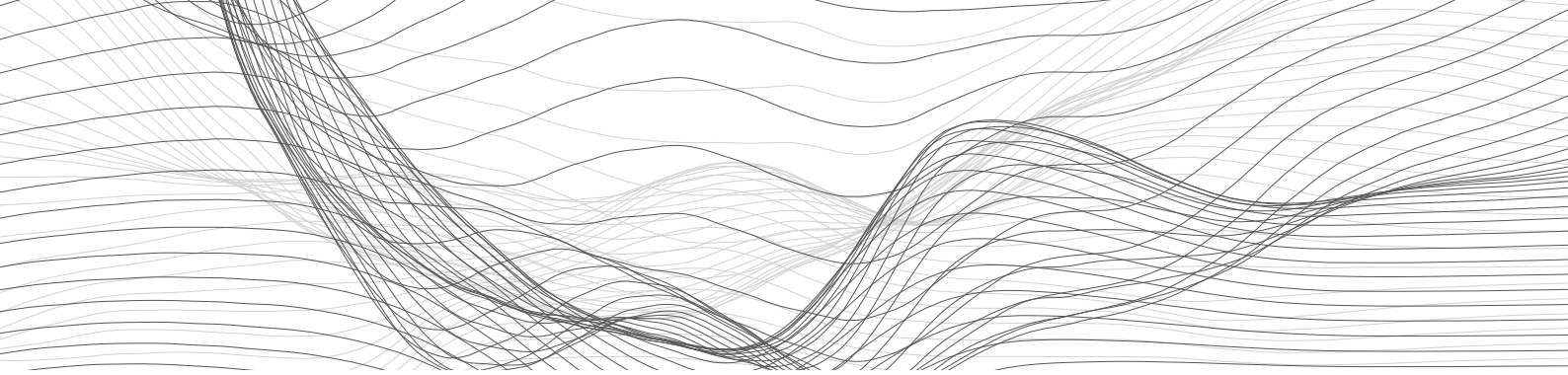

Exchange rates and cross-border consumer spending: Evidence from retail payments data

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Exchange Rates and Cross-Border Consumer Spending: Evidence from Retail Payments Data

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Abstract

This paper examines the effects of exchange rate fluctuations on cross-border consumer spending in small open economies. Exploiting a large, unexpected and persistent central bank-induced exchange rate appreciation and drawing on a unique dataset of over 500 million anonymized debit and credit card transactions, I document a substantial and immediate impact on both cross-border shopping by domestic consumers and tourism spending by foreign consumers. The strongest spending adjustments are observed among domestic consumers living near the border and foreign consumers from neighboring countries. Furthermore, foreign consumers from neighboring countries exhibit high exchange rate sensitivity on both the extensive and intensive margins and shift their consumption from higher- to lower-value goods and services. These findings suggest significant substitution effects in consumption on impact and emphasize the important role of cross-border shopping in small open economies. The paper provides insights for policymakers and central bankers, especially in small open economies where the exchange rate channel is an important channel of monetary policy transmission.

Keywords: Exchange rates, consumption, monetary policy, exchange rate channel, heterogeneity, transaction payments data, tourism, event study
JEL classification: D12, E21, E52, E58, F14, F41, R11, Z30

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1 Introduction

Exchange rates play a pivotal role in shaping economic activity in small open economies. In these economies, which are characterized by high trade and financial integration, an appreciation of the domestic currency reduces exports and increases imports (trade channel). Moreover, an appreciation alters the balance sheets of households, firms and financial institutions (financial channel). In small open economies, exchange rates are therefore especially important in determining monetary conditions. In fact, in small open economies, the exchange rate channel is – along with the other transmission channels, including the interest rate and credit channels – a key channel of monetary policy transmission (see, e.g., Mishkin (1996) for an overview of the transmission mechanisms of monetary policy).

A thorough understanding of the impact of exchange rates on economic activity is crucial to monetary authorities and their mandate to ensure price stability as well as to governments deciding on accompanying fiscal policy measures. In this paper, I contribute to this understanding by providing novel empirical insights into the impact of exchange rates on consumption in small open economies. Along three research questions, I focus on the impact of exchange rate fluctuations on discretionary cross-border consumer spending, which comprises cross-border shopping as well as tourism spending.

To assess my research questions, I use Switzerland, a small open economy, as laboratory. I exploit a large exchange rate shock induced by the Swiss central bank (Swiss National Bank, SNB): the 2015 discontinuation of the minimum exchange rate of the Swiss franc against the Euro. This shift in SNB's monetary policy is suitable for studying my research questions since it led to an immediate, unexpected, and lasting appreciation of the Swiss franc against most currencies and a particularly large appreciation – approximately 20% on the day of the discontinuation – against the Euro (see, e.g., Auer et al. (2021) who study the impact of the same shock on prices and consumer expenditures on domestically produced and imported goods).

I measure consumer spending based on an exceptionally comprehensive source of high-frequency administrative data: millions of debit and credit card transactions that are rich in attributes and that capture domestic within-country consumption by both domestic and foreign consumers at the majority of merchants relevant for discretionary consumer spending in Switzerland.[2] I use these merchant-centric, geocoded and time-stamped

[2]The card transactions used in this paper account for approximately two-thirds of Swiss card transactions (Kraenzlin et al. (2020)). The data is estimated to capture a substantial portion of private consumption in Switzerland, equivalent to approximately one quarter of GDP (Brown et al. (2023) in the context of the initiative 'Monitoring Consumption Switzerland' by the University of St. Gallen and Worldline/SIX).

data to build intensive and extensive margin consumption measures and decompose the impact of exchange rates across currencies, regions, price segments and the main sectors for discretionary consumer spending: retail trade, personal services, food and beverage services and accommodations.

My paper provides three main findings. First, I document a substantial effect of exchange rates on consumer spending by both foreign and domestic consumers. Through an event study, I document an immediate and persistent decline in domestic within-country consumption by Swiss and foreign individuals in the aftermath of the 2015 shock. While Swiss consumption declined by 4% in the quarter of the shock, Euro domestic consumption fell by 9%. Moreover, I set up a gravity model of trade and estimate exchange rate elasticities of 0.06 for domestic consumers and 0.12 to 0.66 for foreign cross-border consumers. The elasticities reveal a large variation in the non-lagged exchange rate sensitivity of foreign and domestic individuals' consumer spending.

Second, I provide empirical evidence that the decline in domestic consumption by domestic individuals is likely the result of increased cross-border shopping activity. In a difference-in-differences exercise with distance to the border as the treatment, I find a small but robust negative relation between domestic consumption and the treatment variable. This finding points to significant substitution effects in consumption by domestic consumers and emphasizes the important role of cross-border shopping in *geographically* small open economies.

Third, through an approximate analysis, I shed light on the heterogeneous impact of the trade channel across consumers of different wealth/income groups. Through another event study, I first decompose the effects of the 2015 shock on domestic spending by domestic and foreign individuals across merchants in different price segments. I do not find substantial evidence for substitution between merchants in different price segments, either by domestic or foreign consumers. However, an additional test with individual transactions as the level of observation provides suggestive evidence that foreign consumers from nearby countries substitute from medium- to low-value goods and services, but not from high- to medium-value goods and services within merchants.

My paper contributes to the empirical literature studying cross-border spillover effects of monetary policy (e.g., Potts and Yerger (2010) and Weber (2006)) and exchange rates (focusing on cross-border shopping activity: Burstein et al. (2024), Baggs et al. (2018), Chandra et al. (2014), and Campbell and Lapham (2004)).[3] Moreover, because this paper studies the impact of a monetary policy-induced exchange rate shock on cross-

[3]In addition, Baggs et al. (2022), Friberg et al. (2024) and Burstein et al. (2024) exploit COVID-19-related travel restrictions to assess cross-border retail shopping.

border consumption and decomposes the impact across regions, it is also connected to the broader literature on the regional effects of monetary policy, for which Dominguez-Torres and Hierro (2019) offer a literature survey. Furthermore, as this paper also decomposes the effects across currencies, price segments and sectors, it is related to the literature on heterogeneity and monetary policy that can be traced back to Bernanke and Gertler (1995), with Alves et al. (2022) providing a thematic review. I contribute to this literature by studying a currency appreciation that was the outcome of a shift in unconventional monetary policy, which has rarely been studied (Dominguez-Torres and Hierro (2019)). In addition, I am among the first to study the effects of exchange rates and monetary policy on consumer spending using card data, with Grigoli and Sandri (2023) and Buda et al. (2025) providing initial assessments of monetary policy transmission and consumption with this type of data.[4]

The paper also contributes to the empirical literature studying the determinants of tourism demand and estimating exchange rate elasticities for tourism (e.g., Culiuc (2014), Chandra et al. (2014) and Ding and Timmer (2023)). I contribute to the literature by estimating elasticities for foreign cross-border consumers based on a data source that is quite novel and promising with respect to the tourism literature. Compared with 'typical' tourism data, which include the number of tourist arrivals and overnight stays at hotels, card data cover a broader range of goods and services consumed by tourists.[5] In the Swiss context, my paper adds to a small set of tourism studies that all measure tourism with the number of overnight stays in Swiss hotels.[6]

Finally, this paper is among a set of papers that exploit the SNB's foreign exchange intervention in January 2015 to answer a variety of questions. Auer et al. (2024) exploit the shock to assess the heterogeneous impact of changes in consumer prices on the cost

[4]Drawing on the same data as used in this paper, Kraenzlin et al. (2020) examine the onset of the COVID-19 pandemic and document significant regional shifts in consumer spending within Switzerland.

[5]'Tourism', as defined by the Balance of Payments Manual (BPM6), is a component of current account services and does not comprise a specific type of service but rather an assortment of goods and services that are purchased by nonresidents visiting another country. Among others, it captures the spending by persons traveling a country for purposes connected with leisure tourism, expenses during travel related to health and education, and purchases by cross-border commuters and holders of short-term residence permits. The card data capture the relevant economic activity fairly well. For accommodations, the card data cover not only the hotel industry but also the parahotel industry, including nonhotel accommodation such as campsites and hostels. The latter are usually not covered by 'typical' tourism data, i.e., survey-based overnight stays. For more information on the tourism/travel component, refer to: `https://www.imf.org/external/pubs/ft/bop/2007/bopman6.htm` (last accessed on March 28, 2025).

[6]Stettler (2017) estimates real exchange rate elasticities based on monthly municipality-times-country-level data between 2005 and 2014. With a focus on tourism and the metal and machinery industry, Abrahamsen and Simmons-Süer (2011) estimate exchange rate elasticities in the aftermath of the 2008 appreciation of the Swiss franc. Ferro Luzzi and Flückiger (2003) study the determinants of tourism demand and estimate the overall real exchange rate elasticity based on quarterly country-level data for seven countries between 1971 and 1995. Jaeger et al. (1996) estimate nominal exchange rate elasticities based on annual country-level data between 1973 and 1993.

of living. They build on Auer et al. (2021), who shed light on the impact of exchange rate movements on import prices, retail prices, and consumer expenditures on domestically produced and imported nondurable goods. Brown et al. (2024) examine the heterogeneous impact of monetary policy on retail investors' portfolio composition. Bonadio et al. (2020) analyze the speed and degree of the pass-through of exchange rate movements on import prices. Efing et al. (2023) study how effectively the pass-through of the costs of exchange rate risks to customers and hedging address firms' exchange rate exposure under extreme exchange rate shocks. Freitag and Lein (2023) examine the impact of exchange rate movements on product quality and the effect of product adjustments on the aggregate pass-through to export prices. Kaufmann and Renkin (2018) assess the 2015 shock's impact on manufacturing prices and employment. Kaufmann and Renkin (2019), drawing on Kaufmann and Renkin (2018), study export prices, markups, and currency choice in the aftermath of the shock. Steiner (2024) estimates the pass-through of exchange rate fluctuations on the markups of Swiss manufacturing firms. von Schweinitz et al. (2020) investigate the impact of the discontinuation on stock market prices.

Section 2 presents my empirical setting, the three research questions and describes the data and the sample construction. Section 3 presents the empirical analyses. Specifically, Section 3.1 documents the relative and absolute impact of the 2015 exchange rate shock on domestic within-country consumption – overall and across currency groups. Section 3.2 then assesses the role of cross-border shopping. Finally, Section 3.3 decomposes the effects of exchange rates on consumer spending across merchants in different price segments and across low-, medium- and high-value goods and services within merchants. Section 4 concludes the paper.

2 Empirical setting, research questions and data

2.1 Empirical setting

To study the impact of exchange rates on cross-border consumption in small open economies, I use Switzerland as laboratory and exploit a large exchange rate shock induced by the Swiss central bank. The 2015 discontinuation of the minimum exchange rate against the Euro led to a large, unexpected and persistent appreciation of the Swiss franc against most currencies and, in particular, the Euro. Notably, the central bank reacted to a period of overvaluation of the Swiss franc by temporarily setting a minimum exchange rate against the Euro on September 6, 2011. With the exchange rate held close to its lower bound of CHF 1.20 per Euro from then on, the SNB discontinued the minimum exchange

rate on January 15, 2015.[7] On the day of the discontinuation, the Swiss franc appreciated more than 20% against the Euro. After a transition phase, the exchange rate against the Euro was again fairly constant at approximately 1.08 until the beginning of 2017. In the years before and after the shock, the Swiss economy and prices were relatively stable.

Figure 1 shows the development of the daily real exchange rates between 2012 and 2018 for the three currency groups examined in this paper: 'Swiss franc cards' or short 'Swiss cards' (cards from countries where the Swiss franc constitutes legal tender, i.e., Switzerland and Liechtenstein), 'Euro cards' (cards from the Euro area) and 'other currency cards' (cards from countries where other currencies are used as legal tender). The Euro card and other currency card exchange rates are the average of the respective countries' real exchange rates, weighted by the 2013-Q2 to 2014-Q1 country-level values of card transactions. The Swiss card exchange rate is a synthetic exchange rate. It is the average of 37 bilateral exchange rates, weighted by the 2013 Swiss tourism expenses.[8] Moreover, the figure shows the Swiss CPI, the quarterly Euro pre-shock exchange rate forwards and the Goldman Sachs Financial Conditions Index for Switzerland. The forwards confirm that the discontinuation was indeed unexpected. The Financial Conditions Index shows that, despite a simultaneous reduction in the policy rate, the discontinuation led to a tightening of monetary conditions; thus, the 2015 shock can be seen as a restrictive monetary policy shift.[9]

[7]The SNB press release from September 6, 2011, is published here: https://www.snb.ch/en/publications/communication/press-releases/2011/pre_20110906 (last accessed on March 28, 2025). The SNB press release from January 15, 2015, is published here: https://www.snb.ch/en/publications/communication/press-releases/2015/pre_20150115 (last accessed on March 28, 2025). Note that for Switzerland, which is located in the middle of Europe and has its own currency (the Swiss franc), interest rates and exchange rates are both important in determining monetary conditions. The SNB implements its monetary policy by setting the level of the SNB policy rate and, if necessary, using additional monetary policy measures to influence the exchange rate or interest rate level. See https://www.snb.ch/en/the-snb/mandates-goals/monetary-policy/strategy for an overview of the SNB's monetary policy strategy and a recent speech on the complementary role of foreign exchange interventions: https://www.snb.ch/en/publications/communication/speeches/2024/ref_20240418_anmartmo (both last accessed on March 28, 2025). Moreover, see Cwik and Winter (2024) for a study on the effectiveness of the SNB's foreign exchange interventions.

[8]Swiss tourism expenses can be downloaded from the SNB's data portal: https://data.snb.ch/en (downloaded on December 19, 2023).

[9]On January 15, 2015 the SNB not only discontinued the minimum exchange rate but also lowered the interest rate on sight deposits by 0.5 percentage points to -0.75%. The SNB's intention in lowering the interest rate was 'to ensure that the discontinuation of the minimum exchange rate does not lead to an inappropriate tightening of monetary conditions' (the SNB's press release from January 15, 2015, p.1: https://www.snb.ch/en/publications/communication/press-releases/2015/pre_20150115 (last accessed on March 28, 2025)). The Goldman Sachs Financial Conditions Index for Switzerland shows that, despite the lowered interest rate, the monetary conditions tightened substantially.

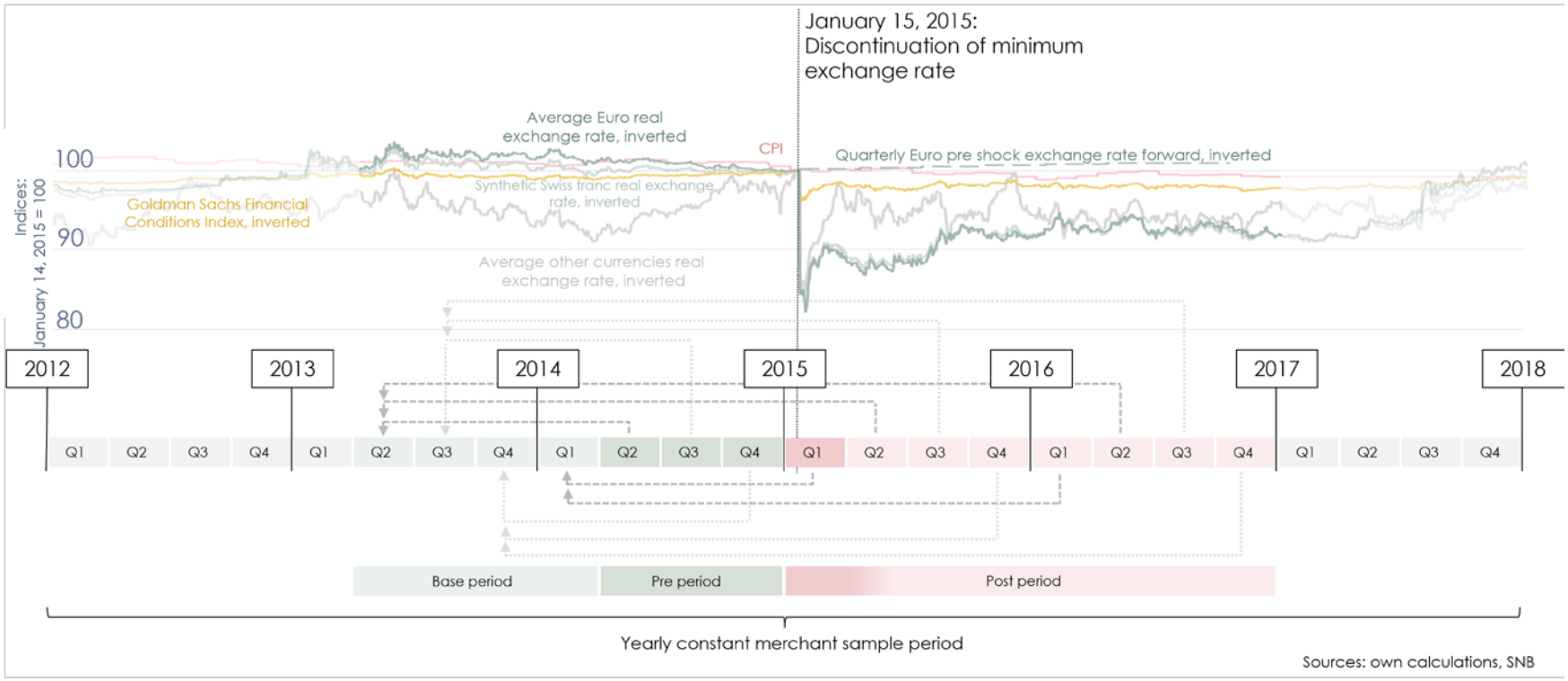


Figure 1: Schematic representation of the sample period, the development of the average real exchange rates of Euro cards, Swiss cards and other currency cards between 2012 and 2018, the CPI, the quarterly Euro pre-shock exchange rate forwards and the Goldman Sachs Financial Conditions Index for Switzerland.

Notes: The non-Swiss card exchange rates are the inverted average of real exchange rates, weighted by the 2013-Q2 to 2014-Q1 country-level value of card transactions. The synthetic Swiss card exchange rate is the inverted average of 37 bilateral exchange rates, weighted by the 2013 Swiss tourism expenses. The quarterly Euro pre-shock exchange rate forwards are the January 14, 2015 3-, 6-, 9-, 12-, 15-, 18- and 24-month forward rates. The 21-month forward rate is the average of the 18- and 24-month rates. The Goldman Sachs Financial Conditions Index for Switzerland is a measure of the ease or tightness of monetary conditions in Switzerland. For visualization purposes, it has been inverted. Decreasing (increasing) values of the inverted index indicate a tightening (easing) of monetary conditions.

2.2 Research questions

Exchange rates play a crucial role in shaping economic activity, particularly in small open economies. Accordingly, in such economies, the exchange rate channel is an important mechanism through which monetary policy operates.[10]

Exchange rates transmit to the economy through two main channels: the trade channel and the financial channel. Via the trade channel, exchange rates affect countries' import and export positions. Depending on a country's disparity in foreign currency-denominated assets and liabilities, the financial channel might counteract or add to the trade channel through balance sheet effects. In fact, the trade channel tends to dominate in small open economies with a high trade openness and relatively low foreign currency liabilities (Anaya Longaric (2022)).[11]

In this paper, I focus on the trade channel and its dynamics through cross-border consumer spending. First, I study the impact of exchange rate fluctuations on domestic within-country consumption and cross-border shopping by domestic consumers. Second, I study the impact on domestic cross-border spending by tourists and other foreign consumers.

The trade channel gradually unfolds its impact on consumption of both consumer groups over time. An appreciation of a country's currency makes domestic goods and services more expensive internationally, which dampens foreign demand and reduces consumer exports while making imported goods and services cheaper for domestic consumers. This shift in relative price levels stimulates cross-border shopping by domestic consumers, i.e., the share of directly imported goods and services, on impact (see, e.g., Burstein et al. (2024)). Moreover, it prompts an instant reaction in intensive margin tourism spending, i.e., the consumption of foreigners already on site. However, other effects unfold more gradually. Extensive margin tourism spending is expected to adjust with a delay, as trips abroad are often planned and booked in advance. Likewise, the pass-through of exchange rates to retail import prices and prices of competing domestic goods is incomplete and somewhat sluggish (see, e.g., Auer et al. (2021)), such that a stimulation of demand for such goods is muted and expected to unfold over time only. Finally, sustained appreciation is expected to erode a country's export industry in the longer run, with –

[10] On the one hand, policy rates set by small open economy central banks impact aggregated demand and prices via interest rates (interest rate channel of monetary policy). On the other hand, policy rates impact exchange rates via interest rates and thus indirectly transmit to the economy via exchange rates. In addition, typically as a secondary monetary policy tool, small open economy central banks conduct foreign exchange interventions to influence exchange rates and economic activity more directly.

[11] In line with Anaya Longaric (2022), Kearns and Patel (2016) find that the financial channel contradicts the trade channel relatively less in advanced economies, which typically have lower foreign-to-domestic-liability ratios.

particularly in export-oriented economies such as small open economies – an adverse impact on employment and a delayed drag on consumption by domestic consumers (see, e.g., Kaufmann and Renkin (2018)).

Moreover, the trade channel is expected to affect cross-border consumption heterogeneously. From a consumer perspective, exchange rate sensitivity is likely to be most pronounced for tourists from nearby countries. Tourists from countries that are further away are presumably relatively 'richer' and therefore less price sensitive. Furthermore, they are likely visiting several countries in one trip, and a small open economy's exchange rate might not be their main consideration (Abrahamsen and Simmons-Süer (2011)). Cross-border shopping activity by domestic consumers is likely to vary across wealth/income groups as well.

Given the above theoretical considerations, I empirically assess the impact of exchange rate fluctuations on discretionary cross-border consumer spending along three research questions. First, in a small open economy setting, I examine the impact and timing of an unexpected and persistent currency appreciation on domestic within-country consumption by both domestic and foreign consumers (Section 3.1). Second, I investigate the role of cross-border shopping by domestic consumers in the impact of the currency appreciation on consumption (Section 3.2). Third, I conduct an approximate analysis of the heterogeneous impact of the currency appreciation across consumers of different wealth/income groups (Section 3.3).

2.3 Data and sample construction

I measure consumption using debit and credit card data from Switzerland's largest acquirer, Worldline Switzerland Ltd (Worldline, formerly SIX Payment Services). The card data are transactional and available from January 2011 onward. The data comprise point-of-sale and e-commerce transactions at merchants located in Switzerland and are anonymized such that no actor involved in the transaction – namely, merchants, card holders or card issuing banks – can be identified.

Each transaction has a number of attributes, including the transaction date and time, a hashed identifier of the paying card, a hashed identifier of the receiving merchant, the value of the transaction in Swiss francs, and, with high coverage from March 2013 onward, the country of the card-issuing bank (clearing country). Moreover, for merchants, the data includes, with high coverage from mid-2015 onward, information on the location (up to the zip code level) as well as the sector (indicated by 2-digit NOGA codes).[12] On

[12]Zip codes are available only for merchants located in municipalities with multiple merchants.

the other hand, as my data are merchant-centric, they do not comprise information on cardholders or their sociodemographics. In fact, the data allow me to observe merchants and cards over time, but not cardholders or individuals. In my analyses, I thus assume implicitly that one card equals one cardholder.[13] In addition, I assume that the indicated clearing country equals the country of origin or nationality of the cardholder conducting the transaction, and that merchant information is not changing. The latter allows me to backfill information on merchants' locations and sectors that was missing before mid-2015 with information from more recent transactions.

My sample covers transactions conducted at merchants in the four most relevant sectors of discretionary consumer spending (retail trade, personal services, food and beverage services and accommodations), by both domestic and foreign cards. I limit my sample to foreign cards from 54 countries for which bilateral exchange rate information is available.[14] With respect to time, the sample covers consumer spending that took place between the second quarter of 2013 and the fourth quarter of 2016. This period covers approximately two years before and two years after the January 2015 exchange rate shock. Within my sample period, the first four quarters serve as 'Base period', the three quarters before the exchange rate shock serve as 'Pre period' and the quarters after the shock serve as 'Post period'. See Figure 1 for a schematic representation of the sample period.

With the card transactions on hand, I face the challenge that shifts in market shares and payment behavior may lead to a misleading signal of consumption growth. On the one hand, a growing market share of card transactions and, in particular, payment terminal adoption by merchants, lead to upward biased numbers. On the other hand, card adoption by consumers may inflate the data.

To address the issue of changing market shares, I build a 'constant merchant sample' and exclusively retain transactions of merchants that are active over my entire observation period. Specifically, the constant merchant sample comprises only merchants who are observed at least once every year between 2012 and 2017. By applying a yearly filtering criterion, I respect seasonal merchant composition and the fact that merchants in touristic sectors are not active all year long. Considering the years adjacent to my period of interest,

NOGA stands for the General Classification of Economic Activities. It is the Swiss version of the Statistical Classification of Economic Activities in the European Community NACE. NOGA and NACE correspond to the United Nations' International Standard Industrial Classification of all Economic Activities.

[13] The assumption is backed by surveys on payment methods that imply that a typical cardholder regularly uses only one card (see, e.g., Swiss National Bank (2018)). Therefore, in this paper, I use the terms 'cards', 'card holders', 'individuals' and 'consumers' synonymously.

[14] The exchange rate information is published by the SNB. For information on the construction of the exchange rate indices see Müller (2017). The indices can be downloaded here: https://data.snb.ch/en (downloaded on September 30, 2023)

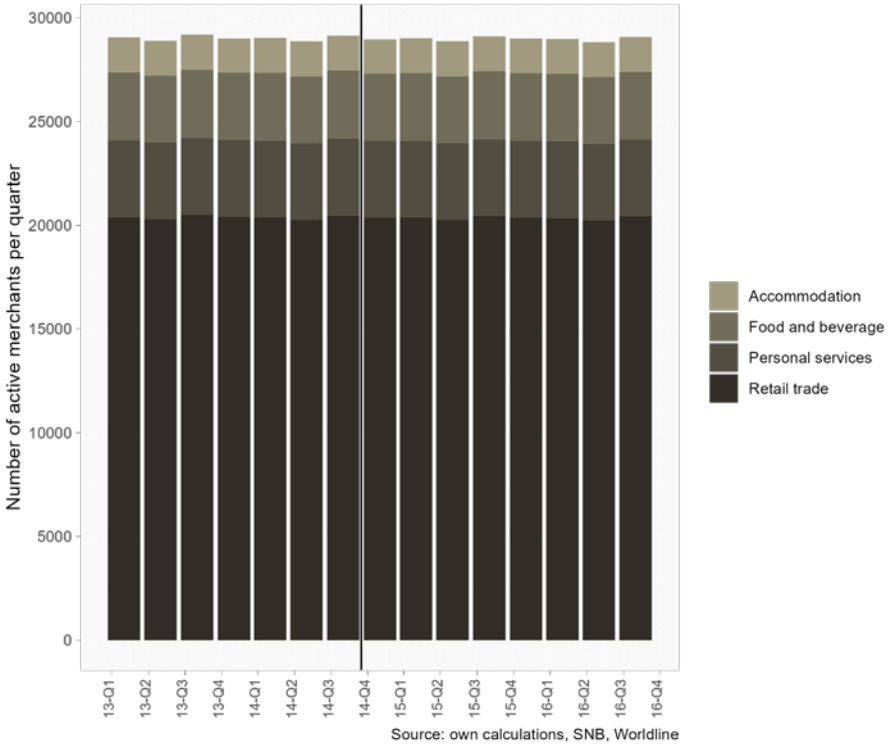
i.e., the years 2012 and 2017, is necessary to include only merchants that already exist at the beginning of my period of interest and exist until the end.[15]

To address the misleading signal of consumption growth resulting from card adoption, at least for Swiss cards, I build an additional 'constant card sample'.[16] I retain only transactions of Swiss cards at constant merchants that are observed at least once every quarter between the first quarters of 2013 and 2017. This sample partially, but certainly not completely, eliminates the cash-card bias inherent in the data owing to the increasing adoption of cards by Swiss consumers. Notably, card adoption is not a binary decision, but depends in particular on the merchant and on the amount spent (see the remarks in the next section).

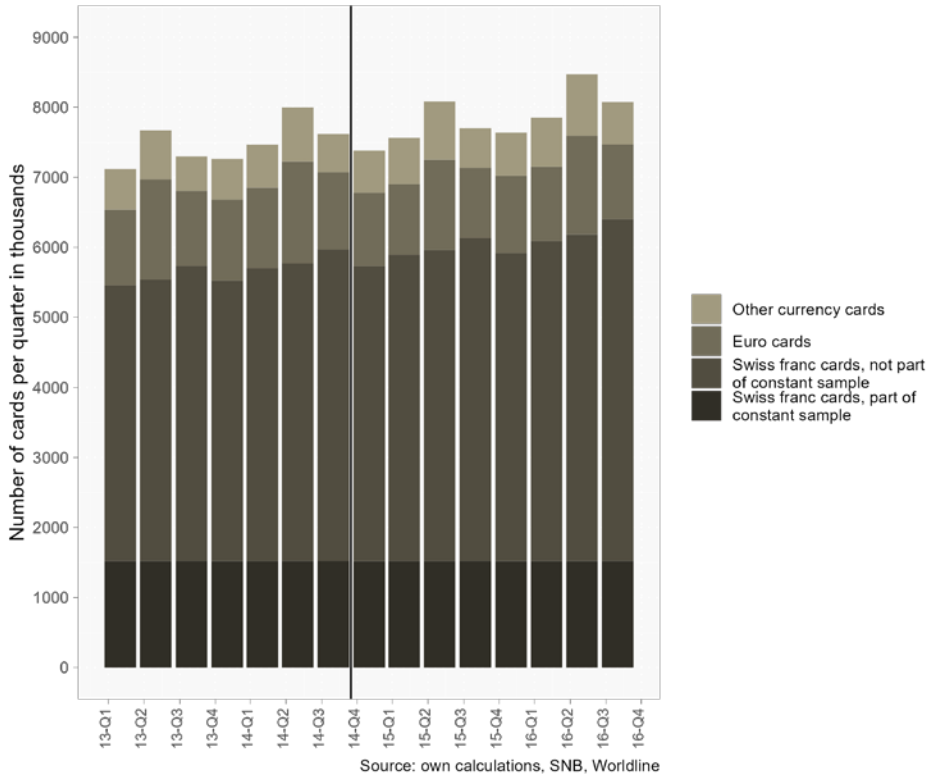
The final sample comprises 29,418 merchants and is based on approximately 750 million transactions by over 30 million cards from 55 countries. When the Swiss card transactions are limited to transactions from quarterly observed cards only, the sample decreases to approximately 500 million transactions by over 20 million cards. Panel (a) of Figure 2 shows that the constructed sample leads to a fairly stable number of active merchants over my period of interest. The figure also shows the sector shares of the constant merchant sample, with 70% being in retail trade, 12% in personal services, 11% in food and beverage services and 6% in accommodations. Panel (b) shows the number of cards by currency group over the sample period. Swiss cards account for 40% of the cards observed over the entire period but constitute approximately 80% per quarter. When limiting the Swiss card sample to quarterly constant cards only, Swiss cards account for 10% of the cards observed over the entire period and reach a share of approximately 50% per quarter. The figure in Panel (b) illustrates that the data are diluted by the ongoing adoption of card payments, especially by Swiss franc consumers, and that the constructed constant Swiss card sample leads to a fairly stable subsample of active Swiss cards over the observation period.

[15] Note that a downside to my approach is that it excludes business openings and closings. Moreover, the basic idea behind the approach of 'constant merchants' is similar to that of the procedures applied in Aladangady et al. (2022), Felber and Beyeler (2023) and Brown et al. (2025).

[16] The table in Appendix 1 shows the pre-discontinuation trend growth in the value of transactions, the number of cards and the value per card spent at merchants for the cards of the three currency groups. The table indicates that the observed number of Swiss cards in particular is biased by the ongoing shift from cash to card payments.



(a) Number of active merchants of yearly constant merchant sample per quarter and by sector



(b) Number of active cards per quarter and by currency group

Figure 2: Panel (a): Number of active merchants in yearly constant merchant sample by sector, with a total of 29,418 merchants. Panel (b): Number of cards by currency group, with a total of 32,591,275 cards observed over the entire period.

Note: The black vertical lines denote the first-quarter 2015 observation, i.e., the quarter of the discontinuation of the minimum exchange rate.

2.4 Outcome variables

I aggregate the transaction payments data included in my sample to quarterly frequency. In fact, I create a balanced panel of consumption (C) with observations on merchant (m)-times-country (c)-times-quarter ($t+h$) level:

$$C_{m,c,t+h}, \text{ with } t = \text{2015-Q1 and } h = [-7, ..., 0, ...7]$$

$h = 0$ denotes the quarter of the discontinuation of the minimum exchange rate and $t + h$ denotes the quarters before and after the shock. I calculate three measures of consumption: the value of transactions, the number of cards and the value per card. The value of transactions approximates a merchant's consumption receipts and consumers' consumption expenditure at a merchant, respectively. It serves as my overall consumption measure. The number of cards (approximating merchants' customer base) serves as my extensive margin consumption measure, and the value per card serves as my intensive margin consumption measure.

It is particularly interesting to distinguish the impact of exchange rates on the intensive and extensive margin consumption of foreign consumers (tourists). However, the two measures also have a more practical feature: they allow for better handling of two artifacts in the data. First, the two measures are affected differently by the cash-card bias inherent in the data as a consequence of the increasing adoption of cards by consumers. Consumers may have adopted card payments at one merchant and increasingly adopt it at other merchants over time, which inflates the observed number of customers – the number of cards – at those merchants. Moreover, it is plausible that consumers may have adopted card payments for higher-value purchases and are only increasingly adopting card payments for lower-value purchases over time. Over time, this is likely slightly increasing (decreasing) the observed value spent per consumer – the average value per card – at higher (lower) price segment merchants. The results of the extensive margin consumption measure should thus be understood as lower bound findings, whereas the direction of the bias of the intensive margin measure is more ambiguous.

Second, the extensive margin measure is robust with respect to price effects. Notably, merchants may have readjusted the prices of imported goods or competing domestic goods in the aftermath of the exchange rate shock (e.g., Auer et al. (2021)). With the card data on hand I cannot distinguish between quantities and prices and thus cannot take into account the pass-through of the exchange rate on prices. However, the observed number of cards at merchants is a good indicator of whether there was an impact on discretionary consumer spending in real terms.

3 The effects of the 2015 exchange rate shock on cross-border consumer spending

3.1 The impact across currency groups

This section is dedicated to the first question outlined in Section 2.2. It empirically analyzes the impact of exchange rates on consumer spending over time – overall and across currency groups. I first investigate the absolute impact of the 2015 exchange rate shock in a simple event study setup. To put things into relation, I then estimate exchange rate elasticities by setting up a gravity model of trade.

The absolute impact

In this subsection, I assess the impact of the 2015 exchange rate shock on consumer spending in a simple event study setup. As discussed in Section 2.1, the SNB's discontinuation of the minimum exchange rate on January 15, 2015, led to a large, unexpected and persistent appreciation of the Swiss franc against most currencies. In addition, pre and post shock, the Swiss economy and prices were relatively stable. The preconditions to conduct an event study with time (pre/post shock) as treatment are therefore reasonably satisfied.[17]

In event study terminology, my Base period constitutes my estimation period and my Pre and Post periods constitute the observation period (recall the schematic sample representation in Figure 1). Moreover, as a measure of 'abnormal' consumption (as pendant to abnormal returns in stock price event studies), I normalize my three consumption measures by the observed consumption in the respective quarter in the Base period:

$$NC_{m,c,t+h} = ln\left(\frac{C_{m,c,t+h}}{C_{m,c,base_{t+h}}}\right), \text{ with } t = \text{2015-Q1 and } h = [-3, ..., 0, ...7]$$

By taking long differences, the normalized consumption NC is a cumulative consumption measure. It is the consumption in the observation period $t+h$ relative to the consumption in the observation period $base_{t+h}$.[18] This measure addresses (quarterly) seasonality of

[17] The unexpected nature of the shock and stable economic conditions make time an appropriate treatment, particularly for Swiss franc and Euro card consumption. Note that the vast majority of observed cards are either Swiss or Euro cards (Figure 2). The cross-sectional variation with regard to the shock – as could, for example, be approximated by the difference between the pre-shock exchange rate forwards and the actual exchange rate – is therefore relatively limited. For this reason, an estimation strategy based on a treatment with varying intensity, such as the local projection approach, would not be suitable.

[18] Note that before logarithmizing consumption, I shift the aggregated consumption numbers C by one

payments data and can be interpreted similarly to levels owing to its cumulative nature.

The constant merchant sample takes care of any growth in the card data resulting from terminal adoption by merchants. To address the cash-card bias as a result of the adoption of card payments by consumers, for Swiss consumption, I use the constant card sample as described in Section 2.3.

I compare consumer spending across merchants ('between-merchant analyses') to quantify the impact of the shock on normalized consumption. Similar to Kaufmann and Renkin (2017) and Kaufmann and Renkin (2019), I estimate the following fixed effects regressions for all cards together and subsamples of the three currency groups separately:

$$NC_{m,c,t+h} = \alpha_{m,c} + \boldsymbol{\beta D^{per}_{t+h \neq t-1}} + \epsilon_{m,c,t+h}, \text{ with } t = \text{2015-Q1 and } h = [-3, ..., 0, ...7]$$

The merchant-times-country fixed effects α control for any time-invariant merchant, country and merchant-country pair-specific characteristics, such as the merchant's geographic location and the travel time to that location across countries. The time or period dummies $\boldsymbol{D^{per}}$ capture the effect of the shock over time and are equal to one in the corresponding quarter or zero otherwise, with the dummy for quarter 2014-Q4 ($D_{t=t-1}$), i.e., the last quarter before the shock, being omitted. I run the above specified regression with analytical country weights (weighted fixed effects regression) to take into account the relative importance of the different countries for the Swiss economy.[19]

Figure 3 shows the total normalized consumption, while Figure 4 shows the normalized consumption for Swiss cards, Euro cards and other currency cards separately. In both figures, the estimated numbers (β coefficients of the period dummies $\boldsymbol{D^{per}}$) are shown for all three consumer spending measures: the overall measure (value of transactions, in red), the extensive margin measure (number of cards, in yellow), and the intensive margin measure (value per card, in blue). The (inverted) quarterly average real exchange rates are plotted as points of reference (in turquoise). The respective figures showing the descriptive numbers (averages of the three consumption measures by period) can be found in Appendix 2.1 and Appendix 2.2. In addition, Appendix 2.2 shows the descriptive numbers and the real exchange rates for all 55 countries in my sample. The respective regression tables can be found in Appendix 3.1 and Appendix 3.2.

When focusing on the pre-shock quarters (shaded green areas in the figures and

and that $NC_{m,c,t+h}$ is nulled (set to missing) if $ln(C_{m,c,t+h})$ or $ln(C_{m,c,base_{t+h}})$ equals zero.

[19] For weighting, I use the 55 countries' relative Base period value shares for the overall outcome variable and intensive margin outcome variable, and their shares based on the number of cards for the extensive margin outcome variable.

$D_{t=-3}$ and $D_{t=-2}$ in the regression tables), I do not find substantial negative normalized consumption in any of the three periods preceding the shock, which was expected given the unanticipated nature of the currency appreciation in question. Moreover, when gauging the relative shares of the three consumption measures, the three measures 'add up' as one would expect with the intensive and extensive margin measures composing the overall consumption measure. In addition, the figures reveal that the extensive margin drives overall consumption: the red overall consumption lines exhibit similar dynamics as the yellow extensive margin lines do. Finally, by comparing Figure 3 to the upper panel in Figure 4, it becomes evident that total consumption is driven by the consumption by Swiss cards; as domestic consumption constitutes the majority of total consumption, Swiss cards are assigned the greatest weight.

With respect to the shock, I find that Swiss normalized consumption dropped in the quarter of the shock, with overall normalized consumption declining to -0.04 (i.e., by 4%). In the second quarter of 2015, consumption was recovering, albeit then showing relatively weak development at a slightly deteriorating rate until the end of the observation period (with an average value of overall normalized consumption of -0.03).[20] While the extensive margin was relatively unaffected (which is to be expected because Swiss consumers are 'locked in'), the intensive margin caused the weak development.[21]

[20] See footnote 29 in Section 3.3, which argues that the recovery of consumption in the second quarter of 2015 observed in Figure 4 was likely the outcome of a campaign by 'Switzerland Tourism'.

[21] The figure in Appendix 2.3 visually compares the development of the consumption measures of the constant Swiss card sample to those of the non-constant sample (all Swiss cards). The figure illustrates the cash-card bias inherent in the data. Post-shock, The extensive margin and the overall measures are biased upward. The constant Swiss sample quite plausibly addresses the bias. However, for this reason, the overall and extensive margin results for non-Swiss consumption are likely to represent lower bounds. The intensive margin consumption measure is less affected by the constant card correction.

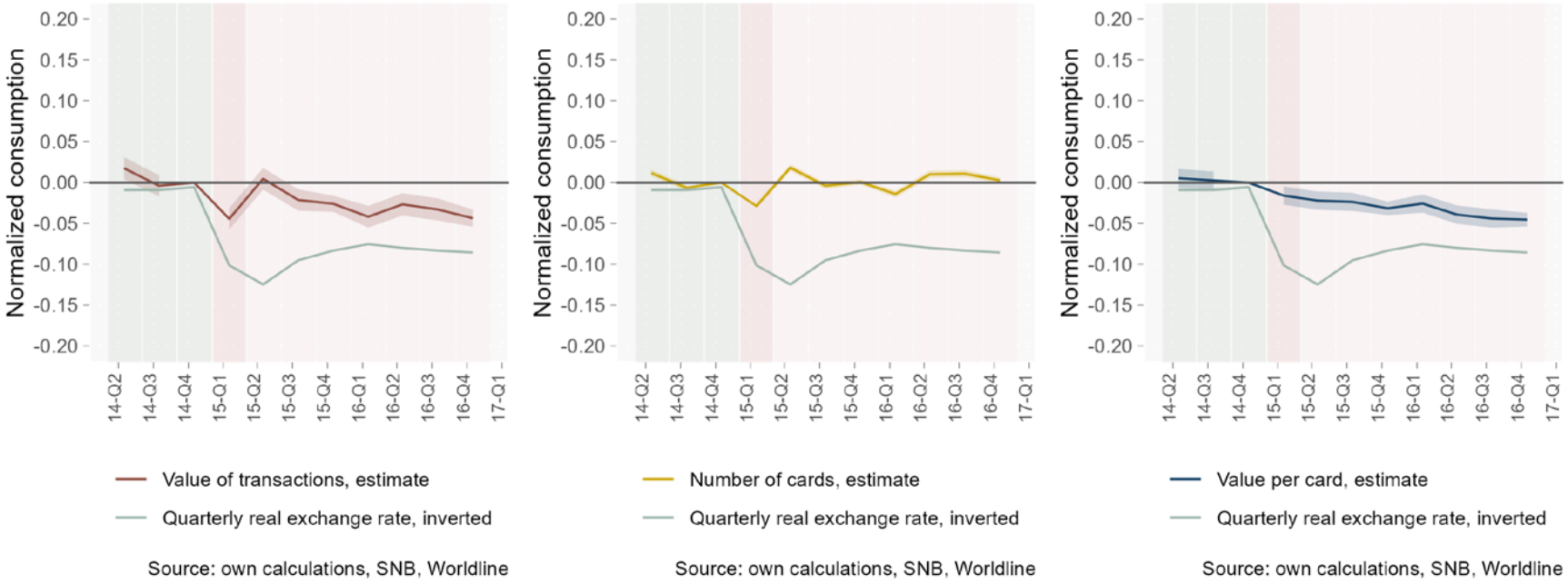


Figure 3: Quarterly total normalized consumption: value of transactions, number of cards and value per card; estimates.

Notes: The shaded ribbons along the red, yellow and blue lines denote the 95% confidence intervals that are derived from the estimated coefficients' standard errors. The real exchange rate is the inverted average real exchange rate, weighted by the 2013-Q2 to 2014-Q1 country-level value of payment transactions. The Swiss real exchange rate is the inverted average of 37 bilateral exchange rates, weighted by the 2013 Swiss tourism expenses, which can be downloaded from the SNB's data portal: https://data.snb.ch/en (downloaded on 19th December 2023).

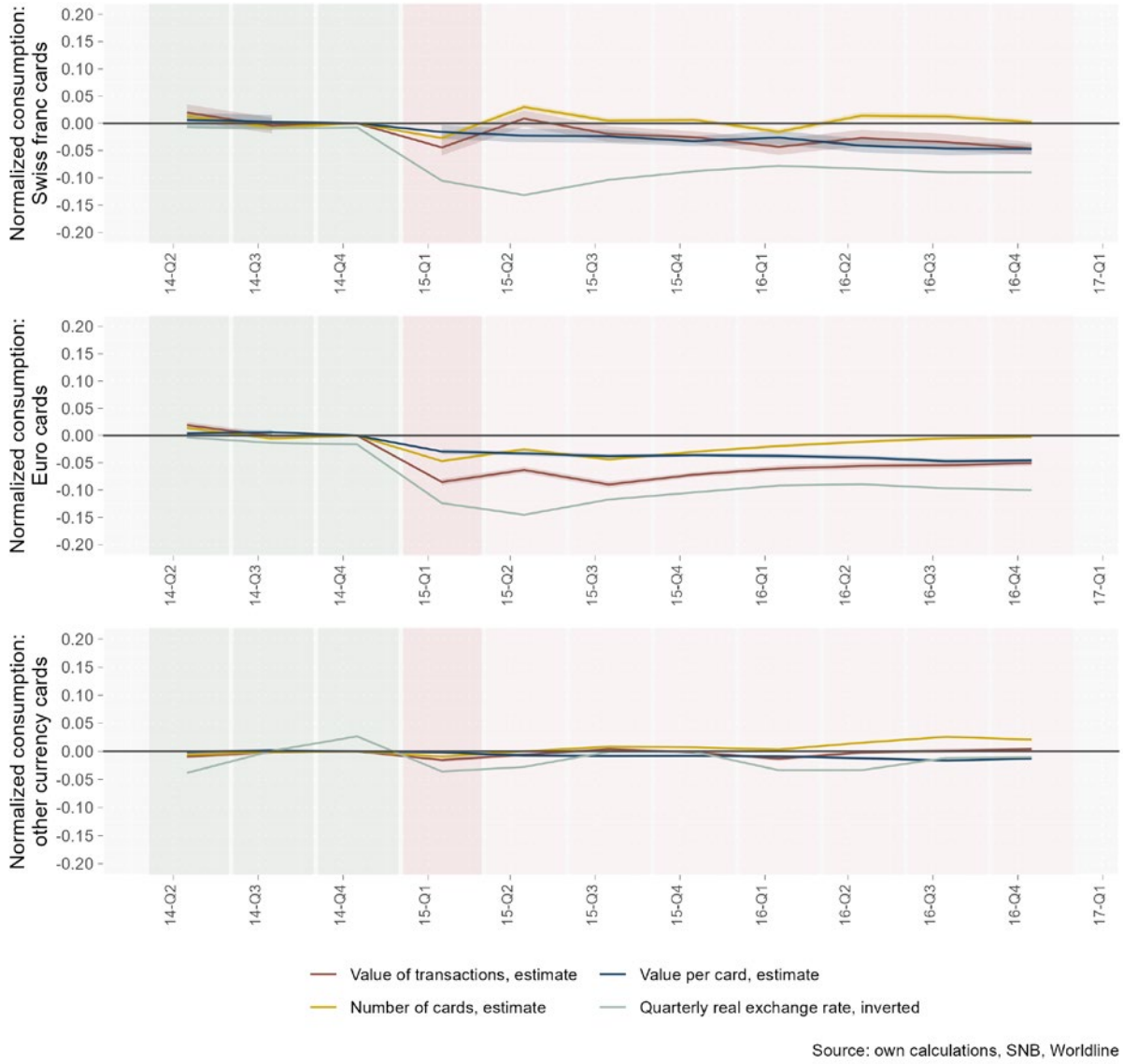


Figure 4: Quarterly normalized consumption for the three currency groups: value of transactions, number of cards and value per card; estimates.

Notes: The shaded ribbons along the red, yellow and blue lines denote the 95% confidence intervals that are derived from the estimated coefficients' standard errors. The non-Swiss franc real exchange rates are the weighted average real exchange rates, weighted by the 2013-Q2 to 2014-Q1 country-level value of payment transactions. The Swiss real exchange rate is the average of 37 bilateral exchange rates, weighted by the 2013 Swiss tourism expenses, which can be downloaded from the SNB's data portal: https://data.snb.ch/en (downloaded on 19th December 2023).

With respect to non-Swiss consumption, Euro consumption declined sharply in the quarter of the shock, with overall normalized consumption dropping by 9%, and – like Swiss normalized consumption – slightly recovered in the second quarter (to -0.06). In the aftermath, Euro overall normalized consumption remained at low levels but was moderately recovering in the following quarters (with an average value of -0.06). While the intensive margin remained in the negative fields over the entire period, the extensive

margin recovered to non-negative numbers.

In contrast, not having been directly subject to the SNB's minimum exchange rate regime, the quarterly average real exchange rate of other currencies and consumption by other currency cards did not react substantially. Consumption by other currency cards showed slightly negative numbers the quarters before the shock and dropped moderately in the quarter of the shock (by 2%). After the shock, consumption by other currency cards recovered.

The relative impact: exchange rate elasticities

The event study shed light on the impact of the 2015 exchange rate shock in absolute terms. However, real exchange rates across currencies differ in the degree to which they were affected by the 2015 discontinuation of the minimum exchange rate and the speed at which they recovered. To put things in relation, in this subsection, I estimate exchange rate elasticities over my sample period for the three currency groups separately.

Unlike in the previous section, in this analysis, I am not interested in the dynamics over time per se; thus, I set up a time series model with quarter-to-quarter transformation instead. The specified fixed effects regression term captures seasonality, and the quarter-to-quarter transformation cushions the ongoing shift from cash to card payments in all three consumption measures. Therefore, in this analysis, I relax my Swiss card sample and include transactions from all Swiss cards rather than from quarterly constant cards only. Specifically, I set up the following regression:

$$ln\left(\frac{C_{m,c,t+h}}{C_{m,c,t+h-1}}\right) = \alpha_{m,c,q_t} + \boldsymbol{\beta}\ \boldsymbol{D_c^{cur}}\ ln\left(\frac{R_{c,t+h}}{R_{c,t+h-1}}\right) + \gamma\ ln\left(\frac{Y_{c,t+h}}{Y_{c,t+h-1}}\right) + \epsilon_{m,c,t+h},$$

$$\text{with } t = \text{2015-Q1 and } h = [-6, ..., 0, ...7]$$

As in the event study setup in the previous section, the target or outcome variable is either the overall, extensive margin or intensive margin consumption measure, i.e., the value of transactions, the number of cards or the value per card, denoted by C, at merchant m from country c in quarter $t + h$. Consumption growth is regressed on merchant-times-country-times-quarter number fixed effects α as well as on countries' real exchange rate growth R and seasonally adjusted real GDP growth Y.[22] The fixed effects capture merchant-, country- and merchant-country-pair-specific characteristics as well as quarter-specific

[22]The GDP numbers were downloaded from the IMF's data portal: https://data.imf.org/ (downloaded on January 4, 2024). Note that seasonally adjusted real GDP numbers are not available for 5 out of the 55 countries of my sample, which slightly reduces the number of observations in this section compared with that of the previous section.

seasonality (with q_t denoting the quarter number, i.e., Q1, Q2, Q3 or Q4). The dummies $\boldsymbol{D^{cur}}$ are mutually exclusive binary variables, allowing me to estimate the above specified regression for the three currency groups simultaneously. As in the event study, I run the above specified regression with analytical country weights.

The regression is set up in the spirit of a gravity model of trade (see, e.g., Song et al. (2009) and Culiuc (2014)). As it is standard in international trade, I predict bilateral trade flows based on the economic size of countries (as captured by GDP) and control for the distance between countries (as captured by the merchant-times-country fixed effects). My specification is similar to the specification by Stettler (2017).

Table 1 presents the regression results for the overall (value of transactions) exchange rate elasticities. It provides both the total exchange rate elasticity over all currency groups and for each currency group separately. The estimates of the extensive and intensive margin exchange rate elasticities can be found in Appendix 4.

Subsample:	All cards		
Outcome variable:	Consumption growth: value of transactions		
real exchange rate growth R	-0.16***	-0.11***	
	(0.02)	(0.02)	
$D_{Swiss\ cards}$ * *real exchange rate growth R*			-0.06**
			(0.02)
$D_{Euro\ cards}$ * *real exchange rate growth R*			-0.66***
			(0.02)
$D_{other\ currency\ cards}$ * *real exchange rate growth R*			-0.12***
			(0.01)
GDP Y		0.97***	1.16***
		(0.19)	(0.20)
Merchant-times-country-times-quarter number fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	29,418	29,418	29,418
Number of countries	50	50	50
Number of periods	14	14	14
Number of observations	18,282,671	18,282,671	18,282,671
R2, adjusted R2	0.72, 0.59	0.72, 0.59	0.72, 0.59

Table 1: Elasticity regressions: value of transactions.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

I find an overall exchange rate elasticity of 0.11, which means that a real appreciation of the Swiss franc by 1% decreases consumption expenditure by 0.11%. The estimated coefficient of GDP has the expected positive sign. With a value of 0.97, the coefficient indicates that a 1% increase in the GDP of country c increases consumption as well as

the number of visitors from that country on average by 0.97%, so rather proportionally.

Examining the exchange rate elasticities by currency groups, I find the strongest relative effect for Euro cards. The overall exchange rate elasticity for Euro cards is 0.66. For Swiss cards, the estimated overall exchange rate elasticity is 0.06, and for other currency cards, it is 0.12. Moreover, the regression tables of the estimated intensive and extensive margin elasticities in Appendix 4 show that the extensive margin elasticity for Swiss consumers, which are 'locked in', is not significantly different from 0, while the intensive margin elasticity is 0.09. For Euro area consumers, the extensive margin elasticity is 0.36, and the intensive margin elasticity is 0.21. For other currency country consumers, the elasticities at the intensive and extensive margins do not differ (both are 0.05).

Given the scope of the paper, Stettler (2017) in particular allows me to validate my estimated coefficients for non-Swiss franc consumers, showing that my elasticities are more or less in line with the Swiss tourism literature.[23]

Assessment of the first research question

The empirical findings in this section are in line with some but not all theoretical considerations outlined in Section 2.2. The observed decline in consumption on impact (i.e., the first-quarter reaction) by domestic consumers is likely the consequence of a substantial increase in cross-border shopping activity by Swiss residents, as elaborated in Section 2.2 and further investigated in Section 3.2. In contrast, the immediate and substantial decline in consumption by foreign Euro area consumers – in terms of both the intensive margin and the extensive margin – is noteworthy. In fact, the relative numbers reveal a non-lagged elasticity that is greater at the extensive margin than at the intensive margin (0.36 and 0.21, respectively). This finding indicates that Euro area visitors are more flexible in their traveling behavior than was assumed in the prior. Moreover, this finding suggests that exchange rate-sensitive Euro area consumers, including leisure tourists, avoid visiting or at least consuming in Switzerland rather immediately post shock, whereas less exchange rate sensitive Euro area consumers, such as business visitors, still travel to Switzerland and then reduce their consumption slightly. However, the significantly lower elasticities of other currency country consumers suggest that visitors from further away are indeed relatively less price-sensitive.

Examining the longer-term findings, it is noteworthy that domestic overall and

[23] Stettler (2017) estimates an average exchange rate elasticity of 0.7. Abrahamsen and Simmons-Süer (2011) estimate average exchange rate elasticities greater than 1 and of 0.6, depending on the model applied. Jaeger et al. (1996) estimate exchange rate elasticities between 0.6 and 1.2. Ferro Luzzi and Flückiger (2003) estimate an exchange rate elasticity of 0.53.

intensive margin consumption, at least by domestic consumers, decrease at a slightly deteriorating rate. This development of nominal consumption would be in line with an incomplete and somewhat sluggish pass-through of exchange rates to retail prices. Moreover, within my observation period, I do not find a substantial delayed impact, e.g., from a hard-hit export industry, on consumption by domestic consumers. In hindsight, however, this finding is plausible. Studies show that the Swiss export industry was remarkably resilient and that the impact on employment was largely offset by natural fluctuations (see, e.g., Brunhart and Geiger (2022), Kaufmann and Renkin (2018)).

3.2 The role of cross-border shopping

This section is dedicated to the second question outlined in Section 2.2. It assesses the role of cross-border shopping in the impact of exchange rates on consumption by domestic consumers. Specifically, I conduct a difference-in-differences exercise using merchants' distance to the border, which serves as a (inverse) proxy for exposure to cross-border shopping, as treatment variable.

It is plausible that the negative normalized consumption by Swiss cards, as observed in Section 3.1, was driven by consumers who increased their cross-border shopping share. In fact, Burstein et al. (2024) document an increase in households' cross-border shopping shares after the 2015 appreciation. Moreover, as travel costs restrict cross-border shopping, it is plausible that consumers closer to the border increased their cross-border shopping activity relatively more and that merchants closer to the border were hit relatively harder by the 2015 shock. Notably, Burstein et al. (2024) document that 2014 cross-border shopping expenditure shares by households reached up to 8% in regions near the border and decreased with increasing distance to the border to shares close to zero. However, Burstein et al. (2024) do not find evidence of a robust relationship between the change in households' cross-border shopping shares and the distance to the border following the 2015 shock.

In this subsection, I conduct difference-in-differences regressions with a measure of distance to the border as the treatment variable to test these hypotheses with my sample. I focus on overall within-country spending (the value of transactions) by Swiss consumers as well as the sector that is most sensitive to cross-border shopping: retail trade.[24] In addition, Appendix 5 shows the results for the extensive margin normalized consumption

[24] Conducting an additional event study and estimating the fixed effects regressions as specified at the beginning of Section 3.1 for Swiss cards and different subsamples of sectors reveals that the decline in within-country consumption by Swiss individuals was indeed driven mainly by decreasing consumer spending in retail trade. See Appendix 2.4 and Appendix 3.3 for the respective figure and regression tables.

measure (number of cards) that is robust to price effects. To capture the longer-term dynamics, I limit the analysis to fourth-quarter observations and, to achieve a balanced panel, filter out any merchants that do not have at least one transaction in all four periods (fourth quarters of 2013, 2014, 2015 and 2016). With respect to my treatment variable, I map the zip code information available in the card data to municipality-level information on the travel time by car to the next border crossing.[25]

Figure 5 reports the average normalized consumption at merchants with above-median (red) and below-median (brown) treatment intensities (i.e., distance to the border greater than and less than 30 minutes). The first fourth-quarter observation of normalized consumption is available for 2014. The 2013 normalized consumption would be zero, and the 2014-to-2013 development of normalized consumption is indicated by the dotted lines. Identification in the difference-in-differences setup relies on the parallel-trends assumption, which is visually supported by the dotted lines. Furthermore, the figure suggests that there is indeed a causal, albeit small, effect of merchants' proximity to the border on normalized consumption (2015: -0.03 vs. -0.06, average of -0.04; 2016: -0.06 vs. -0.09, average of -0.07). The figure in Appendix 5 shows that the parallel-trends assumption is also supported for the extensive margin consumption measure and also suggests a small effect of the treatment variable on consumption.

To quantify the effect, I run the following fixed effects regression where the normalized consumption indicated by $NC_{m,t}$ is the overall consumption measure for merchant m in year t:

$$NC_{m,t} = \alpha_m + \beta_1 \; post_t + \beta_2 \; post_t \; ln(distance_m) + \epsilon_{m,t}$$

The merchant fixed effects α capture time-invariant merchant characteristics. The dummy $post_t$ equals 0 for the 2014 Pre period (2014-Q4) and 1 for one of the following Post periods: 2015-Q4 or 2016-Q4. The variable $ln(distance_m)$ indicates the merchants' proximity to the border (travel time by car).

[25]The data on the travel time to the next border crossing were prepared by an external data analytics company on behalf of the SNB.

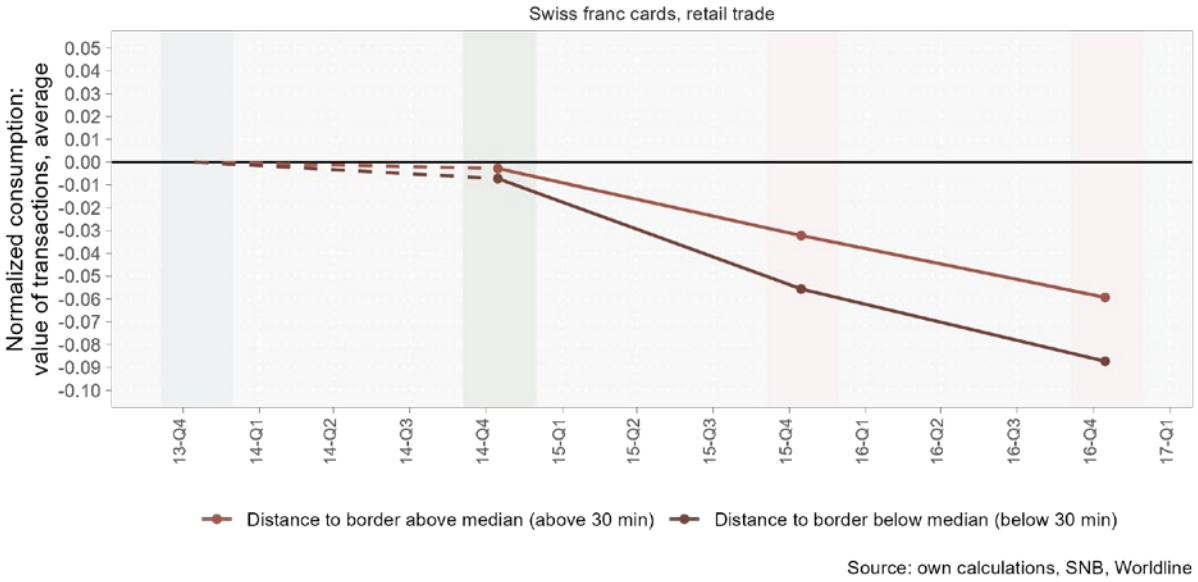


Figure 5: Fourth-quarter normalized consumption by constant Swiss cards at merchants with below- and above-median distance to the border: value of transactions.

Notes: The first fourth-quarter observation of normalized consumption is available for 2014. The 2014-to-2013 development of normalized consumption is indicated by the dotted lines.

Table 2 presents the regression results for the above specified equation. The first column compares the 2015-Q4 Post period to the 2014-Q4 Pre period, and the second column compares the 2016-Q4 Post period to the 2014-Q4 Pre period. The table shows that the decline in consumption indeed seems to have varied to a small extent by merchants' distance to the border: on average, merchants located 1% closer to the border observe a 0.01% stronger decline in normalized consumption. The regression table in Appendix 5 confirms an effect of 0.01% for the extensive margin consumption measure, which rules out that border-specific inflation is driving the finding.

Assessment of the second research question

The empirical findings in this section are in line with the theoretical considerations in Section 2.2. From the simple linear test conducted, I find evidence for a small and - unlike Burstein et al. (2024) – robust negative relation between domestic within-Switzerland normalized consumption and merchants' distance to border.[26] Notably, the findings

[26]There are at least three potential explanations for the small magnitude found. First, the relationship between the distance to the border and cross-border shopping activity could be non-linear. Second, distances in Switzerland are generally short, so even people who live relatively far from the border shop abroad. Third, even before the 2015 discontinuation, the Swiss franc had appreciated strongly. Before the Swiss franc started to appreciate at the beginning of 2008, its exchange rate against the Euro was approximately 1.60. The continuous appreciation ended only in September 2011, when the SNB introduced the minimum exchange rate of CHF 1.20 per Euro. It is therefore likely that only merchants who are less sensitive to Swiss cross-border shopping activity are captured by my sample.

show that the observed decline in consumption on impact by domestic consumers (as documented in Section 3.1) is indeed likely the outcome of increased cross-border shopping activity.

Subsample:	Swiss cards, retail trade	
Outcome variable:	NC: value of transactions	
2014-Q4 pre period vs.	2015-Q4 post period	2016-Q4 post period
post	-0.08***	-0.11***
	(0.02)	(0.02)
post ln(distance)*	0.01**	0.01***
	(0.00)	(0.01)
Merchant fixed effects	yes	yes
Country weights	no	no
Number of merchants	19,289	19,289
Number of countries	1	1
Number of periods	2	2
Number of observations	38,578	38,578
R2, adjusted R2	0.79, 0.59	0.76, 0.52

Table 2: Regressions of fourth-quarter normalized consumption on distance to border treatment intensity: value of transactions.

Notes: Standard errors are clustered at the merchant level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Sources: own calculations, SNB, Worldline

3.3 The impact across price segments

This section is dedicated to the third question outlined in Section 2.2. Through an approximate analysis, I study the impact of the currency appreciation across consumers of different wealth/income groups. I do not observe card holder characteristics in my data. However, it is plausible that lower-wealth or -income individuals, on average, consume at lower-price segment merchants, whereas higher-wealth or -income individuals, on average, consume at higher-price segment merchants. I therefore decompose the impact of the 2015 shock on consumption across merchants of different price segments. In addition, I conduct a test at the transaction level and differentiate across goods and services of different price segments within merchants.

The impact across merchants of different price segments

Lower-wealth/income individuals (and leisure tourists) that arguably consume, on average, at lower-price segment merchants are presumably relatively more sensitive to exchange rate movements than higher-wealth/income individuals (and business visitors) that consume at higher-price segment merchants. To shed light on the impact of exchange rates on consumer spending across different price segments, I categorize the merchants of the constant merchant sample into three groups based on their 2013 average card transaction value: low-price segment merchants with an average transaction value below the 33rd percentile, medium-price segment merchants with an average transaction value between the 33rd and 66th percentiles and high-price segment merchants with an average transaction value above the 66th percentile.

Moreover, I restrict my sample to merchants in a sector where the type of the services offered is comparable: food and beverage services. Furthermore, I include only merchants from zip codes in which at least one merchant (restaurant) from each of the three price segments is observed. The food and beverage services offered by this subset of merchants can thus be seen as substitutes. I then estimate the fixed effects regressions as specified at the beginning of Section 3.1 for domestic and foreign cards and the three price segments separately.

Figure 6 shows the normalized consumption estimates for my overall consumption measure (the value of transactions) separately for Swiss, Euro and other currency cards. As a robustness check, Appendix 2.5 shows the same figure for my extensive margin consumption measure (the number of cards) that is robust to price effects, as well as a figure with the absolute numbers and estimates for all three consumption measures. Appendix 3.4 shows the respective regression tables. As the figures and tables show, normalized consumption in the three price segments does not show significantly different level of development in the first few quarters after the shock. However, the lowest-price segment consumption is substantially less adversely affected toward the end of the observation period. Nonetheless, as it is plausible – and supported by the pre-shock descriptive numbers in the second figure in Appendix 2.5 – that the cash-card bias is stronger in the low-price segment, I conclude that I find only weak evidence for consumers substituting between merchants in different price segments.

The impact across goods and services of different price segments

Conducting an event study for merchants in different price segments in the previous subsection, I find no substantial evidence that exchange rates impact merchants in different price segments differently. Nevertheless, it is still plausible that at a given

merchant, the consumption of goods and services of different price segments is affected differently by exchange rate movements. For that reason, in this subsection, I conduct a 'within-merchant analysis' that sheds light on the impact on the relative sales volumes of goods and services in different price segments.

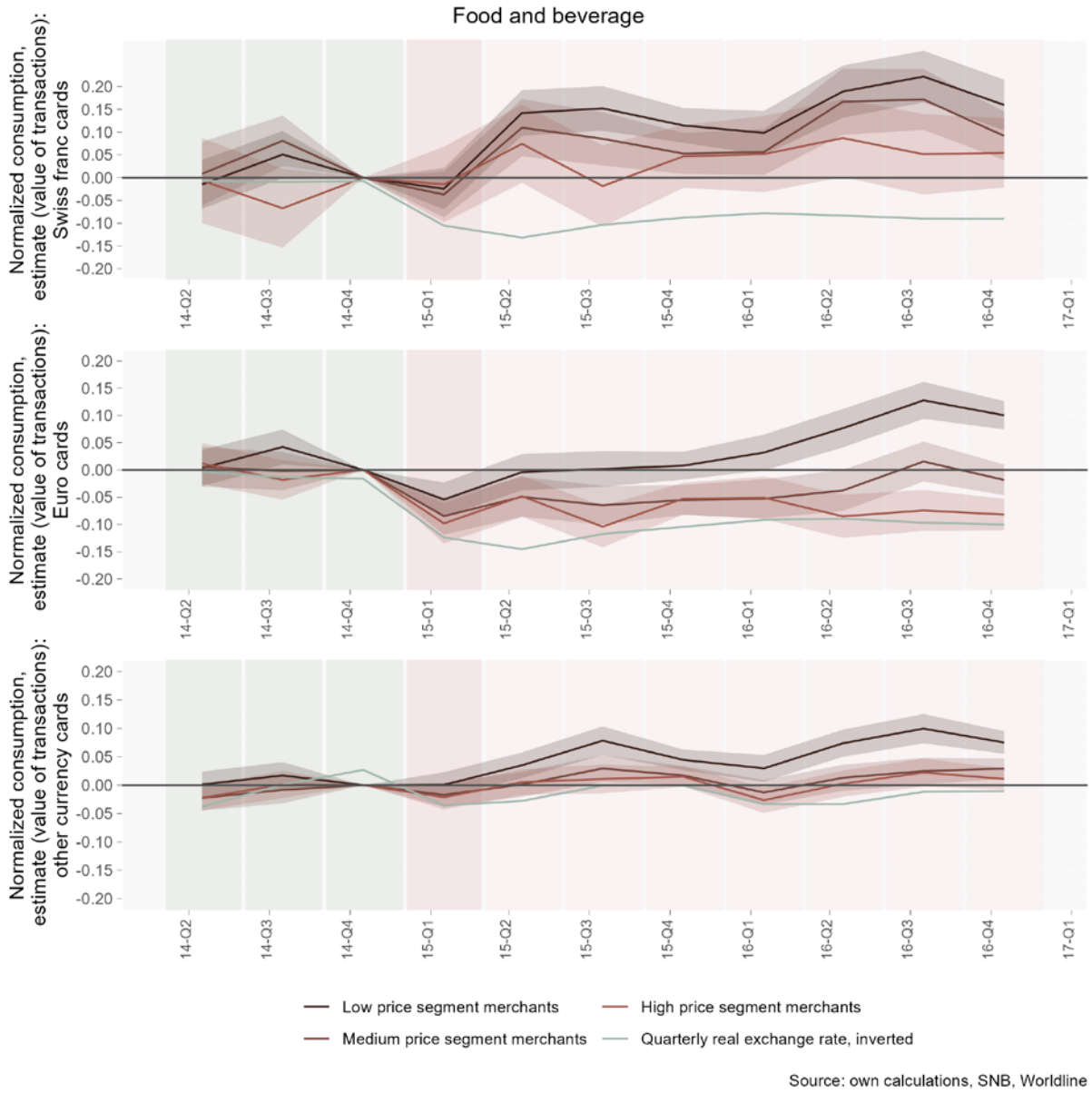


Figure 6: Quarterly normalized consumption for the three currency groups in food and beverage services for low-, medium- and high price-segment merchants: value of transactions; estimates.

Notes: The shaded ribbons along the red lines denote the 95% confidence intervals that are derived from the estimated coefficients' standard errors. The Swiss real exchange rate is the inverted average of 37 bilateral exchange rates, weighted by the 2013 Swiss tourism expenses, which can be downloaded from the SNB's data portal: https://data.snb.ch/en (downloaded on 19th December 2023). The non-Swiss franc real exchange rates are the inverted average of the countries' real exchange rates, weighted by the 2013-Q2 to 2014-Q1 country-level value of payment transactions.

Notably, I conduct a test with observations at the transaction level. Based on these high-frequency data and in the style of a regression discontinuity design in time (RDDiT; see Lee and Lemieux (2010) and Hausman and Rapson (2017)), I choose a relatively small sample window, with the assignment variable (running variable) being time and the threshold being the discontinuation of the minimum exchange rate on January 15, 2015.[27] Concretely, my bandwidth spans from one week before to one week after the threshold and includes all transactions conducted at my constant merchants during that period. As an intervention sample, I choose seven days from Thursday, January 8 to Wednesday, January 14, 2015, and seven days from Friday, January 16 to Thursday, January 22, 2015, omitting the day of the discontinuation. Moreover, I specify a placebo or control sample, namely, the same two weeks a year earlier: Thursday, January 9 to Wednesday, January 15, 2014, and Friday, January 17 to Thursday, January 23, 2014.

To assess the relative shifts across transaction values (approximating prices), I calculate the pre- and post-threshold deciles of the values and categorize the transactions into the interdecile ranges. I then run the following transaction-level regression for different interdecile subsamples that take together the same pre- and post-threshold interdecile ranges:

$$ln(value_{i,m,t}) = \alpha_{m,d_t,h_t} + \beta_1\ time_t + \beta_2\ post_t + \epsilon_{i,t}$$

With this RDDiT equation, causal inference is established by disentangling the discontinuity ($post_t = 1$ if $time_t >$ threshold) from the smooth function $f(time_t)$ (Angrist and Pischke (2009)). The value of transaction i conducted at merchant m at time t (in seconds) is regressed on merchant-times-day of the week-times-hour of the day fixed effects α, the transaction time ($time$) and the dummy $post$ that indicates whether a transaction took place post threshold (i.e., whether it took place after the discontinuation). The fixed effects control for time-invariant merchant characteristics (e.g., the merchant sector and overall price segment) as well as seasonalities with respect to the weekday and the time of the day. β_2 is my coefficient of interest. For a given subsample, the estimate reveals whether and to what extent the average value in an interdecile range differs between the pre- and post-threshold period (post-to-pre transaction value growth). As a robustness check, and to address the concern that weekly seasonality may impact the results, I run the same regression for my intervention and control samples.

Figure 7 shows the estimated β_2 coefficients for the different interdecile ranges,

[27] Similar to the simple event study specified at the beginning of Section 3.1, RDDiT is suitable when there is no or only limited cross-sectional variation. In fact, RDDiT is related to the event study methodology but is typically used with high-frequency data, incorporates controls for seasonality and is applied to a narrow sample window (Hausman and Rapson (2017)).

separately for the two samples – the intervention sample (pink) and the control sample (light green) – and the three currency groups. The respective regression tables can be found in Appendix 6. As the figure and tables show, Euro consumer spending decreases substantially in the middle part, less in the lower part and not at all in the upper part of the value distribution (approximating the price distribution). This finding suggests some substitution toward lower-value purchases and likely lower-value goods and services within merchants. In contrast, I do not find a substantial effect for consumption by Swiss or other currency card consumers.

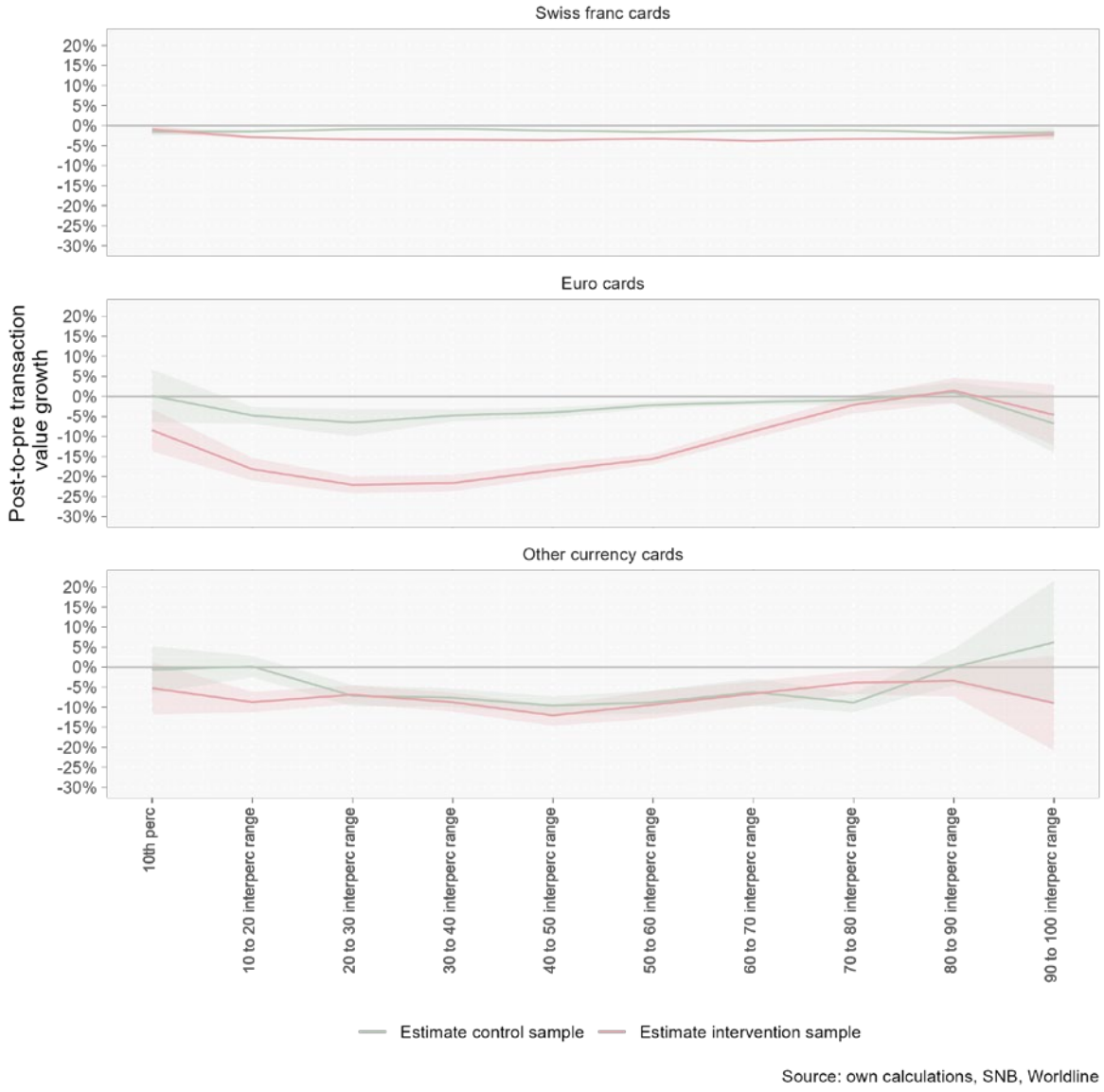


Figure 7: Estimates of post-coefficients of the within-merchant price segment regression for Euro and other currency cards: control and intervention samples.

Notes: The shaded ribbons along the pink and light green lines denote the 95% confidence intervals that are derived from the estimated coefficients' standard errors.

Assessment of the third research question

The empirical findings in this section are largely consistent with the theoretical considerations in Section 2.2. Differentiating the effects on merchants across price segments, I do not find substantial evidence that consumers substitute between merchants. However, I find some substitution by Euro consumers from medium- to lower-value but not from higher- to medium- or lower- value goods and services within merchants. I do not find such a substitution by Swiss or by other currency consumers, with the latter likely being relatively wealthier. This finding indicates that, in small open economies, the trade channel affects cross-border consumption heterogeneously and that consumers with lower wealth/income show a higher sensitivity to exchange rate fluctuations.

An additional test further illustrates the heterogeneous impact of exchange rates across consumers with different price sensitivities and presumably different levels of wealth. Drawing on the event study approach once more, I focus on foreign tourism spending and differentiate between touristic and non-touristic areas.[28] The figure and regression tables in Appendices 2.6 and 3.5, respectively, show that in my empirical setting the negative impact of currency appreciation on cross-border consumption by foreign consumers was stronger for merchants in touristic areas (as a proxy for spending by leisure and thus presumably more price-sensitive tourists) than for merchants in non-touristic areas (as a proxy for spending by business visitors who are presumably less price sensitive). Specifically, in the quarter of the shock, consumption by Euro cards declined by 15% and that of other currency cards declined by 5% at merchants in touristic areas, whereas it declined by 8% and 1%, respectively, at merchants in non-touristic areas.[29]

[28] For categorization into touristic and non-touristic area merchants, I map the zip code information available in the card data to spatial division data provided by the Federal Statistical Office (FSO). The FSO data can be downloaded here: https://www.agvchapp.bfs.admin.ch/de/typologies/query (downloaded on March 1, 2024). I draw on the municipality typology 2012, distinguishing 25 categories, with reference date January 1, 2015, and flag zip codes belonging to the codes 134, 314 and 334 as touristic areas.

[29] Interestingly, the recovery of Euro card consumption in the second quarter of 2015, as already observed in Figure 4, was more pronounced in touristic areas than non-touristic areas. In fact, the relatively sharp increase in the second quarter of 2015 was likely the outcome of a successful campaign by 'Switzerland Tourism'. Following the appreciation of the Swiss franc, increased efforts were made to attract foreign as well as Swiss tourists despite the unfavorable exchange rate. See, e.g., https://www.nzz.ch/schweiz/schweiz-tourismus-rechnet-mit-einbruch-beim-bergtourismus-ld.755382 (in German; last accessed on March 28, 2025).

4 Discussion

Understanding the effects of exchange rates on economic activity is essential for monetary authorities and their mandate to ensure price stability. This is especially true in small open economies where the exchange rate channel is a main channel of monetary policy transmission. Moreover, heterogeneous effects across economic agents naturally raise the question of distributional consequences and the appropriate policy mix. This paper contributes to this understanding by providing new empirical insights into the impact of exchange rate fluctuations on cross-border consumption. Leveraging a unique dataset of over 500 million debit and credit card transactions, it reveals distinct responses among foreign and domestic consumers across regions, price segments and sectors following the Swiss central bank's 2015 discontinuation of the minimum exchange rate.

A key takeaway from this paper is the differential impact of exchange rates on consumption by foreign and domestic consumers. The immediate and lasting decline of 9% in domestic within-country consumption by visitors from neighboring countries in the aftermath of the 2015 exchange rate shock suggests a pronounced impact on consumer exports, particularly in tourism-related industries. In contrast, the somewhat more moderate but also instant and lasting first-quarter 4% decline in domestic consumption by domestic consumers points to substitution effects, with domestic consumers shifting their spending toward cheaper alternatives abroad (imports). Furthermore, an elasticity analysis reveals that non-lagged consumer spending by foreign consumers from countries nearby is significantly more responsive to exchange rate movements (elasticity of 0.66) than that by other foreign consumers (elasticity of 0.12) and by domestic residents (elasticity of 0.06). Finally, additional analyses assessing the effects on consumption across price segments provide suggestive empirical evidence that wealth heterogeneity plays a crucial role in monetary policy transmission, with less wealthy or lower-income consumers showing a higher sensitivity to exchange rate fluctuations.

The decline in consumption by domestic and foreign consumers on impact is noteworthy. The immediate first-quarter reaction of consumption found in this paper mirrors a finding by Buda et al. (2025). Notably, the authors emphasize that the found immediate reaction in consumption contradicts the conventional view that spending is 'slow-moving' (Bernanke et al. (2005)).[30] This finding suggests that, with regard to consumption, exchange rate fluctuations entail more than price effects on impact. They

[30]Note that Buda et al. (2025), who measure consumption based on bank transactions including card data, find a same-quarter response to monetary policy when aggregating their data to daily, weekly and monthly frequencies. However, they find that the aggregation of their data to a quarterly frequency smooths out the observed same-quarter response. Such a 'time aggregation bias' does not seem to interfere with my analysis and the data on which is based.

trigger immediate and non-lagged adjustments in consumer export and import volumes as a consequence of shifts in tourism spending and cross-border shopping activity.

This paper's findings underscore how the structure of the economy and the size of the tourism sector shape the effectiveness and speed of the exchange rate channel of monetary policy transmission. Moreover, they highlight the importance of the spatial distribution of the domestic population and the role of cross-border shopping as an adjustment mechanism in *geographically* small open economies. In these economies, goods and services typically deemed as non-tradable are effectively tradable, with demand exhibiting substantial sensitivity to exchange rate fluctuations. In addition, the relatively more muted reaction of other foreign consumers compared with the reaction of consumers from neighboring countries shows that the composition of tourists matters. Finally, the findings indicate that heterogeneity in consumption responses extends beyond nationality to wealth and income groups.

In conclusion, this paper sheds light on the heterogeneous effects of exchange rate fluctuations on cross-border consumer spending, including tourism spending and cross-border shopping. By providing empirical evidence on the differential effects across economic agents, this paper contributes to the broader discourse on monetary policy effectiveness and the transmission of macroeconomic shocks in small open economies.

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Appendix

1 Pre-shock trend growth of card transactions

	Value of transactions	Number of cards	Value per card
Swiss franc cards	0.27%	1.57%	-0.48%
Euro cards	0.37%	0.19%	-0.07%
Other currency cards	0.14%	0.05%	-0.03%

Table 3: Average quarterly pre-discontinuation trend growth according to the yearly constant merchant card sample of card transactions.

Sources: own calculations, SNB, Worldline

2 Additional event study figures

2.1 Total normalized consumption

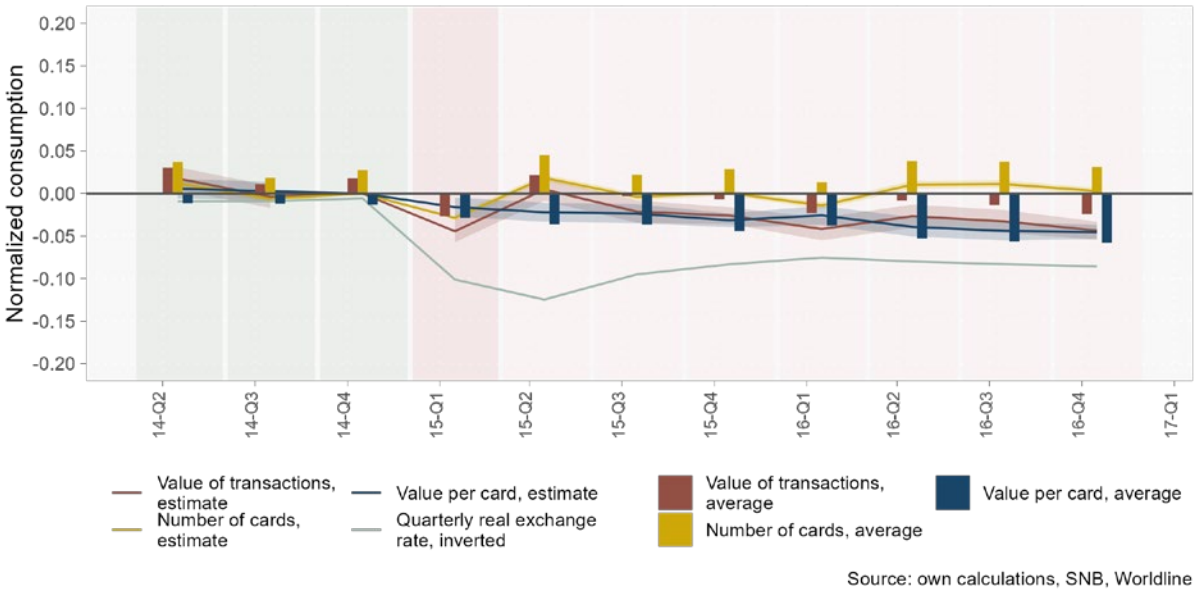

Figure 8: Quarterly total normalized consumption: value of transactions, number of cards and value per card; descriptive numbers and estimates.

Notes: The shaded ribbons along the red, yellow and blue lines denote the 95% confidence intervals that are derived from the estimated coefficients' standard errors. The averages of the value of transactions and the value per card are weighted by the 2013-Q2 to 2014-Q1 country-level value of payment transactions. The averages of the number of cards are weighted by the 2013-Q2 to 2014-Q1 country-level number of payment cards. The real exchange rate is the inverted average of the countries' real exchange rates, weighted by the 2013-Q2 to 2014-Q1 country-level value of payment transactions. The Swiss real exchange rate is the inverted average of 37 bilateral exchange rates, weighted by the 2013 Swiss tourism expenses, which can be downloaded from the SNB's data portal: https://data.snb.ch/en (downloaded on 19th December 2023).

2.2 Normalized consumption across currency groups and countries

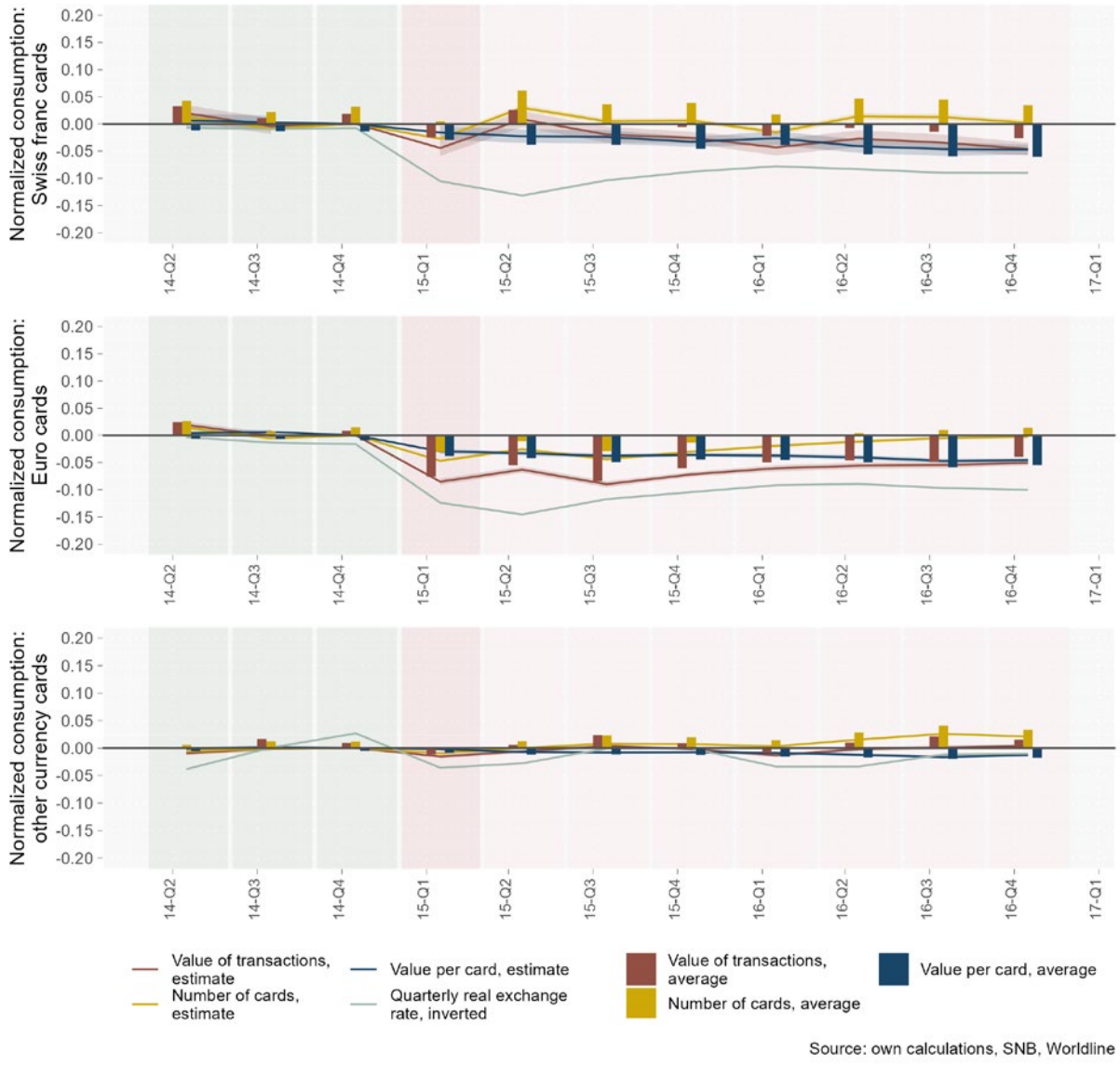

Figure 9: Quarterly normalized consumption for the three currency groups: value of transactions, number of cards and value per card; descriptive numbers and estimates.

Notes: The shaded ribbons along the red, yellow and blue lines denote the 95% confidence intervals that are derived from the estimated coefficients' standard errors. The averages of the value of transactions and the value per card are weighted by the 2013-Q2 to 2014-Q1 country-level value of payment transactions. The averages of the number of cards are weighted by the 2013-Q2 to 2014-Q1 country-level number of payment cards. The Swiss real exchange rate is the inverted average of 37 bilateral exchange rates, weighted by the 2013 Swiss tourism expenses, which can be downloaded from the SNB's data portal: https://data.snb.ch/en (downloaded on 19th December 2023). The non-Swiss franc real exchange rates are the inverted average of the countries' real exchange rates, weighted by the 2013-Q2 to 2014-Q1 country-level value of payment transactions.

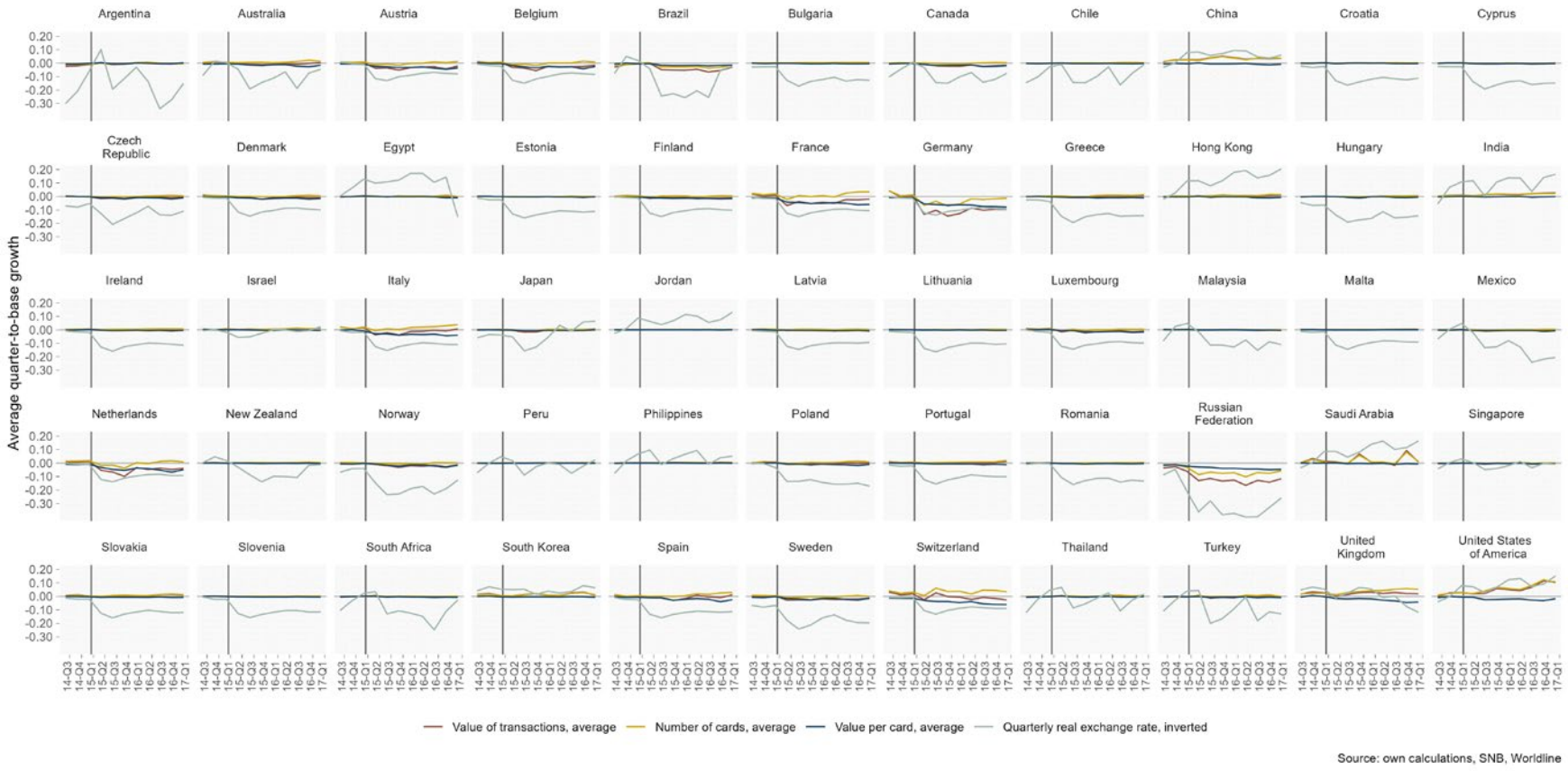

Figure 10: Quarterly normalized consumption across countries: value of transactions, number of cards and value per card; descriptive numbers.

Notes: The real exchange rate for Switzerland is the average of 37 bilateral exchange rates weighted by the 2013 Swiss tourism expenses, which can be downloaded from the SNB's data portal: https://data.snb.ch/en (downloaded on 19th December 2023).

2.3 Comparison of normalized consumption by Swiss franc cards: all cards and constant card sample

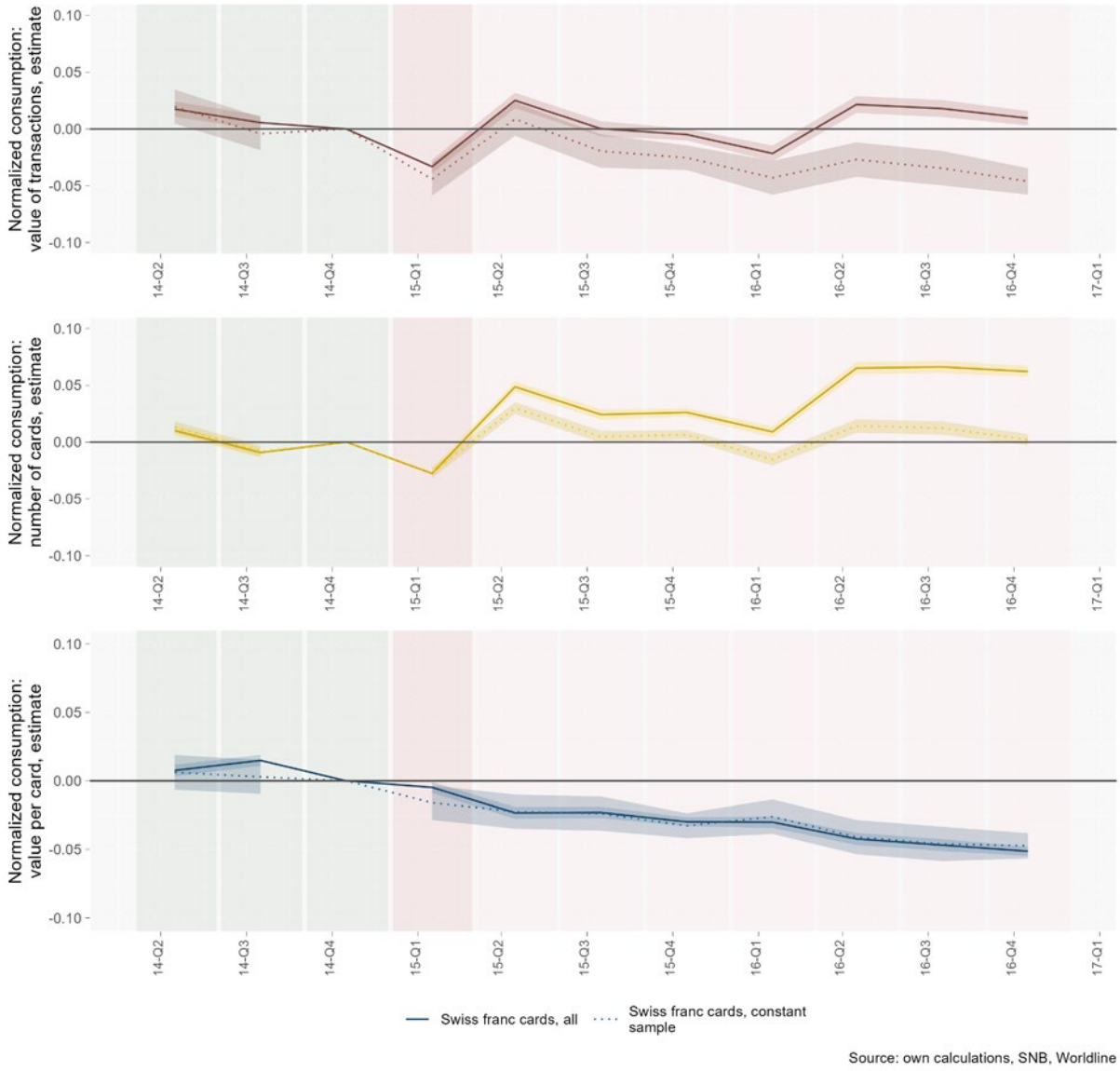

Figure 11: Quarterly normalized consumption for the overall Swiss franc card sample ('all cards') and the quarterly constant subsample: value of transactions, number of cards and value per card; estimates.

Notes: The shaded ribbons along the red, yellow and blue lines denote the 95% confidence intervals that are derived from the estimated coefficients' standard errors.

2.4 Domestic normalized consumption across sectors

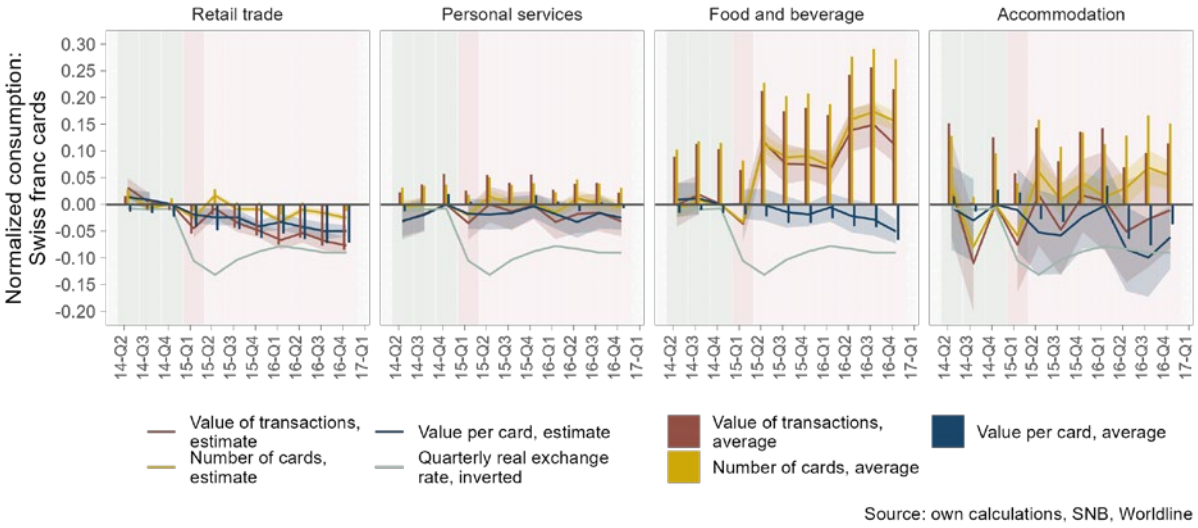

Figure 12: Quarterly normalized consumption for Swiss franc cards across sectors: value of transactions, number of cards and value per card; descriptive numbers and estimates.

Notes: The shaded ribbons along the red, yellow and blue lines denote the 95% confidence intervals that are derived from the estimated coefficients' standard errors. The Swiss real exchange rate is the inverted average of 37 bilateral exchange rates, weighted by the 2013 Swiss tourism expenses, which can be downloaded from the SNB's data portal: https://data.snb.ch/en (downloaded on 19th December 2023). Note that for food and beverage services, the intensive margin measure is a more reliable consumption indicator than the extensive margin measure is. As the descriptive numbers in the figure reveal, the strong growth in overall food and beverage service consumption was likely driven by a strong increase in cashless payments within that sector.

2.5 Normalized consumption across price segments

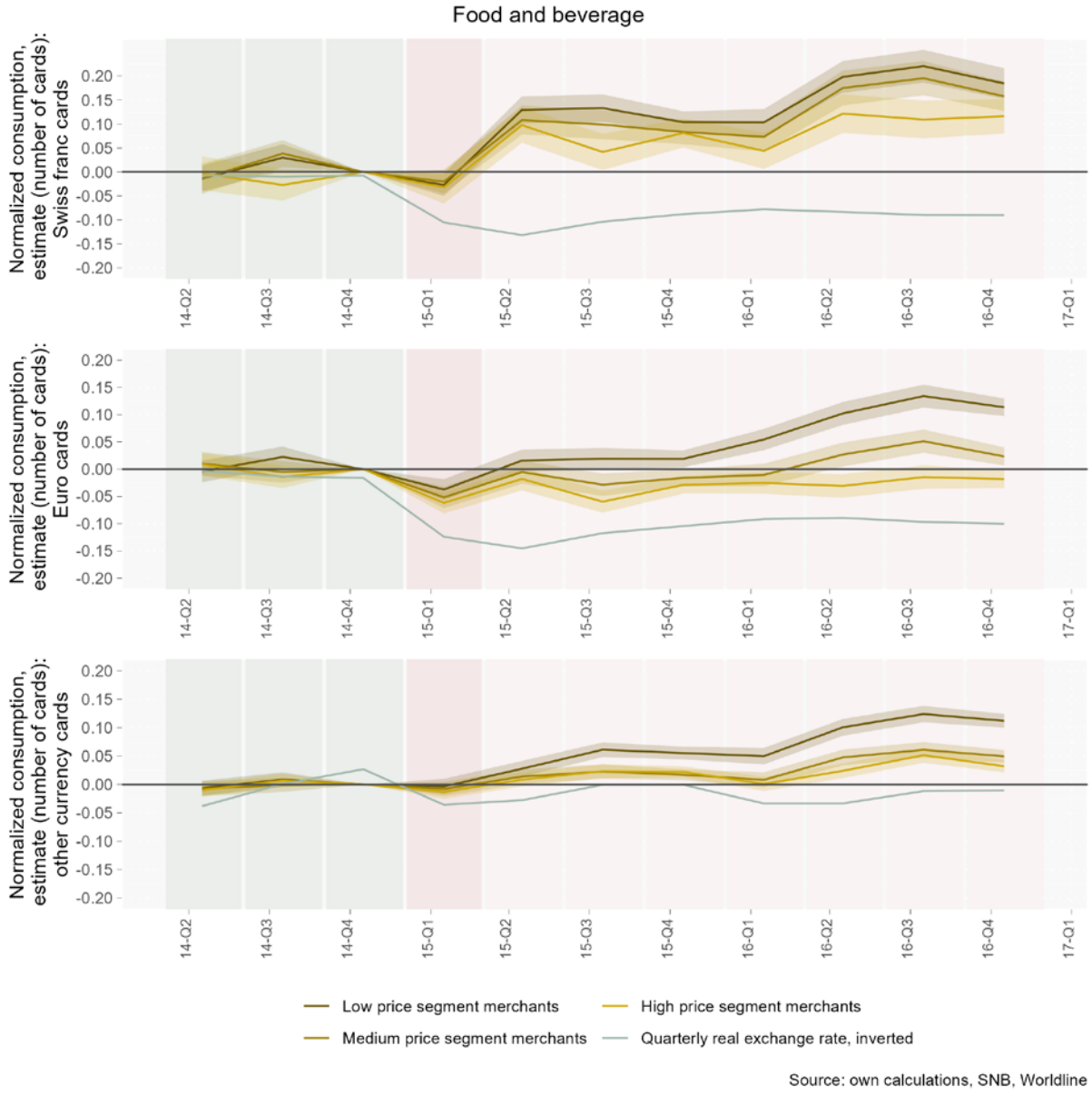

Figure 13: Quarterly normalized consumption for the three currency groups in food and beverage services for low-, medium- and high-price segment merchants: number of cards; estimates.

Notes: The shaded ribbons along the red lines denote the 95% confidence intervals that are derived from the estimated coefficients' standard errors. The Swiss real exchange rate is the inverted average of 37 bilateral exchange rates, weighted by the 2013 Swiss tourism expenses, which can be downloaded from the SNB's data portal: https://data.snb.ch/en (downloaded on 19th December 2023). The non-Swiss franc real exchange rates are the inverted average of the countries' real exchange rates, weighted by the 2013-Q2 to 2014-Q1 country-level value of payment transactions.

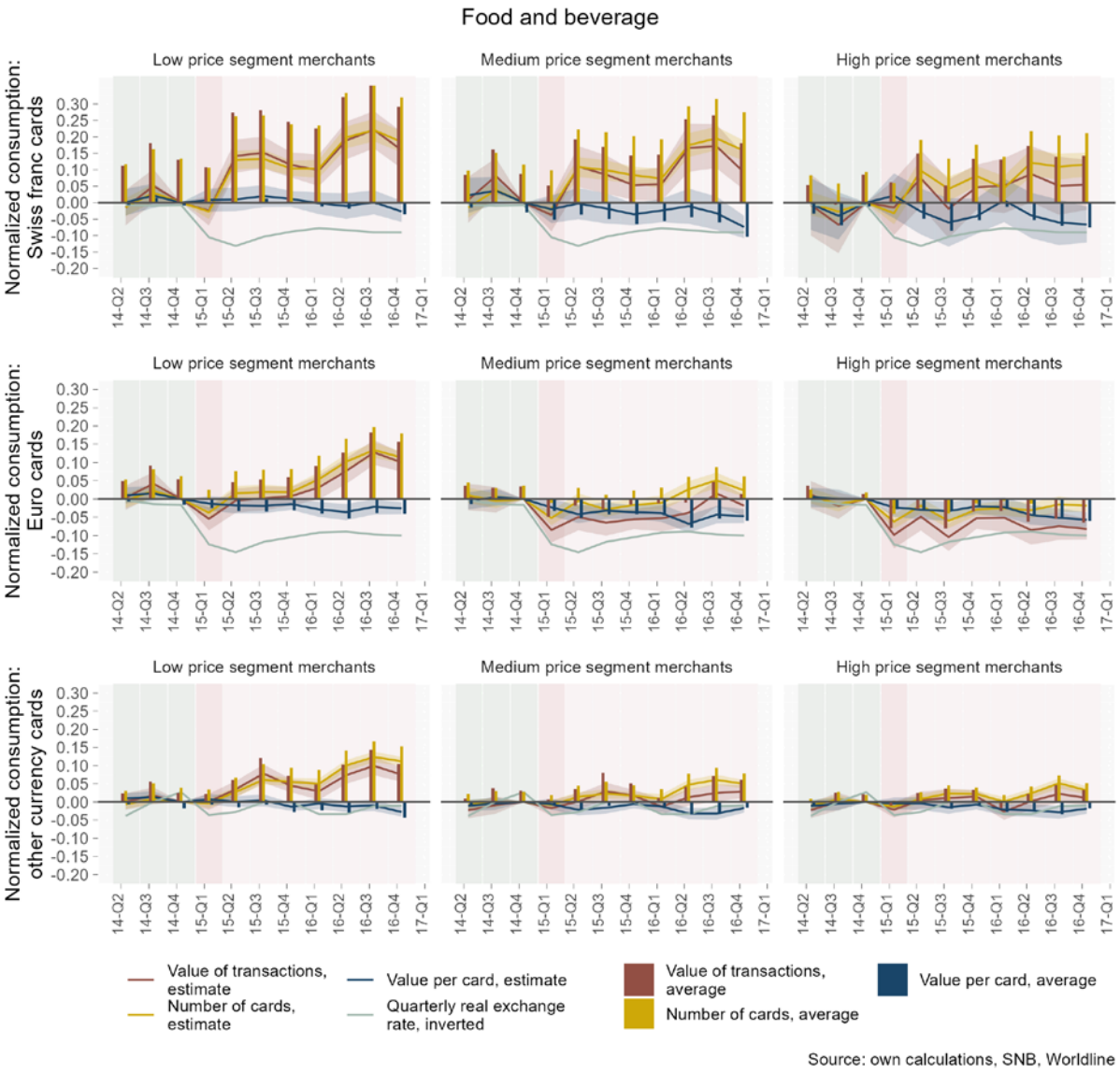

Figure 14: Quarterly normalized consumption for the three currency groups in food and beverage services for low-, medium- and high-price segment merchants: value of transactions, number of cards and value per card; descriptive numbers and estimates.

Notes: The shaded ribbons along the red, yellow and blue lines denote the 95% confidence intervals that are derived from the estimated coefficients' standard errors. The averages of the value of transactions and the value per card are weighted by the 2013-Q2 to 2014-Q1 country-level value of payment transactions. The averages of the number of cards are weighted by the 2013-Q2 to 2014-Q1 country-level number of payment cards. The Swiss real exchange rate is the inverted average of 37 bilateral exchange rates, weighted by the 2013 Swiss tourism expenses, which can be downloaded from the SNB's data portal: https://data.snb.ch/en (downloaded on 19th December 2023). The non-Swiss franc real exchange rates are the inverted average of the countries' real exchange rates, weighted by the 2013-Q2 to 2014-Q1 country-level value of payment transactions.

2.6 Foreign normalized consumption in touristic and non-touristic areas

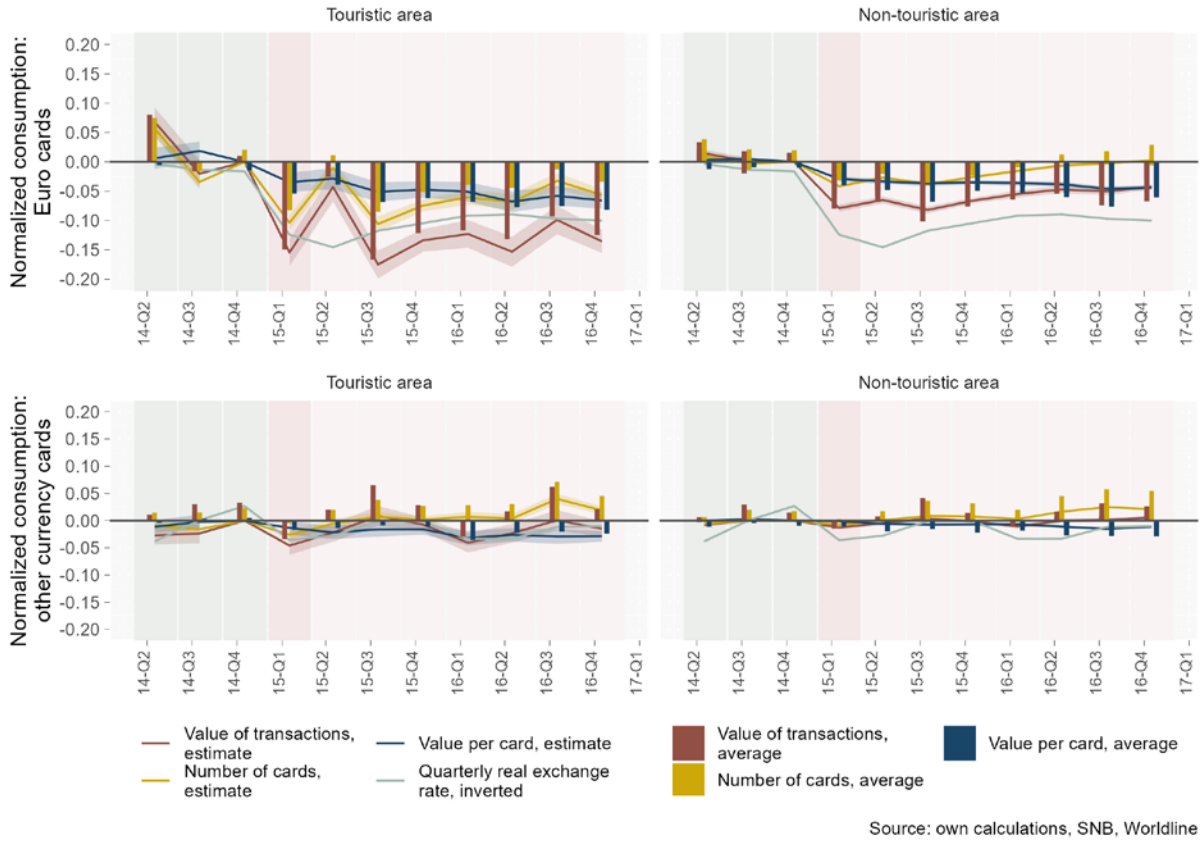

Figure 15: Quarterly normalized consumption for Euro and other currency cards in touristic and non-touristic areas: value of transactions, number of cards and value per card; descriptive numbers and estimates.

Notes: The shaded ribbons along the red, yellow and blue lines denote the 95% confidence intervals that are derived from the estimated coefficients' standard errors. The averages of the value of transactions and the value per card are weighted by the 2013-Q2 to 2014-Q1 country-level value of payment transactions. The averages of the number of cards are weighted by the 2013-Q2 to 2014-Q1 country-level number of payment cards. The real exchange rates are the inverted average of the countries' real exchange rates, weighted by the 2013-Q2 to 2014-Q1 country-level value of payment transactions.

3 Event study regression tables

3.1 Total normalized consumption

Outcome variable:	NC: value of transactions	NC: number of cards	NC: value per card
$D_{t=-3}$	0.02**	0.01***	0.01
	(0.01)	(0.00)	(0.01)
$D_{t=-2}$	0.00	-0.01***	0.00
	(0.01)	(0.00)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	-0.04***	-0.03***	-0.02***
	(0.01)	(0.00)	(0.01)
$D_{t=1}$	0.00	0.02***	-0.02***
	(0.01)	(0.00)	(0.01)
$D_{t=2}$	-0.02***	0.00*	-0.02***
	(0.01)	(0.00)	(0.01)
$D_{t=3}$	-0.03***	0.00	-0.03***
	(0.01)	(0.00)	(0.00)
$D_{t=4}$	-0.04***	-0.01***	-0.03***
	(0.01)	(0.00)	(0.01)
$D_{t=5}$	-0.03***	0.01***	-0.04***
	(0.01)	(0.00)	(0.01)
$D_{t=6}$	-0.03***	0.01***	-0.04***
	(0.01)	(0.00)	(0.01)
$D_{t=7}$	-0.04***	0.00	-0.05***
	(0.01)	(0.00)	(0.00)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	29,418	29,418	29,418
Number of countries	55	55	55
Number of quarters	11	11	11
Number of observations	15,876,987	15,876,987	15,876,987
R2, adjusted R2	0.32, 0.24	0.46, 0.39	0.25, 0.16

Table 4: Quarterly total normalized consumption: value of transactions, number of cards and value per card.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

3.2 Normalized consumption across currency groups

Subsample:	Swiss franc cards	Euro cards	Other currency cards
Outcome variable:	NC: value of transactions	NC: value of transactions	NC: value of transactions
$D_{t=-3}$	0.02***	0.02***	-0.01***
	(0.01)	(0.00)	(0.00)
$D_{t=-2}$	0.00	0.00	0.00
	(0.01)	(0.00)	(0.00)
$D_{t=-1}$			
$D_{t=0}$	-0.04***	-0.09***	-0.02***
	(0.01)	(0.00)	(0.00)
$D_{t=1}$	0.01	-0.06***	-0.01***
	(0.01)	(0.00)	(0.00)
$D_{t=2}$	-0.02***	-0.09***	0.00**
	(0.01)	(0.00)	(0.00)
$D_{t=3}$	-0.03***	-0.07***	0.00
	(0.01)	(0.00)	(0.00)
$D_{t=4}$	-0.04***	-0.06***	-0.01***
	(0.01)	(0.00)	(0.00)
$D_{t=5}$	-0.03***	-0.06***	0.00
	(0.01)	(0.00)	(0.00)
$D_{t=6}$	-0.03***	-0.05***	0.00
	(0.01)	(0.00)	(0.00)
$D_{t=7}$	-0.05***	-0.05***	0.00***
	(0.01)	(0.00)	(0.00)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	29,402	29,418	29,418
Number of countries	1	19	35
Number of quarters	11	11	11
Number of observations	317,317	5,378,596	10,181,074
R2, adjusted R2	0.32, 0.25	0.28, 0.20	0.31, 0.24

Table 5: Quarterly normalized consumption for the three currency groups: value of transactions.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Swiss franc cards	Euro cards	Other currency cards
Outcome variable:	NC: number of cards	NC: number of cards	NC: number of cards
$D_{t=-3}$	0.01***	0.01***	-0.01***
	(0.00)	(0.00)	(0.00)
$D_{t=-2}$	-0.01***	-0.01***	0.00
	(0.00)	(0.00)	(0.00)
$D_{t=-1}$			
$D_{t=0}$	-0.03***	-0.05***	-0.01***
	(0.00)	(0.00)	(0.00)
$D_{t=1}$	0.03***	-0.03***	0.00
	(0.00)	(0.00)	(0.00)
$D_{t=2}$	0.00*	-0.04***	0.01***
	(0.00)	(0.00)	(0.00)
$D_{t=3}$	0.01***	-0.03***	0.01***
	(0.00)	(0.00)	(0.00)
$D_{t=4}$	-0.02***	-0.02***	0.00***
	(0.00)	(0.00)	(0.00)
$D_{t=5}$	0.01***	-0.01***	0.02***
	(0.00)	(0.00)	(0.00)
$D_{t=6}$	0.01***	0.00***	0.03***
	(0.00)	(0.00)	(0.00)
$D_{t=7}$	0.00	0.00**	0.02***
	(0.00)	(0.00)	(0.00)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	29,402	29,418	29,418
Number of countries	1	19	35
Number of quarters	11	11	11
Number of observations	317,317	5,378,596	10,181,074
R2, adjusted R2	0.48, 0.43	0.34, 0.26	0.36, 0.29

Table 6: Quarterly normalized consumption for the three currency groups: number of cards.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Swiss franc cards	Euro cards	Other currency cards
Outcome variable:	NC: value per card	NC: value per card	NC: value per card
$D_{t=-3}$	0.01	0.00*	0.00
	(0.01)	(0.00)	(0.00)
$D_{t=-2}$	0.00	0.01***	0.00
	(0.01)	(0.00)	(0.00)
$D_{t=-1}$			
$D_{t=0}$	-0.02**	-0.03***	0.00
	(0.01)	(0.00)	(0.00)
$D_{t=1}$	-0.02***	-0.03***	-0.01***
	(0.01)	(0.00)	(0.00)
$D_{t=2}$	-0.02***	-0.04***	-0.01***
	(0.01)	(0.00)	(0.00)
$D_{t=3}$	-0.03***	-0.04***	-0.01***
	(0.00)	(0.00)	(0.00)
$D_{t=4}$	-0.03***	-0.04***	-0.01***
	(0.01)	(0.00)	(0.00)
$D_{t=5}$	-0.04***	-0.04***	-0.01***
	(0.01)	(0.00)	(0.00)
$D_{t=6}$	-0.05***	-0.05***	-0.02***
	(0.01)	(0.00)	(0.00)
$D_{t=7}$	-0.05***	-0.05***	-0.01***
	(0.00)	(0.00)	(0.00)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	29,402	29,418	29,418
Number of countries	1	19	35
Number of quarters	11	11	11
Number of observations	317,317	5,378,596	10,181,074
R2, adjusted R2	0.25, 0.17	0.25, 0.17	0.26, 0.18

Table 7: Quarterly normalized consumption for the three currency groups: value per card.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

3.3 Domestic normalized consumption across sectors

Subsample:	Swiss franc cards	Swiss franc cards	Swiss franc cards
Outcome variable:	NC: value of transactions	NC: number of cards	NC: value per card
$D_{t=-3}$	0.03***	0.02***	0.01*
	(0.01)	(0.00)	(0.01)
$D_{t=-2}$	0.00	-0.01**	0.01
	(0.01)	(0.00)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	-0.04***	-0.02***	-0.02**
	(0.01)	(0.00)	(0.01)
$D_{t=1}$	-0.01	0.02***	-0.02***
	(0.01)	(0.00)	(0.01)
$D_{t=2}$	-0.03***	-0.01***	-0.02***
	(0.01)	(0.00)	(0.01)
$D_{t=3}$	-0.05***	-0.01***	-0.04***
	(0.01)	(0.00)	(0.01)
$D_{t=4}$	-0.07***	-0.03***	-0.03***
	(0.01)	(0.00)	(0.01)
$D_{t=5}$	-0.05***	-0.01***	-0.04***
	(0.01)	(0.00)	(0.01)
$D_{t=6}$	-0.07***	-0.02***	-0.05***
	(0.01)	(0.00)	(0.01)
$D_{t=7}$	-0.08***	-0.03***	-0.05***
	(0.01)	(0.00)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	20'662	20'662	20'662
Number of countries	55	55	55
Number of quarters	11	11	11
Number of observations	222'940	222'940	222'940
R2, adjusted R2	0.31, 0.24	0.47, 0.42	0.24, 0.17

Table 8: Quarterly normalized Swiss franc consumption in retail trade.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Swiss franc cards	Swiss franc cards	Swiss franc cards
Outcome variable:	NC: value of transactions	NC: number of cards	NC: value per card
$D_{t=-3}$	-0.03*	0.00	-0.03**
	(0.02)	(0.01)	(0.01)
$D_{t=-2}$	-0.02	0.00	-0.02
	(0.02)	(0.01)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	-0.03**	-0.02***	-0.02
	(0.02)	(0.01)	(0.01)
$D_{t=1}$	0.00	0.01**	-0.02
	(0.02)	(0.01)	(0.01)
$D_{t=2}$	-0.01	0.00	-0.02
	(0.02)	(0.01)	(0.02)
$D_{t=3}$	0.00	0.00	0.00
	(0.01)	(0.00)	(0.01)
$D_{t=4}$	-0.03**	-0.02**	-0.02
	(0.02)	(0.01)	(0.01)
$D_{t=5}$	-0.02	0.01	-0.03**
	(0.02)	(0.01)	(0.02)
$D_{t=6}$	-0.01	0.00	-0.02
	(0.02)	(0.01)	(0.01)
$D_{t=7}$	-0.03**	0.00	-0.02**
	(0.01)	(0.01)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	3'719	3'719	3'719
Number of countries	55	55	55
Number of quarters	11	11	11
Number of observations	40'392	40'392	40'392
R2, adjusted R2	0.33, 0.26	0.51, 0.46	0.25, 0.18

Table 9: Quarterly normalized Swiss franc consumption in personal services.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Swiss franc cards	Swiss franc cards	Swiss franc cards
Outcome variable:	NC: value of transactions	NC: number of cards	NC: value per card
$D_{t=-3}$	0.00	-0.01	0.01
	(0.02)	(0.01)	(0.02)
$D_{t=-2}$	0.02	0.01	0.01
	(0.02)	(0.01)	(0.02)
$D_{t=-1}$			
$D_{t=0}$	-0.04**	-0.03***	0.00
	(0.02)	(0.01)	(0.01)
$D_{t=1}$	0.12***	0.11***	0.00
	(0.02)	(0.01)	(0.02)
$D_{t=2}$	0.08***	0.09***	-0.01
	(0.02)	(0.01)	(0.02)
$D_{t=3}$	0.07***	0.09***	-0.02*
	(0.01)	(0.01)	(0.01)
$D_{t=4}$	0.07***	0.07***	-0.01
	(0.02)	(0.01)	(0.01)
$D_{t=5}$	0.14***	0.16***	-0.02
	(0.02)	(0.01)	(0.02)
$D_{t=6}$	0.15***	0.17***	-0.03*
	(0.02)	(0.01)	(0.02)
$D_{t=7}$	0.11***	0.16***	-0.05***
	(0.02)	(0.01)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	3'298	3'298	3'298
Number of countries	55	55	55
Number of quarters	11	11	11
Number of observations	35'785	35'785	35'785
R2, adjusted R2	0.39, 0.33	0.5, 0.45	0.29, 0.22

Table 10: Quarterly normalized Swiss franc consumption in food and beverage services.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Swiss franc cards	Swiss franc cards	Swiss franc cards
Outcome variable:	NC: value of transactions	NC: number of cards	NC: value per card
$D_{t=-3}$	0.03	0.03**	-0.01
	(0.05)	(0.02)	(0.04)
$D_{t=-2}$	-0.11**	-0.08***	-0.03
	(0.05)	(0.01)	(0.04)
$D_{t=-1}$			
$D_{t=0}$	-0.08*	-0.06***	-0.01
	(0.05)	(0.01)	(0.04)
$D_{t=1}$	0.02	0.06***	-0.05
	(0.05)	(0.02)	(0.04)
$D_{t=2}$	-0.05	0.01	-0.06
	(0.04)	(0.02)	(0.04)
$D_{t=3}$	0.02	0.04***	-0.02
	(0.03)	(0.01)	(0.03)
$D_{t=4}$	0.01	0.01	0.00
	(0.05)	(0.01)	(0.04)
$D_{t=5}$	-0.05	0.03*	-0.08**
	(0.05)	(0.02)	(0.04)
$D_{t=6}$	-0.03	0.07***	-0.1***
	(0.05)	(0.02)	(0.04)
$D_{t=7}$	-0.01	0.05***	-0.06**
	(0.04)	(0.01)	(0.03)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	1'723	1'723	1'723
Number of countries	55	55	55
Number of quarters	11	11	11
Number of observations	18'200	18'200	18'200
R2, adjusted R2	0.30, 0.22	0.40, 0.34	0.26, 0.18

Table 11: Quarterly normalized Swiss franc consumption in accommodations.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

3.4 Normalized consumption across price segments

Regression tables for low-price segment merchants

Subsample:	Swiss franc cards	Euro cards	Other currency cards
Outcome variable:	NC: value of transactions	NC: value of transactions	NC: value of transactions
$D_{t=-3}$	-0.02	0.00	0.00
	(0.03)	(0.02)	(0.01)
$D_{t=-2}$	0.05*	0.04***	0.02
	(0.03)	(0.02)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	-0.02	-0.05***	0.00
	(0.02)	(0.02)	(0.01)
$D_{t=1}$	0.14***	0.00	0.03***
	(0.03)	(0.02)	(0.01)
$D_{t=2}$	0.15***	0.00	0.08***
	(0.02)	(0.02)	(0.01)
$D_{t=3}$	0.11***	0.01	0.04***
	(0.02)	(0.01)	(0.01)
$D_{t=4}$	0.10***	0.03*	0.03**
	(0.02)	(0.02)	(0.01)
$D_{t=5}$	0.19***	0.08***	0.07***
	(0.03)	(0.02)	(0.01)
$D_{t=6}$	0.22***	0.13***	0.1***
	(0.03)	(0.02)	(0.01)
$D_{t=7}$	0.16***	0.1***	0.08***
	(0.03)	(0.01)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	1'034	1'035	1'035
Number of countries	1	19	35
Number of quarters	11	11	11
Number of observations	11'248	177'852	332'028
R2, adjusted R2	0.41, 0.34	0.32, 0.23	0.35, 0.27

Table 12: Quarterly normalized consumption for the three currency groups at low-price segment merchants: value of transactions.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Swiss franc cards	Euro cards	Other currency cards
Outcome variable:	NC: number of cards	NC: number of cards	NC: number of cards
$D_{t=-3}$	-0.01	0.00	-0.01
	(0.01)	(0.01)	(0.01)
$D_{t=-2}$	0.03**	0.02**	0.01
	(0.01)	(0.01)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	-0.03**	-0.04***	0.00
	(0.01)	(0.01)	(0.01)
$D_{t=1}$	0.13***	0.02	0.03***
	(0.01)	(0.01)	(0.01)
$D_{t=2}$	0.13***	0.02*	0.06***
	(0.01)	(0.01)	(0.01)
$D_{t=3}$	0.10***	0.02**	0.06***
	(0.01)	(0.01)	(0.01)
$D_{t=4}$	0.10***	0.05***	0.05***
	(0.01)	(0.01)	(0.01)
$D_{t=5}$	0.20***	0.10***	0.10***
	(0.02)	(0.01)	(0.01)
$D_{t=6}$	0.22***	0.13***	0.12***
	(0.02)	(0.01)	(0.01)
$D_{t=7}$	0.18***	0.11***	0.11***
	(0.02)	(0.01)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	1'034	1'035	1'035
Number of countries	1	19	35
Number of quarters	11	11	11
Number of observations	11'248	177'852	332'028
R2, adjusted R2	0.51, 0.46	0.38, 0.31	0.43, 0.36

Table 13: Quarterly normalized consumption for the three currency groups at low-price segment merchants: number of cards.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Swiss franc cards	Euro cards	Other currency cards
Outcome variable:	NC: value per card	NC: value per card	NC: value per card
$D_{t=-3}$	0.00	0.01	0.01
	(0.02)	(0.01)	(0.01)
$D_{t=-2}$	0.02	0.02	0.01*
	(0.02)	(0.01)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	0.01	-0.01	0.01
	(0.02)	(0.01)	(0.01)
$D_{t=1}$	0.01	-0.02	0.00
	(0.02)	(0.01)	(0.01)
$D_{t=2}$	0.02	-0.02*	0.00
	(0.02)	(0.01)	(0.01)
$D_{t=3}$	0.01	-0.01	-0.01**
	(0.01)	(0.01)	(0.01)
$D_{t=4}$	0.00	-0.03***	0.00
	(0.02)	(0.01)	(0.01)
$D_{t=5}$	-0.01	-0.04***	-0.01
	(0.02)	(0.01)	(0.01)
$D_{t=6}$	0.00	-0.02**	-0.01
	(0.02)	(0.01)	(0.01)
$D_{t=7}$	-0.03*	-0.03***	-0.03***
	(0.02)	(0.01)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	1'034	1'035	1'035
Number of countries	1	19	35
Number of quarters	11	11	11
Number of observations	11'248	177'852	332'028
R2, adjusted R2	0.31, 0.24	0.25, 0.15	0.27, 0.19

Table 14: Quarterly normalized consumption for the three currency groups at low-price segment merchants: value per card.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Regression tables for medium-price segment merchants

Subsample:	Swiss franc cards	Euro cards	Other currency cards
Outcome variable:	NC: value of transactions	NC: value of transactions	NC: value of transactions
$D_{t=-3}$	0.01	0.01	-0.02**
	(0.04)	(0.02)	(0.01)
$D_{t=-2}$	0.08***	0.00	-0.01
	(0.03)	(0.02)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	-0.04	-0.08***	-0.02
	(0.03)	(0.02)	(0.01)
$D_{t=1}$	0.11***	-0.05***	0.00
	(0.03)	(0.02)	(0.01)
$D_{t=2}$	0.09***	-0.06***	0.03**
	(0.03)	(0.02)	(0.01)
$D_{t=3}$	0.05**	-0.06***	0.02**
	(0.02)	(0.01)	(0.01)
$D_{t=4}$	0.06**	-0.05***	-0.01
	(0.03)	(0.02)	(0.01)
$D_{t=5}$	0.17***	-0.04*	0.01
	(0.04)	(0.02)	(0.01)
$D_{t=6}$	0.17***	0.02	0.02**
	(0.03)	(0.02)	(0.01)
$D_{t=7}$	0.09***	-0.02	0.03***
	(0.03)	(0.01)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	979	981	981
Number of countries	1	19	35
Number of quarters	11	11	11
Number of observations	10'656	171'720	324'892
R2, adjusted R2	0.43, 0.37	0.28, 0.19	0.33, 0.25

Table 15: Quarterly normalized consumption for the three currency groups at medium-price segment merchants: value of transactions.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Swiss franc cards	Euro cards	Other currency cards
Outcome variable:	NC: number of cards	NC: number of cards	NC: number of cards
$D_{t=-3}$	-0.01	0.01	-0.01
	(0.02)	(0.01)	(0.01)
$D_{t=-2}$	0.04***	-0.01	0.00
	(0.01)	(0.01)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	-0.02	-0.05***	-0.01
	(0.01)	(0.01)	(0.01)
$D_{t=1}$	0.11***	-0.01	0.01**
	(0.02)	(0.01)	(0.01)
$D_{t=2}$	0.10***	-0.03***	0.02***
	(0.02)	(0.01)	(0.01)
$D_{t=3}$	0.08***	-0.02**	0.02***
	(0.01)	(0.01)	(0.00)
$D_{t=4}$	0.07***	-0.01	0.01
	(0.02)	(0.01)	(0.01)
$D_{t=5}$	0.18***	0.03**	0.05***
	(0.02)	(0.01)	(0.01)
$D_{t=6}$	0.2***	0.05***	0.06***
	(0.02)	(0.01)	(0.01)
$D_{t=7}$	0.16***	0.02***	0.05***
	(0.02)	(0.01)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	979	981	981
Number of countries	1	19	35
Number of quarters	11	11	11
Number of observations	10'656	171'720	324'892
R2, adjusted R2	0.54, 0.49	0.31, 0.23	0.36, 0.28

Table 16: Quarterly normalized consumption for the three currency groups at medium-price segment merchants: number of cards.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Swiss franc cards	Euro cards	Other currency cards
Outcome variable:	NC: value per card	NC: value per card	NC: value per card
$D_{t=-3}$	0.02	0.00	-0.01
	(0.03)	(0.01)	(0.01)
$D_{t=-2}$	0.04*	0.00	0.00
	(0.02)	(0.01)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	-0.02	-0.02*	-0.01
	(0.02)	(0.01)	(0.01)
$D_{t=1}$	0.00	-0.04***	-0.02***
	(0.02)	(0.01)	(0.01)
$D_{t=2}$	-0.02	-0.03***	-0.02**
	(0.02)	(0.01)	(0.01)
$D_{t=3}$	-0.04**	-0.04***	-0.01
	(0.02)	(0.01)	(0.01)
$D_{t=4}$	-0.02	-0.04***	-0.01
	(0.02)	(0.01)	(0.01)
$D_{t=5}$	-0.01	-0.07***	-0.03***
	(0.03)	(0.01)	(0.01)
$D_{t=6}$	-0.03	-0.04***	-0.03***
	(0.03)	(0.01)	(0.01)
$D_{t=7}$	-0.07***	-0.05***	-0.02***
	(0.02)	(0.01)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	979	981	981
Number of countries	1	19	35
Number of quarters	11	11	11
Number of observations	10'656	171'720	324'892
R2, adjusted R2	0.30, 0.23	0.26, 0.17	0.26, 0.17

Table 17: Quarterly normalized consumption for the three currency groups at medium-price segment merchants: value per card.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Regression tables for high-price segment merchants

Subsample:	Swiss franc cards	Euro cards	Other currency cards
Outcome variable:	NC: value of transactions	NC: value of transactions	NC: value of transactions
$D_{t=-3}$	-0.01	0.01	-0.02**
	(0.05)	(0.02)	(0.01)
$D_{t=-2}$	-0.07	-0.02	0.00
	(0.04)	(0.02)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	-0.01	-0.10***	-0.02*
	(0.04)	(0.02)	(0.01)
$D_{t=1}$	0.07*	-0.05**	0.01
	(0.04)	(0.02)	(0.01)
$D_{t=2}$	-0.02	-0.10***	0.01
	(0.05)	(0.02)	(0.01)
$D_{t=3}$	0.05	-0.05***	0.01*
	(0.04)	(0.01)	(0.01)
$D_{t=4}$	0.05	-0.05**	-0.03**
	(0.04)	(0.02)	(0.01)
$D_{t=5}$	0.09**	-0.09***	0.00
	(0.04)	(0.02)	(0.01)
$D_{t=6}$	0.05	-0.07***	0.02*
	(0.05)	(0.02)	(0.01)
$D_{t=7}$	0.05	-0.08***	0.01
	(0.04)	(0.01)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	900	901	901
Number of countries	1	19	35
Number of quarters	11	11	11
Number of observations	9'711	160'410	303'878
R2, adjusted R2	0.39, 0.33	0.26, 0.17	0.31, 0.23

Table 18: Quarterly normalized consumption for the three currency groups at high-price segment merchants: value of transactions.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Swiss franc cards	Euro cards	Other currency cards
Outcome variable:	NC: number of cards	NC: number of cards	NC: number of cards
$D_{t=-3}$	0.00	0.01	-0.01*
	(0.02)	(0.01)	(0.01)
$D_{t=-2}$	-0.03	-0.01	0.01
	(0.02)	(0.01)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	-0.03*	-0.06***	-0.01**
	(0.02)	(0.01)	(0.01)
$D_{t=1}$	0.10***	-0.02*	0.01
	(0.02)	(0.01)	(0.01)
$D_{t=2}$	0.04**	-0.06***	0.02***
	(0.02)	(0.01)	(0.01)
$D_{t=3}$	0.08***	-0.03***	0.02***
	(0.02)	(0.01)	(0.00)
$D_{t=4}$	0.04**	-0.03**	0.00
	(0.02)	(0.01)	(0.01)
$D_{t=5}$	0.12***	-0.03***	0.02***
	(0.02)	(0.01)	(0.01)
$D_{t=6}$	0.11***	-0.01	0.05***
	(0.02)	(0.01)	(0.01)
$D_{t=7}$	0.12***	-0.02**	0.03***
	(0.02)	(0.01)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	900	901	901
Number of countries	1	19	35
Number of quarters	11	11	11
Number of observations	9'711	160'410	303'878
R2, adjusted R2	0.50, 0.45	0.30, 0.22	0.35, 0.28

Table 19: Quarterly normalized consumption for the three currency groups at high-price segment merchants: number of cards.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Swiss franc cards	Euro cards	Other currency cards
Outcome variable:	NC: value per card	NC: value per card	NC: value per card
$D_{t=-3}$	0.00	0.01	-0.01
	(0.04)	(0.01)	(0.01)
$D_{t=-2}$	-0.04	0.00	-0.01
	(0.04)	(0.01)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	0.02	-0.02*	0.00
	(0.03)	(0.01)	(0.01)
$D_{t=1}$	-0.03	-0.03**	0.00
	(0.04)	(0.01)	(0.01)
$D_{t=2}$	-0.06	-0.03**	-0.01
	(0.04)	(0.01)	(0.01)
$D_{t=3}$	-0.04	-0.02*	-0.01
	(0.03)	(0.01)	(0.01)
$D_{t=4}$	0.01	-0.02	-0.02**
	(0.03)	(0.01)	(0.01)
$D_{t=5}$	-0.04	-0.04***	-0.02***
	(0.04)	(0.01)	(0.01)
$D_{t=6}$	-0.06*	-0.05***	-0.03***
	(0.04)	(0.01)	(0.01)
$D_{t=7}$	-0.07**	-0.06***	-0.02***
	(0.03)	(0.01)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	900	901	901
Number of countries	1	19	35
Number of quarters	11	11	11
Number of observations	9'711	160'410	303'878
R2, adjusted R2	0.30, 0.23	0.25, 0.16	0.26, 0.18

Table 20: Quarterly normalized consumption for the three currency groups at high-price segment merchants: value per card.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

3.5 Foreign normalized consumption in touristic and non-touristic areas

Regression tables for merchants in touristic areas

Subsample:	Euro cards	Euro cards	Euro cards
Outcome variable:	NC: value of transactions	NC: number of cards	NC: value per card
$D_{t=-3}$	0.07***	0.06***	0.01
	(0.01)	(0.01)	(0.01)
$D_{t=-2}$	-0.02*	-0.03***	0.02**
	(0.01)	(0.01)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	-0.15***	-0.10***	-0.03***
	(0.01)	(0.01)	(0.01)
$D_{t=1}$	-0.04***	-0.01	-0.03***
	(0.01)	(0.01)	(0.01)
$D_{t=2}$	-0.17***	-0.11***	-0.05***
	(0.01)	(0.01)	(0.01)
$D_{t=3}$	-0.13***	-0.07***	-0.05***
	(0.01)	(0.01)	(0.01)
$D_{t=4}$	-0.12***	-0.06***	-0.05***
	(0.01)	(0.01)	(0.01)
$D_{t=5}$	-0.15***	-0.07***	-0.07***
	(0.01)	(0.01)	(0.01)
$D_{t=6}$	-0.10***	-0.03***	-0.06***
	(0.01)	(0.01)	(0.01)
$D_{t=7}$	-0.14***	-0.06***	-0.07***
	(0.01)	(0.01)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	2'468	2'468	2'468
Number of countries	55	55	55
Number of quarters	11	11	11
Number of observations	436'550	436'550	436'550
R2, adjusted R2	0.25, 0.16	0.30, 0.21	0.23, 0.14

Table 21: Quarterly normalized Euro card consumption in touristic areas.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Oher currency cards	Oher currency cards	Oher currency cards
Outcome variable:	NC: value of transactions	NC: number of cards	NC: value per card
$D_{t=-3}$	-0.03***	-0.01**	-0.01*
	(0.01)	(0.00)	(0.01)
$D_{t=-2}$	-0.02**	-0.02***	0.00
	(0.01)	(0.00)	(0.01)
$D_{t=-1}$			
$D_{t=0}$	-0.05***	-0.03***	-0.01**
	(0.01)	(0.00)	(0.01)
$D_{t=1}$	-0.02**	-0.01	-0.02***
	(0.01)	(0.00)	(0.01)
$D_{t=2}$	0.01	0.01*	-0.02**
	(0.01)	(0.00)	(0.01)
$D_{t=3}$	-0.01	0.00	-0.02***
	(0.01)	(0.00)	(0.00)
$D_{t=4}$	-0.04***	0.01	-0.03***
	(0.01)	(0.00)	(0.01)
$D_{t=5}$	-0.02***	0.00	-0.03***
	(0.01)	(0.00)	(0.01)
$D_{t=6}$	0.00	0.04***	-0.03***
	(0.01)	(0.00)	(0.01)
$D_{t=7}$	-0.02**	0.02***	-0.03***
	(0.01)	(0.00)	(0.01)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	2'468	2'468	2'468
Number of countries	55	55	55
Number of quarters	11	11	11
Number of observations	819'966	819'966	819'966
R2, adjusted R2	0.32, 0.24	0.36, 0.28	0.25, 0.16

Table 22: Quarterly normalized other currency card consumption in touristic areas.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Regression tables for merchants in non-touristic areas

Subsample:	Euro cards	Euro cards	Euro cards
Outcome variable:	NC: value of transactions	NC: number of cards	NC: value per card
$D_{t=-3}$	0.01***	0.01***	0.00
	(0.00)	(0.00)	(0.00)
$D_{t=-2}$	0.00	0.00*	0.01**
	(0.00)	(0.00)	(0.00)
$D_{t=-1}$			
$D_{t=0}$	-0.08***	-0.04***	-0.03***
	(0.00)	(0.00)	(0.00)
$D_{t=1}$	-0.06***	-0.03***	-0.03***
	(0.00)	(0.00)	(0.00)
$D_{t=2}$	-0.08***	-0.04***	-0.04***
	(0.00)	(0.00)	(0.00)
$D_{t=3}$	-0.07***	-0.03***	-0.03***
	(0.00)	(0.00)	(0.00)
$D_{t=4}$	-0.05***	-0.02***	-0.04***
	(0.00)	(0.00)	(0.00)
$D_{t=5}$	-0.05***	-0.01***	-0.04***
	(0.00)	(0.00)	(0.00)
$D_{t=6}$	-0.05***	0.00	-0.05***
	(0.00)	(0.00)	(0.00)
$D_{t=7}$	-0.04***	0.00*	-0.04***
	(0.00)	(0.00)	(0.00)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	26'950	26'950	26'950
Number of countries	55	55	55
Number of quarters	11	11	11
Number of observations	4'942'046	4'942'046	4'942'046
R2, adjusted R2	0.29, 0.21	0.34, 0.27	0.26, 0.17

Table 23: Quarterly normalized Euro card consumption in non-touristic areas.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Subsample:	Oher currency cards	Oher currency cards	Oher currency cards
Outcome variable:	NC: value of transactions	NC: number of cards	NC: value per card
$D_{t=-3}$	-0.01***	-0.01***	0.00
	(0.00)	(0.00)	(0.00)
$D_{t=-2}$	0.00	0.00	0.00*
	(0.00)	(0.00)	(0.00)
$D_{t=-1}$			
$D_{t=0}$	-0.01***	-0.01***	0.00
	(0.00)	(0.00)	(0.00)
$D_{t=1}$	0.00**	0.00	-0.01***
	(0.00)	(0.00)	(0.00)
$D_{t=2}$	0.00*	0.01***	-0.01***
	(0.00)	(0.00)	(0.00)
$D_{t=3}$	0.00	0.01***	-0.01***
	(0.00)	(0.00)	(0.00)
$D_{t=4}$	-0.01***	0.00***	-0.01***
	(0.00)	(0.00)	(0.00)
$D_{t=5}$	0.00	0.02***	-0.01***
	(0.00)	(0.00)	(0.00)
$D_{t=6}$	0.00	0.02***	-0.02***
	(0.00)	(0.00)	(0.00)
$D_{t=7}$	0.01***	0.02***	-0.01***
	(0.00)	(0.00)	(0.00)
Merchant-times-country fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	26'950	26'950	26'950
Number of countries	55	55	55
Number of quarters	11	11	11
Number of observations	9'361'108	9'361'108	9'361'108
R2, adjusted R2	0.31, 0.24	0.37, 0.29	0.26, 0.18

Table 24: Quarterly normalized other currency card consumption in non-touristic areas.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

4 Extensive and intensive margin elasticity regression tables

Outcome variable:	Consumption growth: number of cards		
real exchange rate growth R	-0.13***	-0.09***	
	(0.01)	(0.01)	
$D_{Swiss\ franc\ cards}$ * *real exchange rate growth R*			-0.01
			(0.01)
$D_{Euro\ cards}$ * *real exchange rate growth R*			-0.36***
			(0.01)
$D_{Other\ currency\ cards}$ * *real exchange rate growth R*			-0.05***
			(0.00)
GDP Y		0.86***	1.03***
		(0.06)	(0.06)
Merchant-times-country-times-quarter number fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	29,418	29,418	29,418
Number of countries	50	50	50
Number of periods	14	14	14
Number of observations	18,282,671	18,282,671	18,282,671
R2, adjusted R2	0.79, 0.70	0.79, 0.70	0.79, 0.70

Table 25: Elasticity regressions: number of cards.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

Outcome variable:	Consumption growth: value per card		
real exchange rate growth R	-0.06***	-0.09***	
	(0.01)	(0.01)	
$D_{Swiss\ franc\ cards}$ * *real exchange rate growth R*			-0.09***
			(0.01)
$D_{Euro\ cards}$ * *real exchange rate growth R*			-0.21***
			(0.01)
$D_{Other\ currency\ cards}$ * *real exchange rate growth R*			-0.05***
			(0.01)
GDP Y		-0.68***	-0.66***
		(0.13)	(0.13)
Merchant-times-country-times-quarter number fixed effects	yes	yes	yes
Country weights	yes	yes	yes
Number of merchants	29,418	29,418	29,418
Number of countries	50	50	50
Number of periods	14	14	14
Number of observations	18,282,671	18,282,671	18,282,671
R2, adjusted R2	0.45, 0.19	0.45, 0.19	0.45, 0.19

Table 26: Elasticity regressions: value per card.

Notes: Standard errors are clustered at the merchant-times-country level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
Sources: own calculations, SNB, Worldline

5 Cross-border shopping analysis: extensive margin figure and regression table

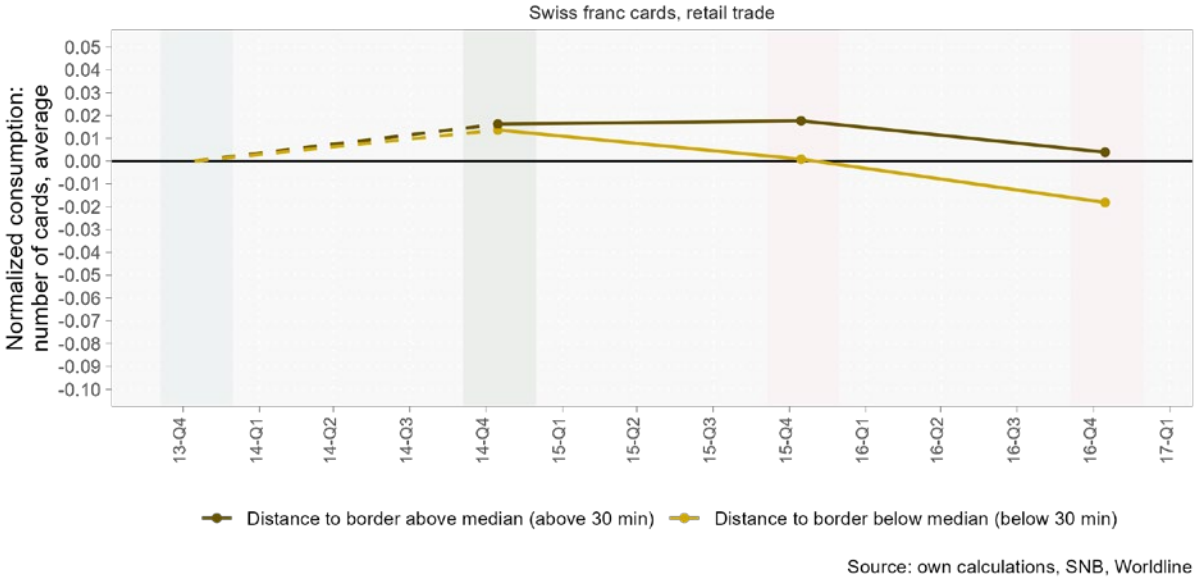

Figure 16: Fourth-quarter normalized consumption by constant Swiss franc cards at merchants with below- and above-median distance to border: number of cards.

Notes: The first fourth-quarter observation of the normalized consumption is available for 2014. The 2013 normalized consumption would be 0 and the 2014-to-2013 development of normalized consumption is indicated by the dotted lines.

Subsample:	Swiss franc cards, retail trade	
Outcome variable:	Normalized consumption: number of cards	
2014-Q4 pre period vs.	2015-Q4 post period	2016-Q4 post period
post	-0.03***	-0.05***
	(0.01)	(0.01)
post ln(distance)*	0.01***	0.01***
	(0.00)	(0.00)
Merchant fixed effects	yes	yes
Country weights	no	no
Number of merchants	19,289	19,289
Number of countries	1	1
Number of periods	2	2
Number of observations	38,578	38,578
R2, adjusted R2	0.82, 0.63	0.77, 0.53

Table 27: Regressions of fourth-quarter normalized consumption on distance to border treatment intensity: number of cards.

Notes: Standard errors are clustered at the merchant level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Sources: own calculations, SNB, Worldline

6 Within-merchant price segment analysis regression tables

6.1 Regression tables for the Swiss card sample

Interdecile range	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
time	0.00	0.00	0.00	0.00	0.00*	0.00*	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
post	-0.02***	-0.01***	-0.01***	-0.01***	-0.01***	-0.02***	-0.01***	-0.01***	-0.02***	-0.02***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Merchant-times-day-										
times-hour fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of merchants	12,737	16,310	18,281	20,137	20,651	20,788	21,088	21,793	23,118	21,780
Number of countries	1	1	1	1	1	1	1	1	1	1
Number of observations	617,526	620,475	626,718	618,501	603,429	617,735	616,326	618,045	616,368	617,069
R2, adjusted R2	0.46, 0.19	0.48, 0.10	0.5, 0.09	0.55, 0.12	0.53, 0.05	0.51, 0.02	0.51, 0.03	0.51, 0.03	0.52, 0.06	0.55, 0.21

Table 28: Within-merchant price segment regressions for Swiss franc cards: control sample.

Notes: Standard errors are clustered at the merchant level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Sources: own calculations, SNB, Worldline

Interdecile range	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
time	0.00*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
post	-0.01*	-0.03***	-0.04***	-0.04***	-0.04***	-0.03***	-0.04***	-0.03***	-0.03***	-0.02***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Merchant-times-day-										
times-hour fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of merchants	12,431	15,067	18,208	19,580	20,365	20,808	20,819	22,230	23,379	22,072
Number of countries	1	1	1	1	1	1	1	1	1	1
Number of observations	662,100	661,116	659,339	660,224	661,106	660,628	659,198	660,090	660,522	660,041
R2, adjusted R2	0.43, 0.17	0.41, 0.06	0.48, 0.07	0.5, 0.06	0.52, 0.08	0.54, 0.10	0.53, 0.10	0.53, 0.09	0.51, 0.08	0.54, 0.21

Table 29: Within-merchant price segment regressions for Swiss franc cards: intervention sample.

Notes: Standard errors are clustered at the merchant level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Sources: own calculations, SNB, Worldline

6.2 Regression tables for the Euro card sample

Interdecile range	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
time	0.00	0.00**	0.00*	0.00	0.00	0.00	0.00	0.00	0.00	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
post	0.00	-0.05***	-0.07***	-0.05***	-0.04***	-0.02***	-0.01***	-0.01	0.01	-0.07*
	(0.03)	(0.01)	(0.02)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.04)
Merchant-times-day-										
times-hour fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of merchants	3,470	4,928	5,779	5,931	5,662	5,042	5,014	5,788	5,797	4,636
Number of countries	19	19	19	19	19	19	19	19	19	19
Number of observations	31,979	32,462	31,293	31,791	31,991	31,835	31,824	31,899	31,940	31,779
R2, adjusted R2	0.76, 0.39	0.78, 0.21	0.81, 0.20	0.82, 0.26	0.76, 0.16	0.68, 0.09	0.67, 0.04	0.77, 0.14	0.79, 0.23	0.83, 0.47

Table 30: Within-merchant price segment regressions for Euro cards: control sample.

Notes: Standard errors are clustered at the merchant level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Sources: own calculations, SNB, Worldline

Interdecile range	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
time	0.00	0.00	0.00**	0.00	0.00*	0.00*	0.00	0.00	0.00	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
post	-0.08***	-0.18***	-0.22***	-0.22***	-0.18***	-0.16***	-0.09***	-0.02*	0.01	-0.05
	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.04)
Merchant-times-day-times-hour fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of merchants	2,930	4,325	5,317	5,664	5,549	5,419	5,459	5,877	5,408	4,312
Number of countries	19	19	19	19	19	19	19	19	19	19
Number of observations	29,009	27,832	28,251	28,648	28,356	28,089	28,419	28,323	28,287	28,355
R2, adjusted R2	0.74, 0.36	0.84, 0.36	0.9, 0.55	0.92, 0.62	0.91, 0.63	0.88, 0.55	0.83, 0.32	0.82, 0.18	0.81, 0.29	0.84, 0.48

Table 31: Within-merchant price segment regressions for Euro cards: intervention sample.

Notes: Standard errors are clustered at the merchant level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Sources: own calculations, SNB, Worldline

6.3 Regression tables for the other currency card sample

Interdecile range	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
time	0.00	0.00***	0.00	0.00	0.00	0.00	0.00	0.00**	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
post	-0.01	0.00	-0.07***	-0.08***	-0.10***	-0.09***	-0.06***	-0.09***	0.00	0.06
	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.08)
Merchant-times-day-times-hour fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of merchants	2,336	2,832	3,587	4,023	4,263	4,261	4,173	3,746	3,175	2,374
Number of countries	35	35	35	35	35	35	35	35	35	35
Number of observations	18,723	17,584	18,244	18,067	17,974	18,157	18,082	18,107	18,108	18,115
R2, adjusted R2	0.78, 0.34	0.78, 0.22	0.81, 0.18	0.85, 0.23	0.87, 0.32	0.86, 0.26	0.84, 0.25	0.81, 0.21	0.76, 0.15	0.82, 0.44

Table 32: Within-merchant price segment regressions for other currency cards: control sample.

Notes: Standard errors are clustered at the merchant level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Sources: own calculations, SNB, Worldline

Interdecile range	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
time	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
post	-0.05	-0.09***	-0.07***	-0.09***	-0.12***	-0.09***	-0.07***	-0.04***	-0.03*	-0.09
	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.06)
Merchant-times-day-times-hour fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of merchants	2,107	2,929	3,398	3,734	4,203	4,225	4,136	3,610	3,099	2,321
Number of countries	35	35	35	35	35	35	35	35	35	35
Number of observations	17,619	17,706	17,442	17,553	17,816	17,375	17,565	17,687	17,422	17,571
R2, adjusted R2	0.78, 0.33	0.78, 0.22	0.82, 0.25	0.85, 0.28	0.88, 0.32	0.87, 0.29	0.84, 0.22	0.81, 0.24	0.77, 0.18	0.82, 0.45

Table 33: Within-merchant price segment regressions for other currency cards: intervention sample.

Notes: Standard errors are clustered at the merchant level and are presented in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Sources: own calculations, SNB, Worldline

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