \))
Step II: Heterogeneous responsiveness
Trade responsiveness by income

\[ d \ln(\frac{X_t^M}{X_t^D}) \text{ for incomes } \leq 60K \text{ minus } d \ln(\frac{X_t^M}{X_t^D}) \text{ for incomes } > 60K \]

- Compare first \( m \) months of 2013, 14, 15 to address issues of seasonality
Trade responsiveness: baseline household regressions

\[ d \ln (X_{ht}^M / X_{ht}^D) = \alpha_t + \beta_t \ln (\text{income}_h) + \rho_t \ln (\text{size}_h) + [\gamma_t \ln (\text{dist}_h)] + \varepsilon_{ht} \]

- \( d \ln (X_{ht}^M / X_{ht}^D) \): Change in expenditure on imports relative to domestic goods
  - Always a single time difference between between \( t \) and \( t + 1 \)
  - Estimate for changes pre-appreciation 2013-14; around appreciation 2014-15
  - Taken over a common interval of months in \( t \) and \( t + 1 \) (starting with January)
  - eg, \( X_{ht}^M \) (and \( X_{ht+1}^M \)) = expenditure on imports btw Jan-May 2014 (and 2015)
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- In all regressions:
  - balanced sample: estimate on \( h \) w/ \( X_{ht}^D X_{ht}^M > 0 \) in 13-15
  - cluster by (\text{income, size}) bins
  - weight: \( h \) share of expenditure w/in (\text{income, size}) \( \times \) \# of \( h \) in (\text{income, size})
    - each (\text{income, size}) gets weight given by number of households
    - within (\text{income, size}), relative weights across \( h \) given by expenditure in 14
Trade responsiveness: baseline household regressions

\[ d \ln \left( \frac{X_{ht}^M}{X_{ht}^D} \right) = \alpha_t + \beta_t \ln(\text{income}_h) + \rho_t \ln(\text{size}_h) + \gamma_t \ln(\text{dist}_h) \] + \varepsilon_{ht}

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     - each (\text{income}, \text{size}) gets weight given by number of households
     - within (\text{income}, \text{size}), relative weights across \( h \) given by expenditure in 14

- Identification assumption in version of model in which eqn is structural:
  - deviations in average HH demand shocks for imported (relative to domestic) goods btw \( t \) and \( t + 1 \) are not correlated w/ HH income or size
Trade responsiveness: baseline results

Distance (Estimate of $\gamma$: 2014-15)

$$d \ln (X_{ht}^M / X_{ht}^D) = \alpha_t + \beta_t \ln (income_h) + \rho_t \ln (size_h) + \gamma_t \ln (dist_h) + \varepsilon_{ht}$$

- No effect of distance on changes in import shares btw 14-15
Trade responsiveness: baseline results

HH size (Estimate of $\rho$: 2014-15)

\[ d \ln \left( \frac{X_{ht}^M}{X_{ht}^D} \right) = \alpha_t + \beta_t \ln(\text{income}_h) + \rho_t \ln(\text{size}_h) + \varepsilon_{ht} \]

No effect of HH size on changes in import shares btw 14-15
Trade responsiveness: baseline results
Income (Estimate of $\beta$: 2014-15)

\[ d \ln \left( \frac{X^M_{ht}}{X^D_{ht}} \right) = \alpha_t + \beta_t \ln(\text{income}_h) + \rho_t \ln(\text{size}_h) + \varepsilon_{ht} \]

- Higher-income HHs experienced a relative decline in import shares btw 14-15
Trade responsiveness: baseline results

Income (Estimate of $\beta$: 2014-15) affected by inclusion of distance? 

$$d \ln(X_{ht}^M/X_{ht}^D) = \alpha_t + \beta_t \ln(income_h) + \rho_t \ln(size_h) + [\gamma_t \ln(dist_h)] + \epsilon_{ht}$$

- Impact of income on changes in import shares robust to controlling for distance btw 14-15 – there are two lines there
No evidence of a continuation of pre-existing trends:
- opposite (although smaller) change btw 13-14
- when aggregated to (income,size) bins, insignificant effects in 13-14
- when identified within product group, insignificant effects in 13-14
Trade responsiveness: robustness exercises

Results are robust to the following:

- Use income per capita rather than income and HH size separately
- Don’t control for HH size
- Don’t weight observations
- Two-way cluster by \((\text{income}, \text{size})\) and 2-digit zip code
- Aggregate up to \((\text{income}, \text{size})\)
- Estimate w/in product groups and \((\text{income}, \text{size})\)
- Estimate w/in product groups and \((\text{income}, \text{size})\) using income per capita
Cross border responsiveness: baseline

\[ d \ln(\frac{X^{CB}_{ht}}{X^{DM}_{ht}}) = \alpha_t + \beta_t \ln(\text{income}_h) + \rho_t \ln(\text{size}_h) + [\gamma_t \ln(\text{dist}_h)] + \varepsilon_{ht} \]

- \( d \ln(\frac{X^{CB}_{ht}}{X^{DM}_{ht}}) \): Change in expenditure on CB relative to non-CB goods
- Same weighting, balanced sample, clustering, identification assumption
Cross border responsiveness: baseline results

Distance (Estimate of $\gamma$: 2014-15)

$$d \ln\left(\frac{X_{jt}^{CB}}{X_{jt}^{DM}}\right) = \alpha_t + \beta_t \ln(\text{income}_j) + \rho_t \ln(\text{size}_j) + \gamma_t \ln(\text{dist}_h) + \varepsilon_{jt}$$

- At the household level, CB responsiveness does not vary by distance
Cross border responsiveness: baseline results

Income (Estimate of $\beta$: 2014-15)

$$d \ln \left( \frac{X_{jt}^{CB}}{X_{jt}^{DM}} \right) = \alpha_t + \beta_t \ln (\text{income}_j) + \rho_t \ln (\text{size}_j) + \varepsilon_{jt}$$

- income HHs a relative ↓ in CB shares btw 14-15 in first 9 months, but...
Cross border responsiveness: baseline results

Income (Estimate of $\beta_t$: 2013-14 and 2014-15) break in trend?

$$d \ln(X_{jt}^{CB} / X_{jt}^{DM}) = \alpha_t + \beta_t \ln(income_j) + \rho_t \ln(size_j) + \varepsilon_{jt}$$

- $\uparrow$-income $HHs$ a relative $\downarrow$ in CB shares btw 14-15 in first 9 months, but...
- ... coefficients statistically different at 95% level only first 3 months
CB responsiveness: robustness exercises

(Negative) Results are robust to the following

- Use income per capita rather than income and HH size separately
- Don’t control for HH size — wider CIs but similar point estimates
- Don’t weigh observations
- Two-way cluster by \((income, size)\) and 2-digit zip code
- Aggregate up to \((income, size)\)
Step III: Heterogeneous (import) elasticities
Trade: Baseline assumptions

Model implication

\[ d \ln \left( \frac{X^M_{ht}}{X^D_{ht}} \right) = (1 - \eta_h) d \ln \left( \frac{P^M_{ht}}{P^D_{ht}} \right) + d \ln \left( \frac{\zeta_{ht}}{1 - \zeta_{ht}} \right) \]

Baseline assumptions

1. Common \( d \ln(P^M_{ht}/P^D_{ht}) \) across households

\[ d \ln \left( \frac{X^M_{ht}}{X^D_{ht}} \right) = (1 - \eta_h) d \ln \left( \frac{P^M_{t}}{P^D_{t}} \right) + d \ln \left( \frac{\zeta_{ht}}{1 - \zeta_{ht}} \right) \]

2. Parametric restrictions on elasticities \( \eta_h = \eta - \beta_\eta \ln(\text{inc}_h) - \gamma_\eta \ln(\text{size}_h) \)

\[ d \ln \left( \frac{X^M_{ht}}{X^D_{ht}} \right) = (1 - \eta + \beta_\eta \ln(\text{inc}_h) + \gamma_\eta \ln(\text{size}_h)) d \ln \left( \frac{P^M_{t}}{P^D_{t}} \right) + d \ln \left( \frac{\zeta_{ht}}{1 - \zeta_{ht}} \right) \]
Trade: Baseline assumptions and estimating equation

Model implications (+ two assumptions)

\[
d \ln \left( \frac{X_{ht}^M}{X_{ht}^D} \right) = (1 - \eta + \beta \eta \ln(inch) + \gamma \eta \ln(size_h)) d \ln \left( \frac{P_t^M}{P_t^D} \right) + d \ln \left( \frac{\zeta_{ht}}{1 - \zeta_{ht}} \right)
\]

Estimating equation (for single time difference)

- Letting $\tilde{\zeta}_{ht}$ be deviation of $d \ln(\zeta_{ht}^M/\zeta_{ht}^D)$ from average across $h$

\[
d \ln \left( \frac{X_{ht}^M}{X_{ht}^D} \right) = \alpha + \beta \eta \ln(inch) d \ln \left( \frac{P_t^M}{P_t^D} \right) + \gamma \eta \ln(size_h) d \ln \left( \frac{P_t^M}{P_t^D} \right) + \tilde{\zeta}_{ht} \tag{1}
\]

where $\alpha$ combines $(1 - \eta)d \ln(P_t^M/P_t^D)$, avg across $h$ of $d \ln(\zeta_{ht}/(1 - \zeta_{ht}))$

- This is equivalent to baseline reduced form, where previous coefficients are

  - $\beta \eta d \ln(P_t^M/P_t^D)$ and $\gamma \eta d \ln(P_t^M/P_t^D)$
Trade: Baseline assumptions and estimating equation

Model implications (+ two assumptions)

\[
d \ln \left( \frac{X_{ht}^M}{X_{ht}^D} \right) = (1 - \eta + \beta_\eta \ln(\text{inc}_h) + \gamma_\eta \ln(\text{size}_h))d \ln \left( \frac{P_t^M}{P_t^D} \right) + d \ln \left( \frac{\zeta_{ht}}{1 - \zeta_{ht}} \right)
\]

Estimating equation (for single time difference)

- Letting \( \tilde{\zeta}_{ht} \) be deviation of \( d \ln(\zeta_{ht}^M/\zeta_{ht}^D) \) from average across \( h \)

\[
d \ln \left( \frac{X_{ht}^M}{X_{ht}^D} \right) = \alpha + \beta_\eta \ln(\text{inc}_h)d \ln \left( \frac{P_t^M}{P_t^D} \right) + \gamma_\eta \ln(\text{size}_h)d \ln \left( \frac{P_t^M}{P_t^D} \right) + \tilde{\zeta}_{ht} \tag{1}
\]

where \( \alpha \) combines \((1 - \eta)d \ln(P_t^M/P_t^D)\), avg across \( h \) of \( d \ln(\zeta_{ht}/(1 - \zeta_{ht})) \)

- This is equivalent to baseline reduced form, where previous coefficients are

  \( \star \beta_\eta d \ln(P_t^M/P_t^D) \) and \( \gamma_\eta d \ln(P_t^M/P_t^D) \)

Identification assumption for \( \beta_\eta \) and \( \gamma_\eta \) (single time difference)

- Those with higher income or household size do not have systematically larger or smaller demand shocks for imports than average btw 2014-15

Why not identify \( \eta \)?

- Requires assuming average demand shock for imports btw 2014-15 is zero
We assume

1. No product entry or exit
   - Small Homescan sample, particularly at HH income, HH size, geographic levels
   - Regressions often at household level

2. We observe a representative sample of products

For estimation, use a first-order approximation of price indices $P_t^M, P_t^D$
   - Laspeyres: initial period shares
Prices details

- Detailed product price (eancode) change by CB status and horizon
  - monthly price: by detailed product, and CB status of purchase, take unweighted geometric average price across transactions
  - price for given horizon: simple geometric average across months in horizon
  - take ln changes across years w/in common horizon, eancode, and CB status

- Aggregate across eancodes to construct price indices for
  - D domestic purchases of domestically produced goods
  - M domestic purchases of imported goods
  - CB cross border purchases

- Robustness:
  - Sato-Vartia weights rather than first-order approximation
  - Income and size-specific expenditures as weights across products
Structural results for trade: baseline

Estimate of $\beta_{\eta}$

$$d \ln \left( \frac{X_{ht}^M}{X_{ht}^D} \right) = \alpha_t + \left[ \beta_{\eta} \ln(\text{inc}_h) + \gamma_{\eta} \ln(\text{size}_h) \right] d \ln \left( \frac{P_t^M}{P_t^D} \right) + \tilde{\zeta}_{ht}$$
Consider estimate of $\beta_\eta$ at 12 months of 2.66 (or 2.23 w/ varying by incpc)

Consider two households with a 1.9 gap in ln income

- $\approx$ gap btw lowest (20K), second-highest (135K) income groups (out of seven)

Elasticity of substitution btw domestic and imported goods is 5 ($\approx 2.66 \times 1.9$) higher for the lower income household

Large differences in elasticities, yet import shares not systematically correlated with income. Why?

1. In quantitative model (to follow), predicted 2015 import shares (given observed 2015 price changes) not significantly correlated with income (as in the data)

2. Elasticity differences may be smaller over longer horizons

3. In practice, over longer horizons there are demand shocks
Structural results for trade: robustness

Results are robust to the following

- Use income per capita rather than income and HH size separately
- Aggregate up to $j = (\text{income}, \text{size})$
- Use $j = (\text{income}, \text{size})$-specific price index changes
- Use $j = (\text{income}, \text{size})$-specific price index changes, aggregated up to $j$
- Estimate within product-group, aggregated up to $j = (\text{income}, \text{size})$
- Estimate within product-group, aggregated up to $j = (\text{income}, \text{size})$, using income per capita rather than income and size separately
Summary

Heterogeneity in initial exposure in 2014

<table>
<thead>
<tr>
<th></th>
<th>CB expenditure share</th>
<th>M expenditure share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximity to the border</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Income</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Heterogeneity in responsiveness 2014-2015

<table>
<thead>
<tr>
<th></th>
<th>Δ CB exp. share</th>
<th>Δ M exp. share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proximity to the border</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Income</td>
<td>– / 0</td>
<td>–</td>
</tr>
</tbody>
</table>

Differences in elasticities across income levels

- Consider two households with a 1.9 gap in ln income
- The absolute value of the elasticity of substitution between domestic and imported goods is higher for the lower income household by 5
Application I: Retail Employment
Change in retail employment
What are the implications of CB shopping for retail employment?

- In response to CHF appreciation, CB expenditure increases
  - While increase does not depend on distance, starts low far from CB shopping
- Impact on Swiss retail employment should be larger closer to CB shopping

- We stack 4-digit zip codes, $z$, and years, $t$ (2013-16), and estimate
  \[
  \ln(\text{emp}_{zt}) = \alpha_t + \alpha_z + \beta_t \ln(\text{dist}_z) + \gamma_t \ln(\text{inc}_z) + \varepsilon_{zt}
  \]
  using data from the Business Census ("STATENT")

- We do so separately for retail employment and non-retail employment
Change in retail employment
Binscatter across 4-digit zip codes of 2-year ln changes in retail employment: 2014-16

(no controls, weighing by total employment of 4-digit zip in 2014)
Change in non-retail employment

Binscatter across 4-digit zip codes of 2-year ln changes in non-retail employment: 2014-16

(no controls, weighing by total employment of 4-digit zip in 2014)
Change in retail (and non-retail) employment

What are the implications of CB shopping for retail employment across 4-digit zip codes?

\[
\ln(\text{emp}_{zt}) = \alpha_t + \alpha_z + \beta_t \ln(\text{dist}_z) + \gamma_t \ln(\text{inc}_z) + \varepsilon_{zt}
\]

estimated separately in retail and non-retail

(weighing by total employment of 4-digit zip in 2014, over 2600 zip codes)
Change in retail (and non-retail) employment

Conclusions

- Exchange rate appreciation + CB shopping induce large differences in retail employment changes in Swiss regions near and far from CB shopping opportunities
Application II: Welfare
Restrictions imposed in quantitative work

1. Focus on consumption for goods in our data
2. Given empirical results, impose restriction: \( \sigma_h = \sigma \)
3. To calibrate common components of elasticities, assume no systematic demand shock for \( M \) relative to \( D \) or for \( CB \) relative to \( DM \)
   
   ★ Of course, variation in \( \eta_h \) (lack in \( \sigma_h \)) identified without this restriction!
4. Demand shifters common across households

★ \( \mu \): within income \( \times \) size
★ \( \zeta \): within distance

Utility now given by

\[
C_{ht} = \left[ \mu_h \frac{1}{\sigma} \left( C_{ht}^{CB} \right)^{\sigma-1} + (1 - \mu_h) \frac{1}{\sigma} \left( C_{ht}^{DM} \right)^{\sigma-1} \right]^{\frac{\sigma}{\sigma-1}}
\]

\[
C_{ht}^{DM} = \left( \zeta_h \frac{1}{\eta_h} \left( C_{ht}^{M} \right) \frac{\eta_h-1}{\eta_h} + (1 - \zeta_h) \frac{1}{\eta_h} \left( C_{ht}^{D} \right) \frac{\eta_h-1}{\eta_h} \right)^{\frac{\eta_h}{\eta_h-1}}
\]

For welfare, abstract from heterogeneous income changes
Structural results: calibrating $\eta$ and $\sigma$

- Recall that $\eta_h = \eta - \beta_{\eta} \ln(inc_h) - \gamma_{\eta} \ln(size_h)$

- Calibrate $\eta = 32$ to match observed 12-month $\Delta$ aggregate import share

$$\frac{X_t^M}{X_t^D} = \sum_j \frac{X_{jt}^D X_{jt}^M}{X_t^D X_{jt}^D}$$

given data $\frac{X_{14}^D}{X_{14}^D}$, $\frac{X_{15}^D}{X_{15}^D}$, and $\frac{X_{14}^M}{X_{14}^M}$ and predicted $\frac{X_{15}^M}{X_{15}^M}$ by income×size-specific given elasticities and aggregate relative price of imports

- Calibrate $\sigma = 2$ to match 12 month observed $\Delta$ aggregate CB share

$$\frac{X_t^{CB}}{X_t^{MD}} = \sum_j \frac{X_{jt}^{MD} X_{jt}^{CB}}{X_t^{MD} X_{jt}^{MD}}$$

given data $\frac{X_{14}^{MD}}{X_{14}^{MD}}$, $\frac{X_{15}^{MD}}{X_{15}^{MD}}$, and $\frac{X_{14}^{CB}}{X_{14}^{MD}}$ and predicting $\frac{X_{15}^{CB}}{X_{15}^{MD}}$ by income×size-specific given group specific relative price of imports
Import, domestic elasticity by income×size groups

- Weighted average elasticity = 3.12
- $1 - \Delta \log \text{import share} / \Delta \log \text{relative import price} = 3.05$
- In counterfactuals, exclude top income group
Change in price index by income group

2015 Swiss price changes
Change in price index by income group

3% vs 20% increase in import prices, no CB
Change in price index by income group

20% increase in import prices, high vs low import share, no CB

- Literature mostly concerned with import shares
Change in price index by income group

Price change relative to low income for different size of import price increases, no CB
Change in price index by income group

Autarky imports
Example: Recent closing of Swiss border from Schengen area for non-essential traffic to mitigate spread of Covid-19
Conclusions

- Unequal effects of internationally-induced price changes
  - Spatial variation due to cross-border shopping
    - This margin is mostly missing in literature
    - Quite important for Switzerland, but likely also many other small countries and countries with substantial population along borders (e.g. Canada)
  - Variation by household income
    - This is the heart of a large ‘international’ literature
    - We find large variation in price sensitivities, a margin from which the literature largely abstracts due to data limitations

- Implications for
  - Local retail employment
  - Welfare
    - poor benefit more (or suffer less) from large price changes if more price sensitive
    - those that live closer to the border benefit more from foreign price reduction
Appendix
<table>
<thead>
<tr>
<th></th>
<th>Changes</th>
<th>Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
</tr>
<tr>
<td>1) EUR/CHF</td>
<td>-14.0</td>
<td>-14.7</td>
</tr>
<tr>
<td>2) All EUR inv.</td>
<td>-12.4</td>
<td>-13.8</td>
</tr>
<tr>
<td>3) Non-zero price changes</td>
<td>-15.7</td>
<td>-15.2</td>
</tr>
<tr>
<td>4) All CHF inv.</td>
<td>-3.4</td>
<td>-4.5</td>
</tr>
<tr>
<td>5) Non-zero price changes</td>
<td>-5.8</td>
<td>-6.9</td>
</tr>
<tr>
<td>6) Retail imports</td>
<td>-1.3</td>
<td>-2.9</td>
</tr>
<tr>
<td>7) Retail domestic</td>
<td>-0.3</td>
<td>-0.7</td>
</tr>
</tbody>
</table>
Share of cross-border purchases

(a) CB share - households
(b) Import share - households
(c) CB share - transactions
(d) Import share - transactions
Trade responsiveness: robustness I
Combining income and HH size into income per capita

\[ d \ln(\frac{X^{M}_{ht}}{X^{D}_{ht}}) = \alpha_t + \beta_t \ln(\frac{\text{income}_h}{\text{size}_h}) + \varepsilon_{ht} \]
Trade responsiveness: robustness II
Not controlling for HH size

\[ d \ln \left( \frac{X^M_{ht}}{X^D_{ht}} \right) = \alpha_t + \beta_t \ln(\text{income}_h) + \varepsilon_{ht} \]
Trade responsiveness: robustness III

Unweighted

\[ d \ln \left( \frac{X^M_{ht}}{X^D_{ht}} \right) = \alpha_t + \beta_t \ln (\text{income}_h) + \rho_t \ln (\text{size}_h) + \varepsilon_{ht} \]
Trade responsiveness: robustness IV
Two-way clustering by \((\text{income, size})\) and by 2-digit zip code

\[
d \ln(X_{ht}^M / X_{ht}^D) = \alpha_t + \beta_t \ln(\text{income}_h) + \rho_t \ln(\text{size}_h) + \epsilon_{ht}
\]
Trade responsiveness: robustness V
Aggregating up to the $j = (\text{income}, \text{size})$ level, unclustered

$$d \ln(\frac{X^M_{jt}}{X^D_{jt}}) = \alpha_t + \beta_t \ln(\text{income}_j) + \rho_t \ln(\text{size}_j) + \varepsilon_{jt}$$
Trade responsiveness: robustness VI

Estimating within product groups, aggregating to $j = (income, size)$

$$d \ln \left( \frac{X_{jgt}^M}{X_{jgt}^D} \right) = \alpha_{gt} + \beta_t \ln(income_j) + \rho_t \ln(size_j) + \varepsilon_{jgt}$$

- Product groups include eg: beer, wine, cheese, juices, soups, pet food, toilet paper, chocolate, hair products, detergent...

(Two-way cluster by $g$ and $j$; Weight: # of HHs in $j \times (j$ expenditure in $g) / (j$ expenditure))
Trade responsiveness: robustness VII

Estimating within product groups, aggregating to $j = (\text{income, size})$ + using income per capita

\[
d \ln \left( \frac{X_{jgt}^M}{X_{jgt}^D} \right) = \alpha_{gt} + \beta_t \ln \left( \frac{\text{income}_j}{\text{size}_j} \right) + \varepsilon_{jt}
\]
Combining income and HH size into income per capita

\[ d \ln \left( \frac{X_{ht}^{CB}}{X_{ht}^{DM}} \right) = \alpha_t + \beta_t \ln \left( \frac{\text{income}_h}{\text{size}_h} \right) + \varepsilon_{ht} \]
CB responsiveness: robustness II

Not controlling for HH size

\[ d \ln \left( \frac{X_{ht}^{CB}}{X_{ht}^{DM}} \right) = \alpha_t + \beta_t \ln \left( \text{income}_h \right) + \varepsilon_{ht} \]
CB responsiveness: robustness III

Unweighted

\[ d \ln \left( \frac{X_{ht}^{CB}}{X_{ht}^{DM}} \right) = \alpha_t + \beta_t \ln(\text{income}_h) + \rho_t \ln(\text{size}_h) + \epsilon_{ht} \]
CB responsiveness: robustness IV
Two-way clustering by 2-digit zip code and (income,size) bin

\[ d \ln \left( \frac{X_{ht}^M}{X_{ht}^D} \right) = \alpha_t + \beta_t \ln (income_h) + \rho_t \ln (size_h) + \varepsilon_{ht} \]
CB responsiveness: robustness V

Aggregating up to the $j = (\text{income}, \text{size})$ level, unclustered

$$d \ln \left( \frac{X_{jt}^M}{X_{jt}^D} \right) = \alpha_t + \beta_t \ln(\text{income}_j) + \rho_t \ln(\text{size}_j) + \epsilon_{jt}$$
CB responsiveness: robustness VI

Aggregating up to the $j = 2$-digit zip code level in 2014-2015

$$d \ln(X_{j}^{CB} / X_{j}^{DM}) = \alpha + \gamma \ln(dist_{j}) + \varepsilon_{j}$$

- We sum expenditures across all HHs (whether HH buys CB in all years or not)
- We weigh by number of HHs in 2-digit zip code
- Showing data for 12-month horizon
Trade elasticity responsiveness: robustness I
Combining income and HH size into income per capita

\[ d \ln(\frac{X_{ht}^{CB}}{X_{ht}^{DM}}) = \alpha_t + \beta_t \ln(\text{income}_h/\text{size}_h) + \varepsilon_{ht} \]
Trade elasticity responsiveness: robustness II

Aggregating up to the $j = (\text{income}, \text{size})$ level, unclustered

$$d \ln \left( \frac{X_{ht}^{CB}}{X_{ht}^{DM}} \right) = \alpha_t + \beta_t \ln(\text{income}_h) + \varepsilon_{ht}$$
Trade elasticity responsiveness: robustness III

\[ j = (\text{income}, \text{size}) \text{ specific price changes – using } j\text{-specific expenditure shares} \]

\[
d \ln \left( \frac{X_{ht}^M}{X_{ht}^D} \right) = \alpha + (1 - \eta) d \ln \left( \frac{P_{jt}^M}{P_{jt}^D} \right) + \left[ \beta \eta \ln(\text{inc}_h) + \gamma \eta \ln(\text{size}_h) \right] d \ln \left( \frac{P_{jt}^M}{P_{jt}^D} \right) + \tilde{\zeta}_{ht}
\]
Trade elasticity responsiveness: robustness IV

\( j = (\text{income, size}) \) specific price changes and aggregated up to \( j \) level, unclustered

\[
d \ln(\frac{X^M_{jt}}{X^D_{jt}}) = \alpha + (1 - \eta) d \ln(\frac{P^M_{jt}}{P^D_{jt}}) + [\beta \eta \ln(\text{inc}_j) + \gamma \eta \ln(\text{size}_j)] d \ln(\frac{P^M_{jt}}{P^D_{jt}}) + \tilde{\zeta}_{jt}
\]
Trade elasticity responsiveness: robustness V

Estimating within product group elasticity, aggregating to $j = (income, size)$, how clustered??

$$d \ln \left( \frac{X^M_{jgt}}{X^D_{jgt}} \right) = \alpha_g + [\beta \ln(inc_j) + \gamma \ln(size_j)] d \ln \left( \frac{P^M_{gt}}{P^D_{gt}} \right) + \tilde{\zeta}_{jgt}$$
Trade elasticity responsiveness: robustness VI

Estimating within product group elasticity, aggregating to $j = (\text{income}, \text{size})$, income per capita

$$d \ln(\frac{X_{jgt}^M}{X_{jgt}^D}) = \alpha_g + \beta_n \ln(\frac{\text{inc}_j}{\text{size}_j})d \ln(\frac{P_{gt}^M}{P_{gt}^D}) + \tilde{\zeta}_{jgt}$$
Decompose changes in aggregate import share $\omega_t$ over time

- Let $g$ denote product categories, $X^M_t, X^{DM}_t$ exp on M and M + D
- Aggregate import share $\omega_t$: $\omega_t \equiv \frac{X^M_t}{X^{DM}_t} = \sum g \frac{X^M_{gt}}{X^{DM}_{gt}} \frac{X^{DM}_{gt}}{X^M_{gt}}$

$$\Delta \omega_t = \sum_g \Delta \left( \frac{X^M_{gt}}{X^{DM}_{gt}} \right) \text{Avg} \left( \frac{X^{DM}_{gt}}{X^M_{gt}} \right) + \sum_g \text{Avg} \left( \frac{X^M_{gt}}{X^{DM}_{gt}} \right) \Delta \left( \frac{X^{DM}_{gt}}{X^M_{gt}} \right)$$

\[\text{within} + \text{between}\]

- Within share of aggregate change by horizon always dominates between

Does relative importance of within share vary with income per capita?

- Construct $\Delta \omega_{jt}$ by $j =$ HH income $\times$ HH size bins and regress on $\ln income_j$
- Insignificant relationship in all horizons
Decomposition

Within share of aggregate change by horizon always large
Suppose that a HH goes shopping at fixed intervals and spends a fixed total amount each trip.

HH chooses where to shop (locally or abroad) given associated price indices:

- HH utility if shopping in location $x \in \{CB, DM\}$ is $\frac{\varepsilon_x}{P_x}$
- HH chooses CB $\iff \frac{\varepsilon_{CB}}{P_{CB}} > \frac{\varepsilon_{DM}}{P_{DM}}$

With the right distributional assumption on $\varepsilon_{ht}$ (Fréchet), obtain our CES formulation when aggregating across time:

- The CB shifter in our CES utility, $\mu_{ht}$, is a shifter of the ease of CB shopping in micro-founded formulation (in the Fréchet distribution)
- And the elasticity of substitution in our CES utility, $\sigma$, is the dispersion of $\varepsilon$ in micro-founded formulation (in the Fréchet distribution)
Closing of the border for CB shopping

- Switzerland closed its borders to and from Schengen area for non-essential traffic to mitigate spread of Covid 19

Timeline
- March 17: Borders to Austria, France, and Germany closed
- March 17 - April 26: Lockdown
- April 27 - May 10: Partial reopening
- May 11 - June 15: All shops reopened
- June 16: Borders to EU reopened

- [monitoringconsumption.org/switzerland](http://monitoringconsumption.org/switzerland)

- Debit card expenditures by Swiss on Food and supermarket, Accommodation, Restaurants, Fuel, Personal services, Entertainment, and Transport

- Ratio of CB expenditures / Swiss expenditures $\approx 5\%-7\%$
Debit card expenditures 2019-20
Germany groceries

Figure 3. Purchases by merchant category in Germany
Volume in M CHF by calendar week and year
Debit card expenditures 2019-20

Austria
Debit card expenditures 2019-20
Switzerland

Purchases by Canton: All
Volume in Mio CHF by year and calendar week