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1 Introduction

Since the collapse of the Bretton Woods System of fixed exchange rates in 1972, an enormous body of research has documented the US dollar's dominance in world trade. A recent contribution from Boz et al. (2022) has highlighted the US dollar's global dominance and the relative stability and persistence of global currency shares used for invoicing international trade over long periods. Recently, major shocks to the global trading system have raised the question of whether other, less prominent currencies might rise in importance in the near or distant future, perhaps even challenging the dollar's global dominance. The rise of China as an economic power following its entry into the World Trade Organisation, the war in Ukraine and consequent economic sanctions against Russia, and Britain's departure from the European Union are potentially transformative political events with the power to change trade flows and the currencies in which these flows are invoiced.

In this paper, we examine a major political event, Britain's referendum vote in June 2016 to exit the European Union, and trace out the impact on the currencies used to invoice Britain's international trade. After the "Brexit vote," the sterling depreciated substantially, measures of Britain's economic policy uncertainty rose sharply, and the World Bank's measure of Britain's Government Effectiveness declined absolutely and relative to other countries.[1] Simultaneously, there was a swift decline in the share of British (extra-EU) exports invoiced in sterling. In this study, we use administrative data on *daily* trade transactions to investigate the sterling's decline as an invoicing currency during a period of dramatic political, institutional, and policy uncertainty. We introduce a novel decomposition to show that most of the decline occurred through two intensive margins: (1) continuously-trading firms which switched from sterling to dollars or local currencies and (2) continuously-trading sterling-loyal firms which reduced the total number of their sterling transactions.

The United Kingdom presents a particularly interesting case. Unlike previous research that observed highly stable shares of invoicing currencies over time (Ito and Kawai 2016; Maggiori, Neiman and Schreger 2019; Boz et al. 2022; Berthou, Horny and Mésonnier 2022), we document a significant change in the invoicing practices of UK exporters following the 2016 Brexit vote. The sterling's share of UK exports to extra-EU destinations decreased from 57% in early 2016 to 41% by 2019. This change coincided with rapid increases in the shares of the US dollar and other currencies.

A primary challenge in analyzing changes in aggregate trade shares is that they can be confounded by exchange rate movements. A depreciation of sterling mechanically reduces the value share of sterling-invoiced transactions while increasing the shares of all other currencies,

[1] See Online Appendix figure OA1-1 for time-series graphs of each.

even if there is no change in the underlying trade transactions of firms. With nearly a 15% depreciation of sterling after the Brexit vote, the mechanical effects can be substantial.[2]

Our study uses granular, transaction-level data from His Majesty's Revenue and Customs (HMRC) to minimize the mechanical effects. HMRC maintains records of the entire universe of customs transactions, including data at the firm, product, destination, and *date* level. The detailed invoicing information is available for extra-EU transactions over 2010-2019, which forms the basis of our analysis. By constructing share measures directly based on the number of *daily transactions*, our reported statistics are robust to mechanical changes in currency movements and more likely to reflect the true behavioural changes in firms' currency usage. We document a significant decline of 10.5 percentage points in sterling's *transaction share* for UK exports to extra-EU countries during the 2016-2019 period.

Our results show that the decline in sterling usage for trade invoicing was widespread across different geographic destinations. Building on Bernard, Jensen, Redding and Schott (2009), we introduce a novel decomposition method to examine the micro trade margins influencing the overall changes in invoicing currency. Our analysis reveals a *decrease* of 101.7k sterling transactions between 2016 and 2019. Notably, this reduction cannot be attributed to the conventional extensive margins of trade, i.e., the firm, geographic market, or product extensive margins. British firms, whether new to exporting or expanding into new markets, continue using the sterling throughout our study period. We observe positive contributions from the net firm entry margin (+36.2k), the net market entry margin (+38.2k), and the net product entry margin (+58.0k), indicating a cumulative *increase* of 132.4k in sterling transactions.

We identify two novel micro margins that are the main drivers behind the decline in the aggregate share of sterling-invoiced transactions between 2016 and 2019: (i) currency switches out of sterling among continuing firms in stable product markets (-86.0k) and (ii) an absolute decline in the number of transactions invoiced in sterling (-148.0k) among continuing firms in continuously operating product markets. The currency switching margin indicates proactive management of invoicing currencies by firms, even in established trade relationships. Notably, while this margin is small and close to zero during the stable period of January 2013 - May 2016, its contribution surged after the Brexit vote.[3] The second margin

[2]Consider the case of two currencies, the sterling and the US dollar, each accounting for 50% of export value. Suppose there is a sudden sterling depreciation of 15%; this would reduce the dollar value of sterling-invoiced exports (or would increase the sterling value of dollar-invoiced exports). Even if there is no change in the firms' currency choices, the new *value share* of sterling-invoiced trade decreases to 45.9% [= 0.85/(0.85+1)]. In contrast, our *transaction share*-based measure remains at 50% if there is no change in the firms' currency choices.

[3]See table 1 for more details. In general, our results highlight that the identified margins have different quantitative importance before and after the Brexit vote.

highlights that among continuing firms that had previously invoiced in sterling, those that continued to invoice in sterling engaged in fewer transactions than those firms that switched into alternative currencies. These findings pose new challenges to existing models that do not speak directly to currency switching and the role of currency choice on the frequency of trading.

Finally, our regression analysis underscores the significant influence of firm-level characteristics, such as firm size, the currency used for imports, and the size of foreign markets, on the currency switching decisions of continuing firms. We find that UK exporters that (i) relied more on dollar-invoiced imported inputs or (ii) served larger destination markets replaced the sterling with the dollar more frequently after the Brexit vote. Furthermore, larger firms showed a more pronounced shift towards local currency invoicing after June 2016.

Contribution to literature. The invoicing currency choice of firms plays a central role in the international transmission of shocks and has long been a focus of the international macro literature (Gopinath and Itskhoki 2022). Since prices tend to be sticky in the firm's invoicing currency, the currency composition of a country's international trade is a key predictor of aggregate exchange rate pass-through and its associated expenditure-switching as a result of currency movements.[4] Early research endeavoured to develop a theoretical framework to document macro and micro determinants of invoicing currency choice (Devereux, Engel and Storgaard 2004; Bacchetta and van Wincoop 2005; Engel 2006; Goldberg and Tille 2008; Gopinath, Itskhoki and Rigobon 2010). More recent research focused on empirically testing these determinants using transaction-level data for particular countries (Chung 2016; Goldberg and Tille 2016; Devereux, Dong and Tomlin 2017; Crowley, Han and Son 2021; Amiti, Itskhoki and Konings 2022; Berthou, Horny and Mésonnier 2022), as well as cross-country data (Goldberg and Tille 2008).

An important contribution of our research lies in its focus on an unusual change in invoicing currency induced by an unanticipated political event. Due to the well-known stability of invoicing currency shares, the prior literature focused on cross-sectional variations across firms or industries. Boz et al. (2022) highlight several countries, including Lithuania, Poland and Romania, that had a significant decline in their dollar invoicing shares from 1995 to 2015. Mukhin (2022) shows that these changes can be rationalized by the rise of their trade shares with the EU. In contrast, the swift change in invoicing currency among UK

[4]Thanks to the recent availability of invoicing data, there is increasing micro evidence on the tight linkage between the invoicing currency of firms and the corresponding exchange rate pass-through, see Gopinath, Itskhoki and Rigobon (2010), Barbiero (2020), Bonadio, Fischer and Sauré (2020), Corsetti, Crowley and Han (2022), Auer, Burstein and Lein (2021) and Chen, Chung and Novy (2021).

exports since 2016 was not coupled with any notable change in the UK's trade share with its major trade partners. Rather, our results suggest increased uncertainty surrounding UK government policy and the future value of the sterling following the 2016 Brexit vote had a quick and significant impact on British firms' currency choices.[5]

Relying on detailed transaction-level data and our new decomposition, we provide the first evidence on the relevant micro margins of adjustment for invoicing currency in response to a major unanticipated political event. In particular, we uncover two novel margins that are crucial to the aggregate changes in currency uses: the currency switch margin and the within-currency intensity of transacting margin. These two margins are typically overlooked by studies using more aggregated firm-product level trade flows, where only one record is observed in a certain period (usually a year). Our results naturally complement recent studies analysing the change in currency usage in response to economic sanctions using an event study approach (Berthou 2023, Chupilkin, Javorcik, Peeva and Plekhanov 2023) and those that examined the evolution of aggregate invoicing shares at the global scale (Boz et al. 2022, Mukhin 2022).

Finally, prior research has investigated the impact of firm characteristics, such as firm size (Goldberg and Tille 2016), and the currency used for imports (Chung 2016 and Amiti, Itskhoki and Konings 2022) in determining the choice of invoicing currency, primarily relying on cross-sectional variation in the data. We explore whether these factors play a significant role in explaining currency switches over time among UK exporters. Our findings corroborate the importance of firm size: larger UK exporters, who use more dollar-denominated imports, were significantly more likely to shift away from the sterling starting in 2016.

The rest of the paper is organized as follows. Section 2 examines the evolution of each invoicing currency in UK exports over time and across major destinations. Section 3 decomposes the changes in trade invoiced in each currency pre- and post-Brexit vote into different trade margins. Section 4 conducts a regression analysis to explore firm heterogeneity in Brexit-induced currency switches. Finally, section 5 concludes.

[5]Our findings on the rapid change in currency usage are consistent with the recent papers documenting notable changes in the invoicing currency usage by Russian importers and French exporters to Russia after the introduction of trade and financial sanctions on Russia (Berthou 2023, Chupilkin, Javorcik, Peeva and Plekhanov 2023). Unlike the Brexit vote studied in this paper, changes in Russian trade-invoicing are likely to be driven by a mixture of (1) the direct effect of trade and financial sanctions and (2) the indirect effect due to the uncertainty brought by the war and the sanctions. In contrast, the Brexit vote has no direct impact on the trade and financial costs for British firms selling to extra-EU trade partners and thus our results appear to be driven by uncertainty.

2 Evolution of invoicing currencies in UK exports

Our empirical analysis exploits a unique administrative dataset from HMRC, which maintains records of the entire universe of customs transactions conducted in the UK. For each transaction, the record contains information on the date of transaction, an anonymized firm identifier, an 8-digit Combined Nomenclature (CN) product code, the country of destination/origin, transaction value (expressed in sterling) and quantity. Importantly, the invoicing currency information is recorded for extra-EU trade transactions since January 2010. All UK importers must report their currency of invoicing for every transaction. UK exporters whose annual exports exceed £100,000 must report the invoicing currency for every transaction. Given the availability of data, our analysis focusses on the export transactions to extra-EU destinations over 2010-2019.[6]

Figure 1 shows the aggregate shares of major invoicing currencies used in UK exports to countries outside the EU from 2010 to 2019. Panel (a) shows that, in terms of trade value, the share of exports invoiced in the pound sterling (GBP) had been on a downward trend since the early 2010s, declining from 62.4% in 2010 to 56.7% in 2015. However, this decline accelerated starting in 2016, as indicated by the dashed line, with its share plummeting to 41.2% in 2019. We see a simultaneous surge in the share of the US Dollar (USD), which rose from 31.2% in 2010 to 48.2% in 2019. The ascent of the USD share was more pronounced during the post-Brexit vote period, culminating in its overtaking of the GBP share in 2019. Throughout this period, the share of UK exports invoiced in euros (EUR) to extra-EU destinations remained relatively stable within the range of 3% to 4%.

The sharp decline in the GBP share beginning in 2016 could be partly driven by the depreciation of its value following the Brexit referendum. Panel (b) presents the shares of each currency in terms of the number of transactions, which is robust to mechanical share changes resulting from exchange rate movements. The decline in the GBP share by transaction count is more gradual, falling from 62.9% to 52.4% between 2016 and 2019. This shift is still noteworthy, however, considering the traditionally stable nature of invoicing currencies (Boz et al. 2022).[7]

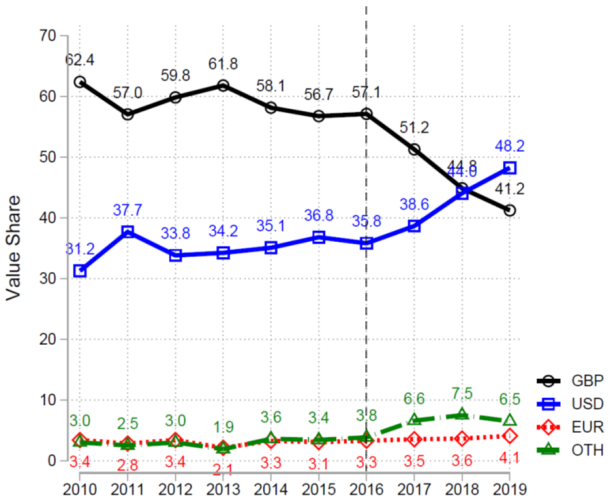
A noticeable trend in the behavior of UK exporters is the increasing adoption of 'other' non-dominant currencies since 2016. To delve deeper, we examine the evolution for the five most-used non-dominant currencies in UK export transactions, including the Swiss Franc

[6] We provide the corresponding results for UK imports in our Online Appendix.

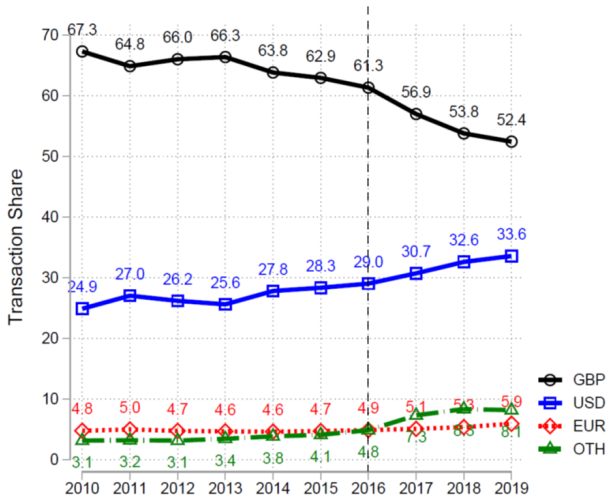
[7] In this paper, we focus on the medium-term shifts in firms' currency usage. In the short term, specifically within the first six months following the Brexit vote, the shares of currency transactions exhibited remarkable stability. This stability likely reflects the time required for contractual adjustments: transactions executed immediately after the Brexit vote were probably under contracts signed before the event.

Figure 1: Invoicing currencies in UK exports (2010-2019)

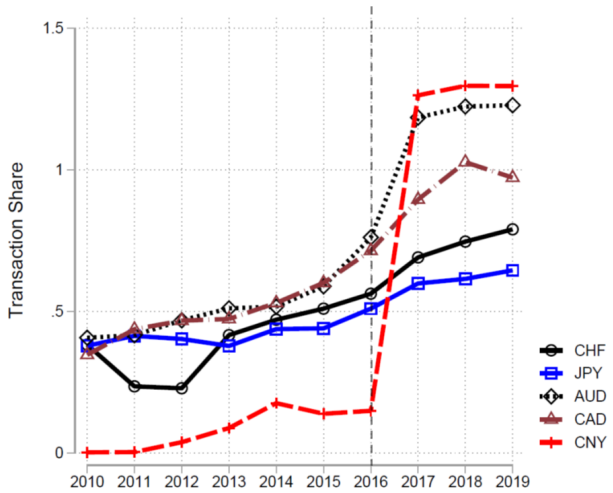
(a) All: Trade value share



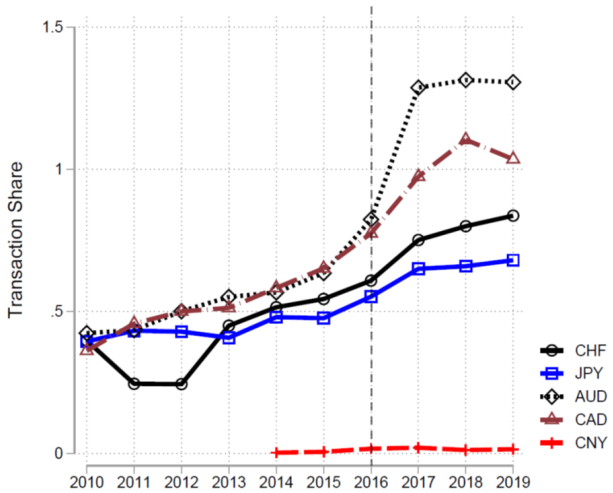
(b) All: Transaction share



(c) Others: Transaction share



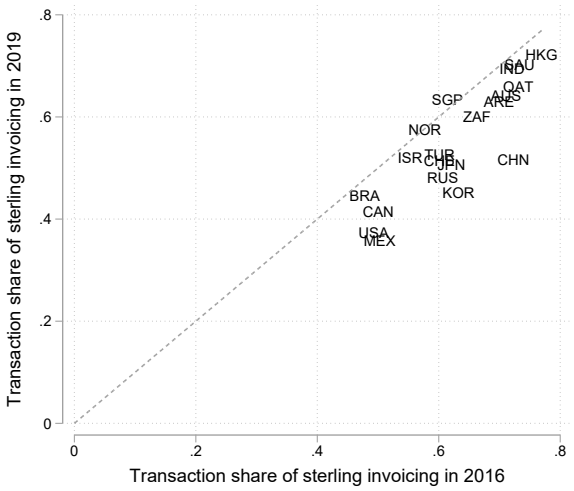
(d) Others: Transaction share (no CHN)



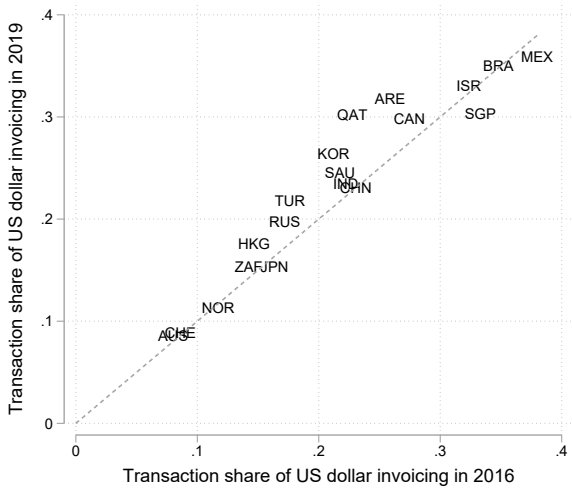
Note: The figure plots the shares of the UK's extra-EU exports invoiced in each currency from 2010 to 2019. Panel (a) is based on the value of exports and panels (b) to (d) are based on the number of export transactions. Panel (d) drops exports to China. Data source: HMRC administrative datasets.

Figure 2: Invoicing currency for the top 20 destinations: 2016 vs 2019
(Export transaction share)

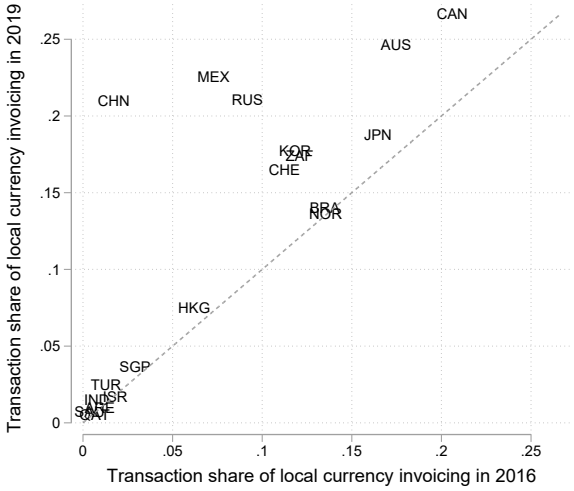
(a) Pound sterling



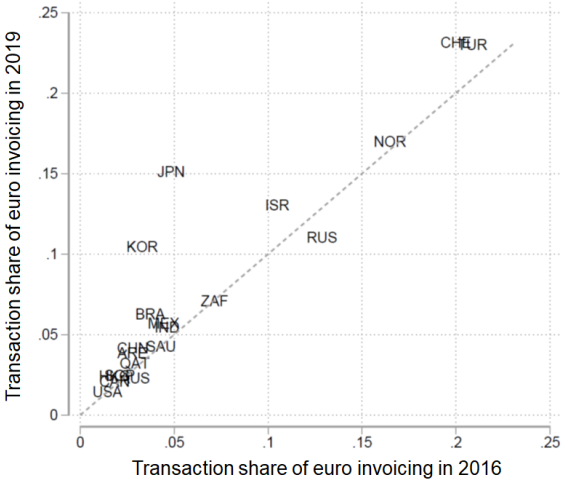
(b) US dollar



(c) Local currency



(d) Euro



The figure plots the transaction share of UK exports invoiced in each currency across the top 20 extra-EU destination countries in 2016 on the x-axis and 2019 on the y-axis. Data source: HMRC administrative datasets.

(CHF), Japanese Yen (JPY), Australian Dollar (AUD), Canadian Dollar (CAD), and Chinese Yuan (CNY). As shown in Panel (c), there is a continuous rise in the usage of all these currencies, particularly evident from 2016 onwards. Notably, the Chinese Yuan (CNY) exhibits a significant increase, with its share surpassing 1%. However, as illustrated in panel (d), the CNY's share remains minimal when considering UK exports to countries other than China. This suggests that the heightened usage of CNY since 2016 is primarily in transactions with China, where it serves as the local currency, rather than as a vehicle currency in trade with non-Chinese partners.[8]

To investigate if these shifts in UK exporters' invoicing currency are broad-based across different destinations or specific to a few markets, such as the United States or China, we compare the distributions of the major invoicing currencies for the top 20 extra-EU destination countries between 2016 and 2019. Figure 2 comprises four distinct panels, each illustrating the shares of GBP, USD, EUR, and local currencies in UK exports for the years 2016 and 2019. Data points falling below the dashed 45-degree line indicate a reduction in the share of exports invoiced in a particular currency to a specific destination in 2019 compared to 2016. Panels (a) and (b) demonstrate a widespread decline in the use of GBP and a corresponding rise in USD among UK exporters across diverse destinations. Panel (c) reveals a substantial increase in the share of local currency invoicing in UK exports to China, with an approximately 20% upswing of the CNY share in 2019 relative to 2016. We also detect noteworthy increases in local currency invoicing among UK exports to Mexico, Russia, Australia, and Canada. As seen in panel (d), in some Asian destinations such as South Korea and China, we see a more frequent use of EUR as well as local currency in 2019. Taken together, these indicate that the shift away from GBP by UK exporters after the 2016 Brexit vote is not limited to specific destinations, but reflects a diminished attractiveness of sterling for international transactions.[9]

3 Which margin matters?

In this section, we delve into which margins of trade have contributed most to the changes in invoicing currency for UK exports, building on an approach proposed by Bernard, Jensen, Redding and Schott (2009). We decompose the universe of UK export transactions using the invoicing currency information reported and the contribution of each transaction to the

[8] In the Online Appendix, additional figures dissect the invoicing currency shares based on (1) OECD membership, (2) the dollar-peg exchange rate regime of destination countries, and (3) the level of product differentiation.

[9] In Online Appendix figure OA1-12, we show that the dramatic change in invoicing patterns is not accompanied by significant shifts in trade shares towards these destination countries.

firm, geographic market, product, and invoicing currency margins of adjustment as shown in (1).[10]

We start with the total change in the number of transactions in a particular currency k between two periods $t-s$ and t, denoted by $\Delta_s x_t^k$, and categorise them into three bins: (a) the firm entry margin summing over the transactions from all firms that used currency k in t but not in $t-s$, denoted as $\sum_{f\in\mathcal{E}} x_{f,t}^k$; (b) the firm exit margin, summing over the transactions from the firms that used currency k in $t-s$ but not in t, denoted as $\sum_{f\in\mathcal{X}} x_{f,t}^k$; and (c) the continuing firm margin summing over the firms that have used currency k in both periods, denoted as $\sum_{f\in\mathcal{C}} x_{f,t}^k$.[11] Following the same logic, we further decompose the continuing firms into different market margins as shown in the second line of equation (1) and different product margins within the continuing markets as shown in the third line of equation (1).

$$
\begin{aligned}
\Delta_s x_t^k &= \underbrace{\sum_{f\in\mathcal{E}} x_{f,t}^k - \sum_{f\in\mathcal{X}} x_{f,t-s}^k}_{\text{Net firm entry}} + \underbrace{\sum_{f\in\mathcal{C}} \Delta_s x_{f,t}^k}_{\text{Continuing firm margin}}, \\
\Delta_s x_{f,t}^k &= \underbrace{\sum_{d\in\mathcal{E}_f} x_{f,d,t}^k - \sum_{d\in\mathcal{X}_f} x_{f,d,t-s}^k}_{\text{Net market entry}} + \underbrace{\sum_{d\in\mathcal{C}_f} \Delta_s x_{f,d,t}^k}_{\text{Continuing market margin}} \qquad \forall f\in\mathcal{C}, \\
\Delta_s x_{f,d,t}^k &= \underbrace{\sum_{p\in\mathcal{E}_{f,d}} x_{f,p,d,t}^k - \sum_{p\in\mathcal{X}_{f,d}} x_{f,p,d,t-s}^k}_{\text{Net product entry}} + \underbrace{\sum_{p\in\mathcal{C}_{f,d}} \Delta_s x_{f,p,d,t}^k}_{\text{Continuing product margin}} \qquad \forall d\in\mathcal{C}_f, f\in\mathcal{C}, \\
\Delta_s x_{f,p,d,t}^k &= \underbrace{x_{f,p,d,t}^k \mathbb{1}(\mathcal{A}_{f,p,d}^k) - x_{f,p,d,t-s}^k \mathbb{1}(\mathcal{B}_{f,p,d}^k)}_{\text{Currency switch margin}} + \underbrace{\Delta_s x_{f,p,d,t}^k \mathbb{1}(\mathcal{C}_{f,p,d}^k)}_{\text{W/in-currency transaction margin}} \qquad \forall p\in\mathcal{C}_{f,d}, d\in\mathcal{C}_f, f\in\mathcal{C}.
\end{aligned}
\tag{1}
$$

At the most granular level, the change in use of currency k for the same firm f selling the same product p to the same destination d, denoted as $\Delta_s x_{f,p,d,t}^k$, can be further decomposed into three categories: (i) the currency k was used in t but not in $t-s$, i.e., $\mathbb{1}(\mathcal{A}_{f,p,d}^k)=1$, indicating the firm switched from an alternative currency to the currency k; (ii) the currency k was used in $t-s$ but not in t, i.e., $\mathbb{1}(\mathcal{B}_{f,p,d}^k)=1$, indicating the firm switched from the

[10] In this section, we focus on decomposing the changes in the number of transactions as they are not directly affected by the currency movements. Our proposed approach can also be applied to decompose the total trade values. The related results are reported in figure OA1-12 of Online Appendix.

[11] We use subscripts to indicate the aggregation level of a variable throughout the paper, where $\mathcal{E}$ indicates the set of new entering firms, $\mathcal{X}$ is the set of exiting firms; $\mathcal{E}_f$ and $\mathcal{X}_f$ represent the set of new and exiting destinations of firm f; $\mathcal{E}_{f,d}$ and $\mathcal{X}_{f,d}$ represent the set of new and exiting products of firm-destination pair f,d; and $\mathcal{C}$, $\mathcal{C}_f$, and $\mathcal{C}_{f,d}$ represent continuing firms, continuing markets within a firm and continuing products within a firm-product pair respectively.

currency k to an alternative currency; and (iii) the currency k was used in both $t-s$ and t, i.e., $\mathbb{1}(\mathcal{C}^k_{f,p,d}) = 1$, but the number of trade transactions may have changed.[12] These margins are new and specific to our currency decomposition. We refer to (i)-(ii) as the currency switch margin and (iii) as the within-currency intensity of transacting margin.

We implement this decomposition on the changes between 2016 ($t-s$) and 2019 (t). The aggregate change can be obtained by summing across all of these margins.[13] It is worth noting that our approach departs from Bernard, Jensen, Redding and Schott (2009)'s decomposition of trade flows in three manners. First, we implement the decomposition separately for each of the invoicing currency categories.[14] Second, we identify two new margins within the conventional intensive margin of trade flows: the currency switch and within-currency intensity of transacting margins. Third, we measure the number of transactions instead of trade values to avoid the potential confounding effects of the depreciation of the sterling.

Table 1 presents the contributions of each trade margin between 2016 and 2019 in terms of the number of transactions in thousands. The first three rows show the firm entry margin. In row (1-1), we observe that a significant fraction of transactions by new entrants were invoiced in GBP, covering 66.1% of all transactions conducted by new UK exporters during this period. This implies that new exporters, probably with little experience of using foreign currency and smaller export volumes, tended to opt for producer currency pricing, as documented in earlier work (Lyonnet, Martin and Mejean 2021). The GBP also covers a significant fraction of transactions by firms that ceased exporting (65.1%) as shown in row (1-2). Net firm entry in row (1), defined as firm entry minus firm exit, predominantly occurred in GBP (70.5%) and USD (22.7%). The next three rows show the changes in the number of export transactions by firms entering new destinations and firms exiting from existing destinations. Similar to firm entry, a majority of transactions in new markets were invoiced in GBP (62.1%) or USD (20.2%) in row (2-1). When it comes to the net market entry (market entry minus exit) in row (2), however, the landscape is somewhat different. Although GBP still accounts for the largest share (38.4%), 'others,' including local currencies, also played an important role, with their cumulative share of more than 29.1% in net market entry. The higher share of 'others' in the net market margin is due to the fact that firms using local currencies were far less likely to exit from markets (2.2%) as seen in row (2-2). Moving on to net product entry in row (3), we find a net increase in the number of transactions invoiced in GBP and

[12] Note that the three categories are mutually exclusive, i.e., $\mathbb{1}(\mathcal{A}^k_{f,p,d}) + \mathbb{1}(\mathcal{B}^k_{f,p,d}) + \mathbb{1}(\mathcal{C}^k_{f,p,d}) = 1$ for any k.

[13] For example, the aggregate contribution of the currency switching margin can be calculated as $\sum_{f\in\mathcal{C}} \sum_{d\in\mathcal{C}_f} \sum_{p\in\mathcal{C}_{f,d}} \left[x^k_{f,p,d,t}\mathbb{1}(\mathcal{A}_{f,p,d}) - x^k_{f,p,d,t-1}\mathbb{1}(\mathcal{B}_{f,p,d})\right]$.

[14] The original decomposition of Bernard, Jensen, Redding and Schott (2009) can be obtained by summing over k in each of the margins we defined here.

USD for newly added products among continuing exporters, contributing around 39.6% and 40.0% to net product entry, respectively. In sum, the three conventional extensive margins – (1) firm, (2) destination, and (3) product – were found to have *positively* contributed to the usage of GBP between 2016 and 2019. This reflects that new entrants as well as continuing exporters entering new markets or adding new products preferred to use their home currency even after the Brexit vote.

What margins are then responsible for the rapid decline of the GBP share since the 2016 Brexit vote? One factor is the significant switch away from GBP among continuing exporters. As shown in the (4), (4-1) and (4-2) rows, the GBP was abandoned by incumbent firms exporting the same products to the same markets (-86.0k). A majority of these transactions were reallocated to USD (+59.8k) and local currency (+45.4k). More strikingly, the within-currency trade margin in row (5) indicates that UK firms reduced the volume of their sterling-invoiced transactions for continuously served product-markets (-148.0k). Compared to the positive within-currency intensity of transacting margins for all other currencies in row (5), our results show that firms that stick with sterling transact less frequently than those firms which switched to other currencies.

Overall, we find the significant losses for the GBP in the currency switch and the within-currency of transacting margins stand in contrast to the gains in both margins for all other currencies. Combining all the margins we have explored, row (6), we find that GBP lost 18.7% of its transaction share in UK exports between 2016 and 2019, and was replaced by USD and 'others,' which saw increases of 69.9% and 34.5%, respectively.

Table 1: Decomposition of invoicing currency changes by trade margin (2016-2019)

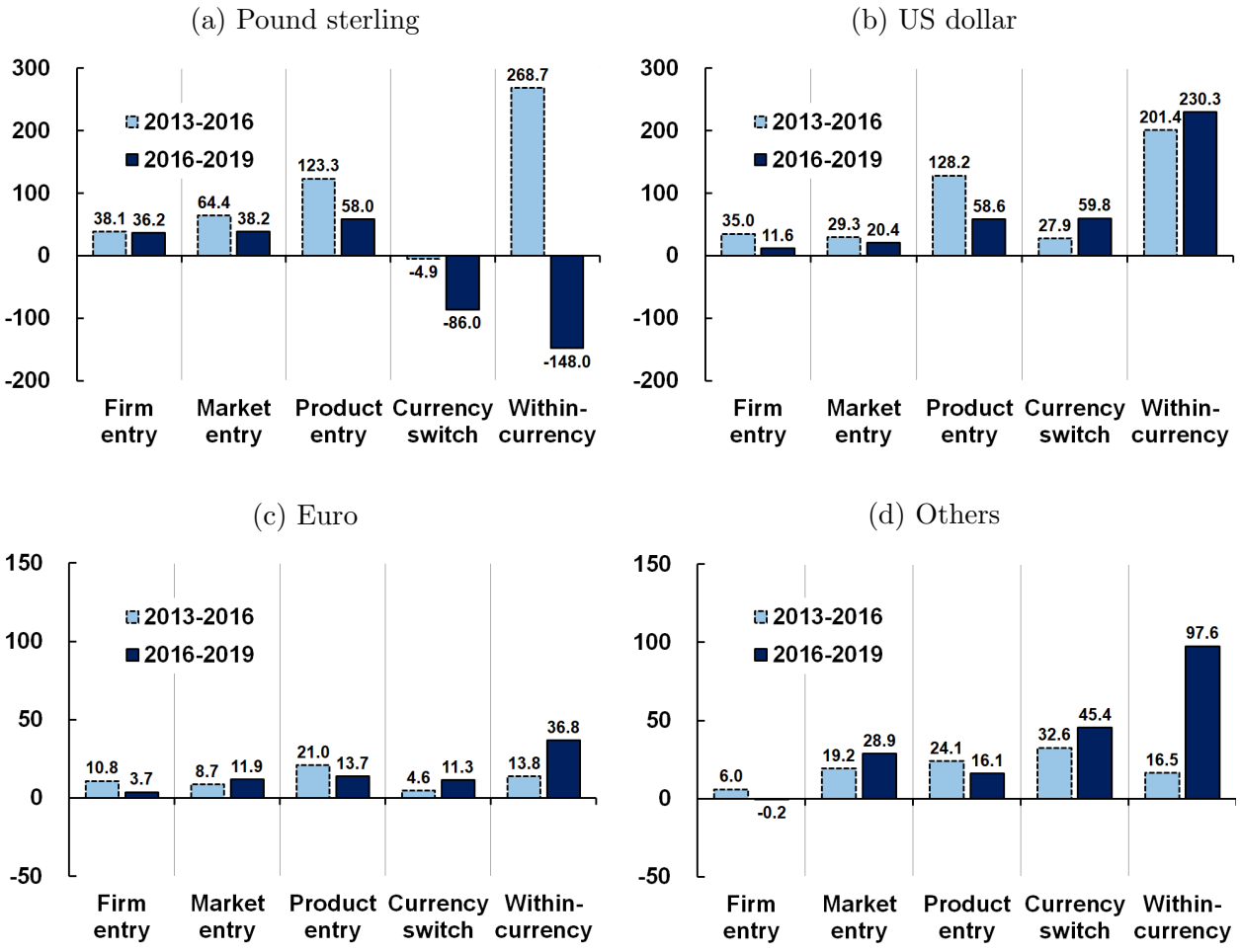
Margins	GBP	USD	EUR	Others	Total
(1) Net firm entry	**36.2 (70.5%)**	**11.6 (22.7%)**	**3.7 (7.2%)**	**-0.2 (-0.3%)**	**51.3 (100.0%)**
(1-1) Exporter entry	180.9 (66.1%)	66.6 (24.4%)	19.6 (7.2%)	6.4 (2.3%)	273.6 (100.0%)
(1-2) Exporter exit	144.7 (65.1%)	55.0 (24.7%)	16.0 (7.2%)	6.6 (3.0%)	222.3 (100.0%)
(2) Net market entry	**38.2 (38.4%)**	**20.4 (20.5%)**	**11.9 (12.0%)**	**28.9 (29.1%)**	**99.3 (100.0%)**
(2-1) Market entry	237.2 (62.1%)	77.1 (20.2%)	32.6 (8.5%)	35.0 (9.2%)	381.9 (100.0%)
(2-2) Market exit	199.1 (70.5%)	56.7 (20.1%)	20.7 (7.3%)	6.1 (2.2%)	282.5 (100.0%)
(3) Net product entry	**58.0 (39.6%)**	**58.6 (40.0%)**	**13.7 (9.4%)**	**16.1 (11.0%)**	**146.4 (100.0%)**
(3-1) Product added	552.5 (60.4%)	261.3 (28.6%)	60.0 (6.6%)	40.7 (4.5%)	914.5 (100.0%)
(3-2) Product dropped	494.4 (64.4%)	202.7 (26.4%)	46.3 (6.0%)	24.6 (3.2%)	768.1 (100.0%)
(4) Currency switch	**-86.0 (-282.0%)**	**59.8 (196.1%)**	**11.3 (37.2%)**	**45.4 (148.8%)**	**30.5 (100.0%)**
(4-1) Currency added	50.5 (20.7%)	105.5 (43.2%)	32.5 (13.3%)	55.9 (22.9%)	244.4 (100.0%)
(4-2) Currency dropped	136.5 (63.8%)	45.8 (21.4%)	21.2 (9.9%)	10.5 (4.9%)	213.9 (100.0%)
(5) Within-currency	**-148.0 (-68.4%)**	**230.3 (106.3%)**	**36.8 (17.0%)**	**97.6 (45.1%)**	**216.6 (100.0%)**
(6) Total changes	**-101.7 (-18.7%)**	**380.6 (69.9%)**	**77.4 (14.2%)**	**187.8 (34.5%)**	**544.2 (100.0%)**

Note: This table presents the decomposition of the changes in the number of the UK's extra-EU export transactions in thousands by trade margin (rows) and by currency (columns) between 2016 and 2019. The numbers in parentheses represent the currency's percentage contribution to each margin, calculated as the change for that currency divided by the sum of all changes identified in this margin (i.e., the number in the Total column). Data source: HMRC administrative datasets.

To gain deeper insights into the impact of the 2016 Brexit vote, figure 3 compares each trade margin of the pre- (2013-2016) and post-Brexit vote period (2016-2019). For brevity, we plot only the net margins for firm entry, market entry, product entry, and currency switching over the two separate periods. There was little change in the strong preference for the GBP among new exporters before and after the Brexit vote. However, changes in net market entry indicate that firms entering new destinations increased their use of local currency ('Others') at the expense of the GBP share since 2016. Across all currencies, we uncover a decline in the net product margin among continuing exporters. We again find that more UK exporters have shifted away from the GBP toward local currency and the USD in their existing product-markets post-2016.

Most notable is the dramatic change in the currency switch and the within-currency intensity of transacting margins between 2013-2016 and 2016-2019. As illustrated by the GBP graph in figure 3, the currency switch margin was negligible when currency shares remained relatively stable (2013-2016). However, it became a significant factor in the rapid decline of sterling use from 2016 to 2019. Similarly, while the within-currency intensity of transacting margin made a strong positive contribution to the change in sterling use from 2013 to 2016, it emerged as the primary driver of sterling's decline during 2016 to 2019, coinciding with a substantial increase in transaction volumes of 'other' local currencies. In summary, our analysis indicates that the most significant post-Brexit shift in sterling usage was not driven by the firm, market, or product extensive margins of trade, which are widely seen as the primary sources of big changes in trade shares. Instead, the shift resulted from the changing invoicing behavior of continuing firms in their established product and destination markets.

Figure 3: Comparing the contribution of micro margins during 2013-2016 vs 2016-2019



Note: This figure compares the decomposition for pre- (2013-2016) and post-Brexit vote (2016-2019) periods. The bars represent the net change in number of export transactions for the stated currency during the specified period. Data source: HMRC administrative datasets.

4 The role of firm heterogeneity

In the previous section, we documented a widespread shift in invoicing currencies, particularly among continuing exporters, beginning in 2016. This section presents a regression analysis aimed at investigating whether the changes in within-firm currency choices, triggered by the 2016 Brexit vote, varied according to specific characteristics of firms and destination markets. Specifically, we estimate the following equation for the transaction shares of each invoicing currency at the firm-product-country-year level from 2010 to 2019:

$$\begin{aligned} S^k_{f,p,d,t} = \quad & \beta_1 \times (size_{f,t} \times D_t) + \delta_{1,1} \times (\psi^{\text{Local}}_{f,d,t} \times D_t) + \delta_{2,1} \times (\psi^{\text{USD}}_{f,t} \times D_t) \\ & + \delta_{3,1} \times (\psi^{\text{EUR}}_{f,t} \times D_t) + \gamma_1 \times (mktsize_{p,d,t} \times D_t) \\ & + \beta_0 \times size_{f,t} + \delta_{1,0} \times \psi^{\text{Local}}_{f,d,t} + \delta_{2,0} \times \psi^{\text{EUR}}_{f,t} + \delta_{3,0} \times \psi^{\text{USD}}_{f,t} + \gamma_0 \times mktsize_{p,d,t} \\ & + \alpha_f + \nu_{p,d} + \vartheta_t + \epsilon_{f,p,d,t} \end{aligned} \tag{2}$$

where the subscripts f, p, d and t denote a firm, a 8-digit Combined Nomenclature (CN) product, a destination country, and year, respectively. The outcome variable $S^k_{f,p,d,t}$ represents the invoicing share of currency k in UK firm f 's exports of product p to extra-EU destination d in a given year t. We separately estimate the equation for three currency options: GBP, USD, and the local destination currency.[15]

The selection of regressors draws from prior literature on endogenous currency choice, such as Chung (2016), Crowley, Han and Son (2021), and Amiti, Itskhoki and Konings (2022). These studies commonly underscore the motive of operational hedging by firms due to their use of foreign intermediate inputs. It predicts that firms tend to export in the currency that is also used for their imports as a means to net out the exchange rate risk. To capture this channel, we include the share of the US dollar ($\psi^{\text{USD}}_{f,t}$), of the euro ($\psi^{\text{EUR}}_{f,t}$), and of local currency ($\psi^{\text{Local}}_{f,d,t}$) in the firm's imports at year t. Another important factor in currency choice is firm size. Studies by Lyonnet, Martin and Mejean (2021) and Goldberg and Tille (2016) point out that large firms are more likely to use foreign currencies, especially local currency, as they are better capable of handling financial instruments to hedge the exchange rate risk associated with the use of foreign currencies. Considering this, we include firm size ($size_{f,t}$), measured as the logarithm of the total value of exports by individual firms in a given year t. Apart from these firm-specific determinants, we add the product-market size for each destination ($mktsize_{p,d,t}$), which is measured as the UK's aggregate exports of product p to a particular destination d in a given year t. This is to account for importers' bargaining

[15] To discern the use of local currency from the USD, our regression sample excludes exports to the United States.

power, which may potentially lead exporters to use local currency (Friberg and Wilander 2008; Goldberg and Tille 2016). Additionally, the hypothesis of strategic complementarities in pricing among firms (Atkeson and Burstein 2008 and Amiti, Itskhoki and Konings 2022) suggests that a firm tends to price in the currency more broadly used by its competitors in order to keep its own price relative to its competitors' prices stable in the face of exchange rate fluctuations. This hypothesis predicts that exporters are less inclined to use their domestic currency in large destinations with more foreign competitors.

Our key contribution is to examine the heterogeneity in the effect of the 2016 Brexit vote across firms and destinations by introducing a set of interaction terms for each regressor with a time dummy equal to one if the transaction year is on and after 2016 (D_t). To control for other unobserved factors that could independently affect the firm's currency choice, our regression includes a comprehensive array of firm (α_f), product-destination fixed effects ($\nu_{p,d}$), and year fixed effects (ϑ_t). Firm fixed effects allow us to examine within-firm changes in invoicing currency over time, particularly before and after the 2016 Brexit vote. Product-destination fixed effects effectively absorb all destination-specific time-invariant factors such as institution, location, language, and the stage of economic development, as well as product-specific characteristics including product differentiation, durability and the end-use category (e.g. consumer goods vs. industrial goods). Finally, we add year fixed to control for the common effect of macroeconomic shocks. Standard errors are clustered at the firm level as in Amiti, Itskhoki and Konings (2022).

The estimation results are presented in panel (a) of table 2.[16] As noted earlier, our dependent variable is the share of each currency in UK exports, based on the number of transactions.[17] Column 1 represents the regression for GBP invoicing, while columns 2 and 3 are for USD and local currency invoicing, respectively. The findings from the level variables largely confirm the previous literature's findings on the determinants of invoicing currency. Thus, we focus on the interaction term between these variables and the post-2016 dummy. The coefficient on the interaction term for firm size (1st row) is negative for GBP, while being positive for both USD and local currency. It is statistically significant solely for local currency. These results indicate that larger UK exporters leaned more towards using local currency after the 2016 Brexit vote. The next three rows present heterogeneity related to the currency denomination of firms' imports. The interaction terms for imports denominated in local currency were imprecisely estimated across all currency options (2nd row). By contrast, firms using more dollar-denominated imports (3rd row) were more likely to shift away from

[16]For summary statistics of the variables used, see Online Appendix table OA2-3.

[17]As reported in Online Appendix table OA2-2, using the trade value share of each currency as the dependent variable yields very similar results.

GBP towards USD beginning in 2016. In line with the operational hedging hypothesis, our estimates suggest that a higher reliance on dollar-denominated imports is associated with a greater share of dollar invoicing in their exports and a smaller share of GBP invoicing. Moreover, firms with more intensive use of euro-denominated imports (4th row) are more likely to switch away from GBP after 2016. Finally, firms exporting to larger destinations (5th row) exhibited a stronger inclination towards using foreign currencies, notably the USD, after the Brexit vote.

In panel (b), we quantify the degree of heterogeneity in currency switches attributable to each regressor. This quantification is based on the estimated coefficients of the interaction terms, combined with the distributions of each regressor. We consider only statistically significant coefficient estimates.[18] The first row shows that a UK firm at the 75th percentile of the size distribution (16.62) increased its share of local currency invoicing by approximately 0.46 percentage points more than a firm at the 25th percentile (12.46) post-2016. In the second row, we assess the quantitative impact of dollar-denominated imports on Brexit-induced currency switches. A firm with a dollar import share at the 75th percentile (0.96) reduced its share of sterling invoicing by 2.37 percentage points more than a firm at the 25th percentile (0.10), while simultaneously increasing its share of dollar invoicing by 2.49 percentage points. This heterogeneity is significant, considering that the average change in the dollar invoicing share of UK exports between the pre- and post-Brexit periods was around 4.9 percentage points. Finally, the third row indicates that moving to a destination with a market size at the 75th percentile (14.02) from the 25th percentile (10.42) amplifies the relative loss of sterling invoicing by 0.32 percentage points and similarly increases the relative share of dollar invoicing.

[18]The interaction term for local currency-denominated imports is not statistically significant across all currency options. Despite being significant in the regression for the GBP, the interactive effect concerning euro-denominated imports was negligible, with its share being less than 2% up to the 75th percentile. For these reasons, we excluded both local currency- and euro-denominated import shares from our quantification exercise.

Table 2: Regressions for invoicing currency in UK exports

	GBP	USD	Local
	(1)	(2)	(3)
(a) Empirical estimates			
Firm size × post 2016	-0.09	0.03	0.11**
	(0.08)	(0.05)	(0.05)
Local currency import share × post 2016	-1.68	-1.83	4.69
	(1.35)	(1.63)	(3.09)
Dollar import share × post 2016	-2.75***	2.89***	-0.12
	(0.39)	(0.29)	(0.22)
Euro import share × post 2016	-2.92***	-0.29	0.36
	(1.03)	(0.62)	(0.36)
Destination market size × post 2016	-0.09***	0.08***	0.03
	(0.03)	(0.02)	(0.02)
Observations	5,964,067	5,964,067	5,964,067
R-squared	0.478	0.499	0.295
Firm FE	Y	Y	Y
Country-Product FE	Y	Y	Y
Year FE	Y	Y	Y
(b) Quantification of heterogeneity			
Firm size [4.16]	–	–	0.46
Dollar import share [0.86]	-2.37	2.49	–
Destination market size [3.6]	-0.32	0.29	–

Notes: Panel (a) of the table reports the OLS estimates for equation (2). The dependent variable is the transaction share of each invoicing currency in the UK's exports to extra-EU countries, at the firm-product-destination-year level, multiplied by 100. All level control variables are included in the estimation equation, and their estimates are available upon request. Standard errors, in parentheses, are clustered by firms. Significance levels are indicated as follows: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Panel (b) quantifies the heterogeneity in the currency switches by multiplying the estimated coefficients on the interaction terms with the difference between the 75th and 25th percentiles in the observed distribution of the relevant regressors (shown in brackets). Data source: HMRC administrative datasets.

5 Concluding remarks

The unexpected outcome of the Brexit referendum not only led to a significant depreciation of sterling but also ushered in a period of widespread uncertainty regarding future government policy in the UK. While the value of sterling quickly stabilized in 2017, the uncertainty around government policy remained elevated throughout our sample period.[19] Our research provides a unique example demonstrating that major political events, which call into question the policy predictability of a nation, can change currency invoicing practices.

Using transaction-level data from HMRC, we document a widespread shift away from sterling towards the US dollar among UK exporters after the Brexit vote. In contrast to a conventional belief that changes in aggregate invoicing shares are driven by changes in the importance of geographic markets or industrial sectors, our decomposition finds that the majority of the decline of sterling's share occurred through two novel channels: continuously-operating firms switching invoicing currencies and significant reductions in transactions for firms that continued with sterling invoicing after the Brexit vote.

[19] As illustrated in the Online Appendix figure OA1-2, the volatility of sterling returned to its pre-Brexit vote level in 2017 in panel (a), while Nick Bloom's Economic Uncertainty Index remained elevated after 2017 in panel (b), and the World Bank's Government Effectiveness measure continued to decrease after 2017 in panel (c).

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Online Appendix for "The Swift Decline of the British Pound: Evidence from UK Trade-invoicing after the Brexit Vote"*

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February 2024

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OA1 Supplementary Statistics

OA1.1 Measures of UK policy uncertainty

The Brexit referendum vote ushered in a period of widespread uncertainty about future government policy in the UK. This was reflected in quantitative measures including a 14% decline in the World Bank's average measure of government effectiveness for the UK between 2010-2015 and 2016-2022, as shown in Figure OA1-1c.[1] A more heuristic measure of the predictability and stability of future UK government policy can be seen in the marked decline in the tenure in office of UK prime ministers before and after the referendum vote.[2] The average tenure in office of a (pre-referendum vote) UK prime minister from Thatcher (1979-1990) through Cameron (2010-2016) was 2653 days (about 88 months or 7 years 4 months). The average tenure in office of a UK prime minister after the referendum vote from May (2016-2019) through Truss (2022-2022) was only 747 days (about 25 months or 2 years 1 month).[3]

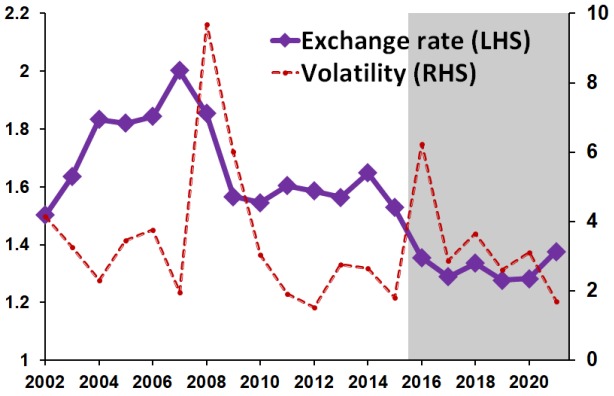
[1] In the World Bank's World Goverenance Indicators Database, "Government Effectiveness" captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.

[2] In contrast to presidential systems with fixed terms of office, the term of office of a UK prime minister is determined endogenously by the strength of Parliament's support for the prime minister's leadership and policy platforms. Thus, a succession of prime ministers with short tenures can reflect a lack of consensus over future policy within the governing political party.

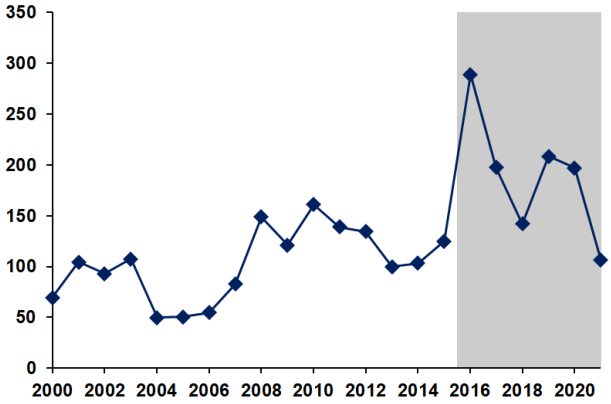
[3] Excluding the unusually short tenure of Elizabeth Truss in 2022, even the average tenure in office of May (2016-2019) and Johnson (2019-2022) of 1096 days (about 36 months or 3 years) was less than half that of their five predecessors.

Figure OA1-1: Measures of UK policy uncertainty

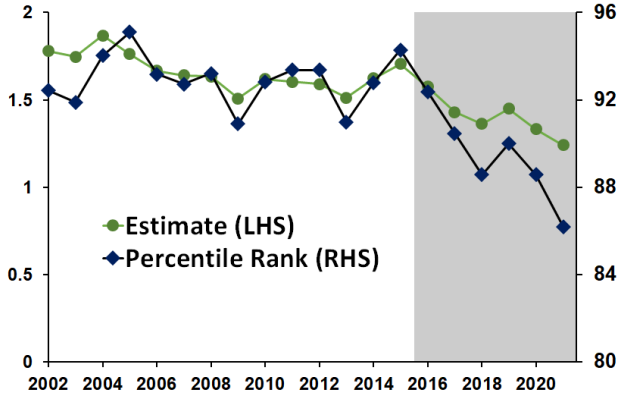
(a) GBP-USD exchange rate



(b) Economic policy uncertainty index



(c) Government effectiveness



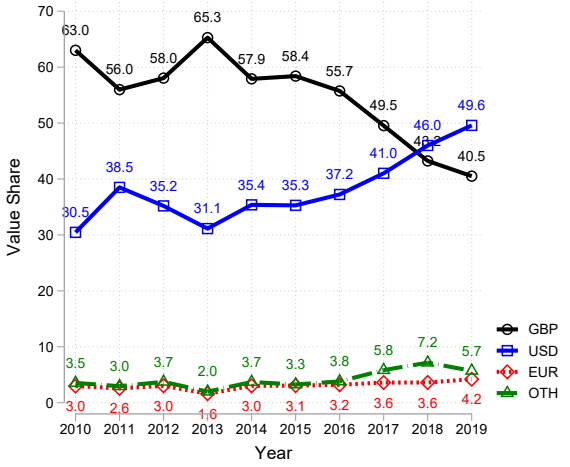
Note: Panel (a) plots the annual average of the daily exchange rate for the pound sterling (GBP) expressed in units of the US dollar (USD) and its coefficient of variation. Panel (b) plots the annual average of the monthly UK economic policy uncertainty index. Panel (c) plots the estimate and the percentile rank of the World Bank Government Effectiveness. Data source: Federal Researve Bank of St. Louis, Economic Policy Uncertainty, and World Bank.

OA1.2 Further breakdowns of aggregate invoicing share changes

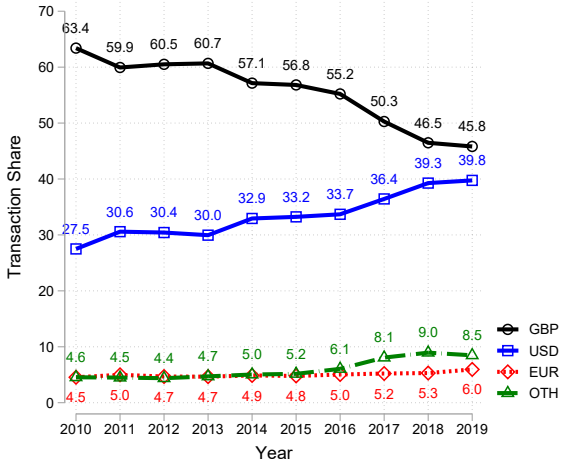
Figures OA1-2 and OA1-3 demonstrate a more marked reduction in sterling invoicing for exports to OECD countries (from 55.2% in 2016 to 45.8% in 2019) and to countries with a dollar-peg regime (from 60.8% in 2016 to 51.4% in 2019), compared to non-OECD countries (from 69.6% in 2016 to 62.0% in 2019) and those without a dollar-peg (from 61.6% in 2015 to 54.2% in 2019). In terms of product differentiation, following the classification methodology in Corsetti, Crowley, Han and Song (2018), we observe that the decline in sterling invoicing is more pronounced in the export of highly differentiated goods (from 65.3% in 2016 to 46.2% in 2019) than in less differentiated goods (from 58.8% in 2016 to 57.7% in 2019). This trend suggests that, in the aftermath of the 2016 Brexit vote, British firms have been increasingly inclined to move away from using sterling or to reduce the volume of transactions invoiced in sterling, especially for exports of highly differentiated goods to developed countries, while augmenting their reliance on other currencies, particularly the US dollar.

Figure OA1-2: Invoicing currencies in UK exports by OECD

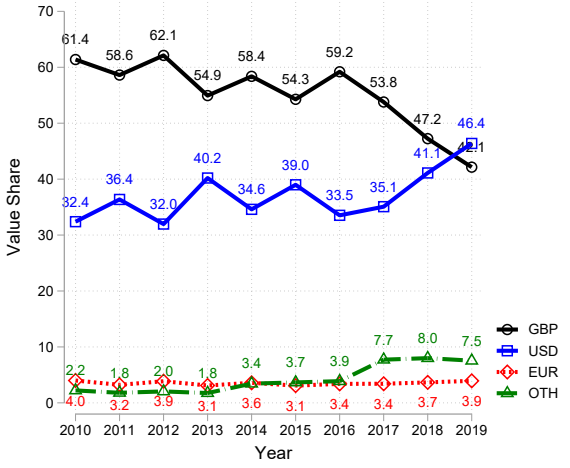
(a) OECD: Trade value share



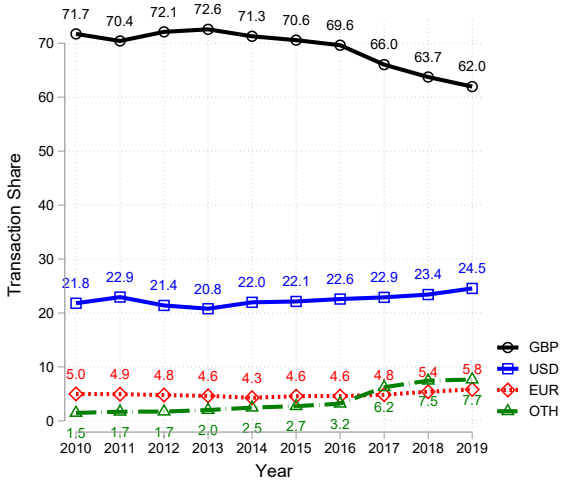
(b) OECD: Transaction share



(c) Non-OECD: Trade value share



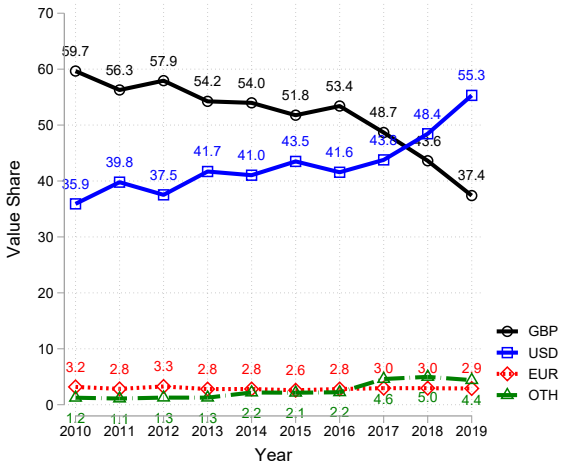
(d) Non-OECD: Transaction share



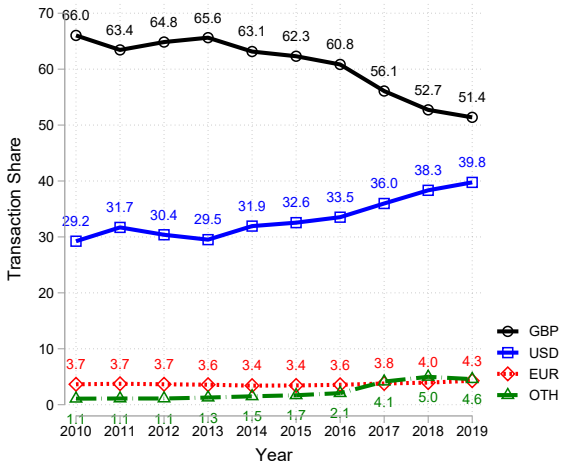
Note: The figure plots the shares of the UK's extra-EU exports invoiced in each currency by OECD group. Panels (a) and (c) are based on the value of exports and panels (b) and (d) are based on the number of export transactions. Data source: HMRC administrative datasets.

Figure OA1-3: Invoicing currencies in UK exports: dollar peg vs. non-dollar peg

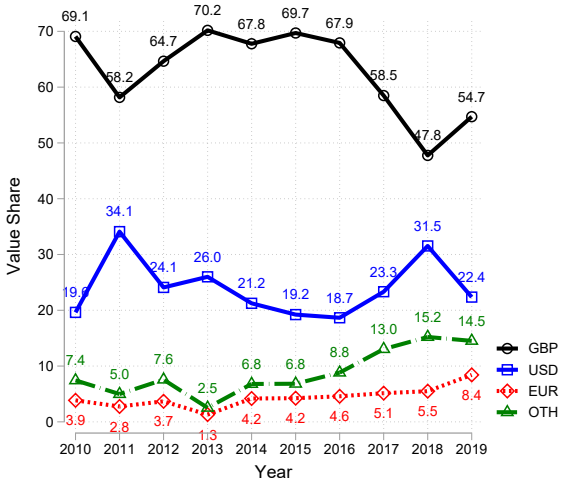
(a) Dollar peg: Trade value share



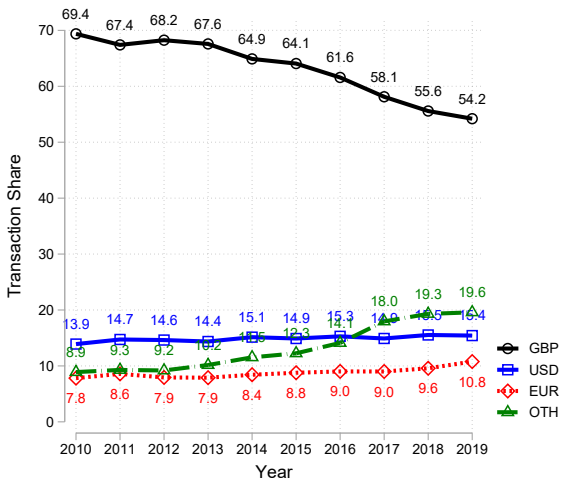
(b) Dollar peg: Transaction share



(c) Non-dollar peg: Trade value share



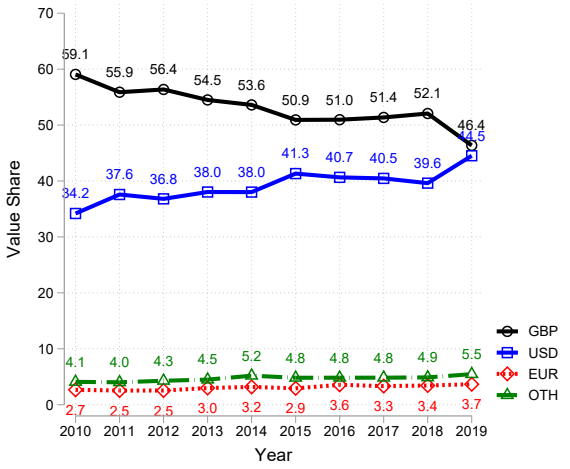
(d) Non-dollar peg: Transaction share



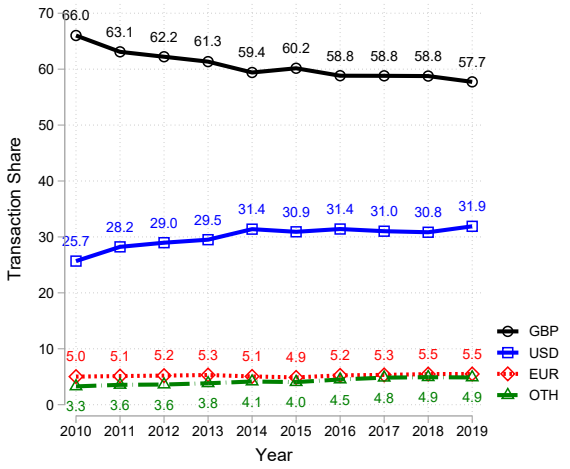
Note: The figure plots the shares of the UK's extra-EU exports invoiced in each currency by dollar-peg countries. Panels (a) and (c) are based on the value of exports and panels (b) and (d) are based on the number of export transactions. Data source: HMRC administrative datasets.

Figure OA1-4: Invoicing currencies in UK exports by product differentiation

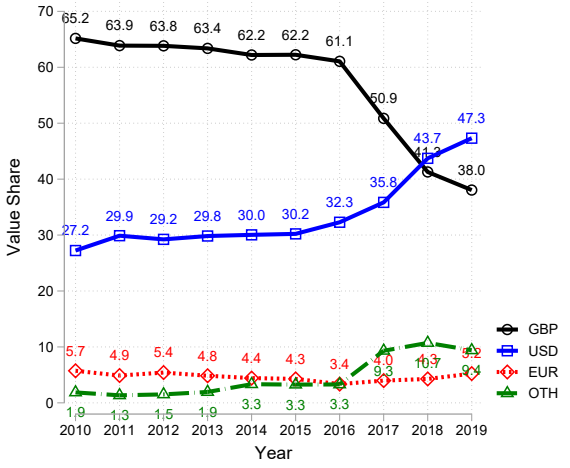
(a) Non-differentiated: Trade value share



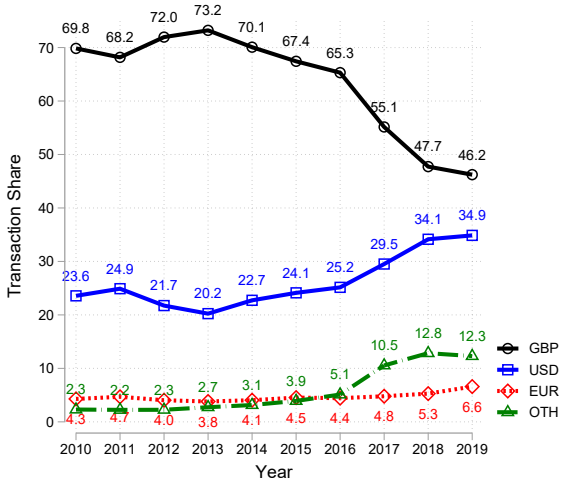
(b) Non-differentiated: Transaction share



(c) Differentiated: Trade value share



(d) Differentiated: Transaction share



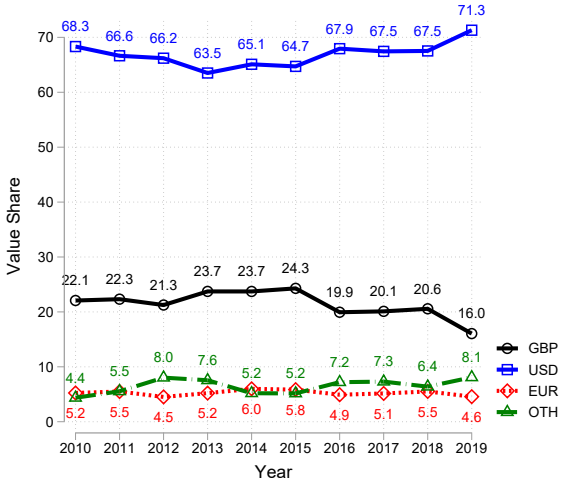
Note: The figure plots the shares of the UK's extra-EU exports invoiced in each currency by product differentiation using the methodology by Corsetti, Crowley, Han and Song (2018). Panels (a) and (c) are based on the value of exports and panels (b) and (d) are based on the number of export transactions. Data source: HMRC administrative datasets.

OA1.3 Aggregate share changes for UK's extra-EU imports

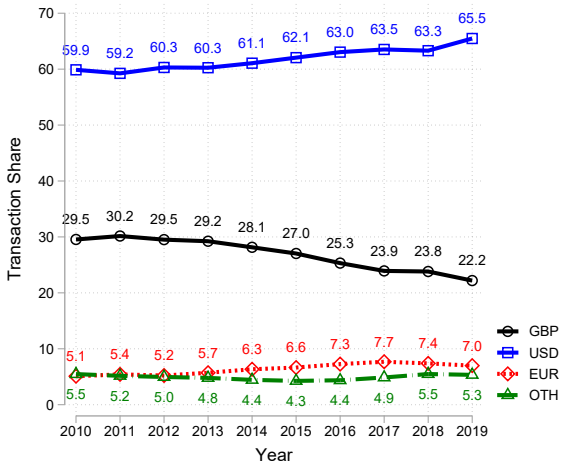
One might question whether there were comparable changes in invoicing patterns for UK imports. To address this question, we investigate the evolution of invoicing currencies in UK imports and compare them for the top 20 extra-EU origin countries between 2016 and 2019. Online Appendix figures OA1-5 to OA1-8 illustrate that, although sterling invoicing declined since 2010, the change was gradual without any significant break in its downward trend after the Brexit vote in 2016. Furthermore, as depicted in figure OA1-9, the shares of each major currency option in UK imports from the top 20 origin countries are located more closely around the 45-degree line. This indicates that the changes in invoicing currency for UK imports between 2016 and 2019 were neither as drastic nor as widespread as those observed in UK exports. This observation is in line with previous theoretical literature, which posits that the choice of invoicing currency is primarily that of exporters and is closely linked to their pricing strategies.Amiti, Itskhoki and Konings (2022) provide empirical support for this assumption in their research on Belgian firms.

Figure OA1-5: Invoicing currencies in UK's extra-EU imports (2010-2019)

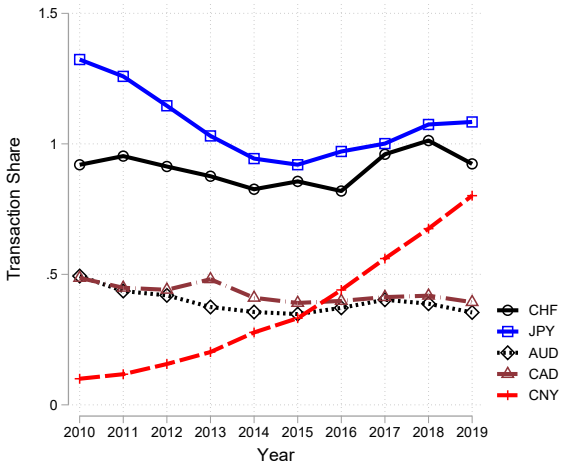
(a) All: Trade value share



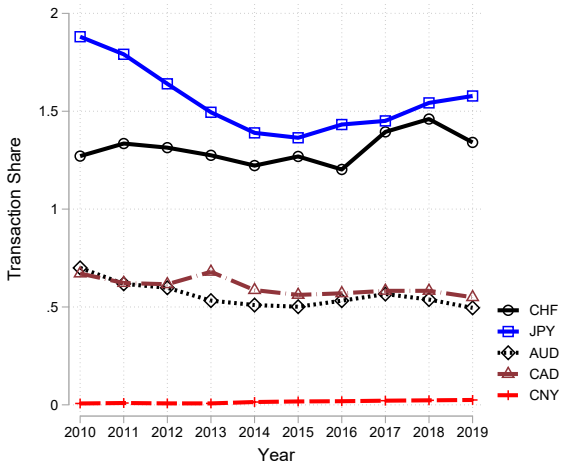
(b) All: Transaction share



(c) Others: Transaction share



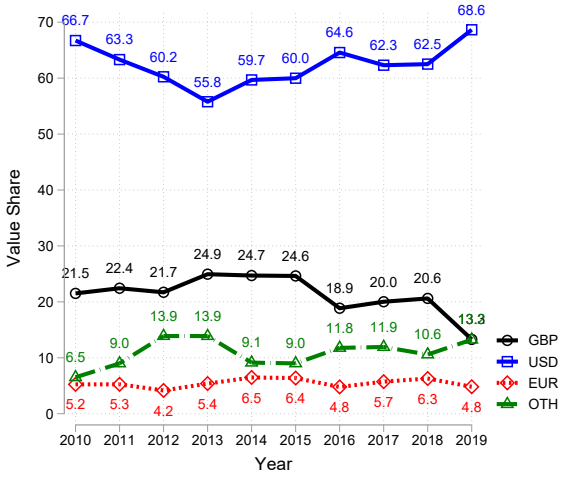
(d) Others: Transaction share (no CHN)



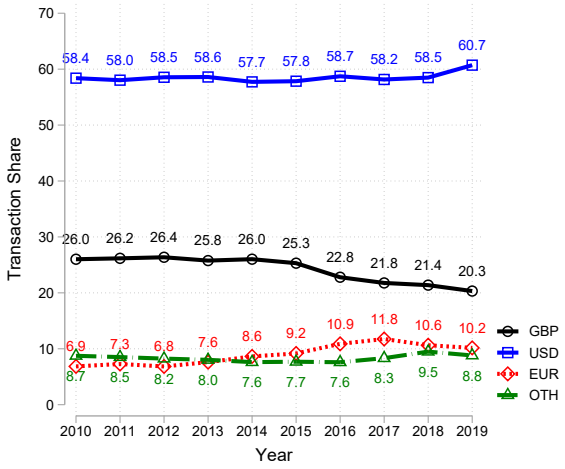
Note: The figure plots the shares of the UK's extra-EU imports invoiced in each currency from 2010 to 2019. Panel (a) is based on the value of imports and panels (b) to (d) are based on the number of import transactions. Panel (d) drops imports from China. Data source: HMRC administrative datasets.

Figure OA1-6: Invoicing currencies in UK's extra-EU imports by OECD

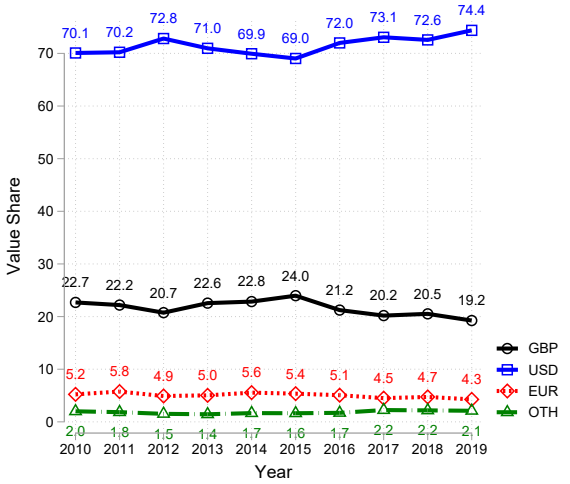
(a) OECD: Trade value share



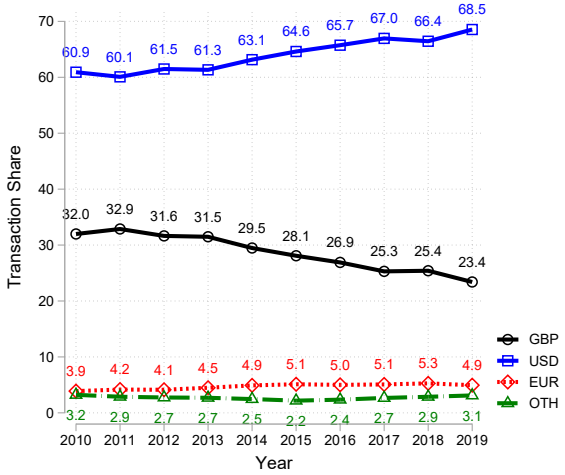
(b) OECD: Transaction share



(c) Non-OECD: Trade value share



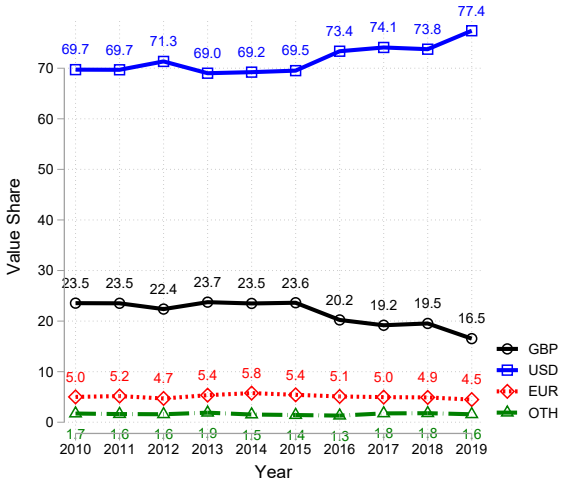
(d) Non-OECD: Transaction share



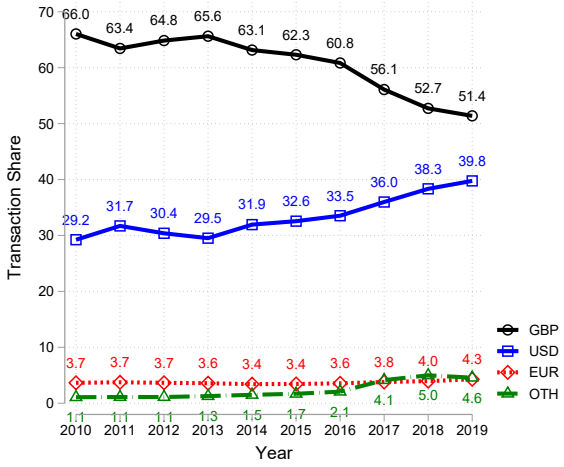
Note: The figure plots the shares of the UK's extra-EU imports invoiced in each currency by OECD group. Panels (a) and (c) are based on the value of imports and panels (b) and (d) are based on the number of import transactions. Data source: HMRC administrative datasets.

Figure OA1-7: Invoicing currencies in UK's extra-EU imports: dollar peg vs. non-dollar peg

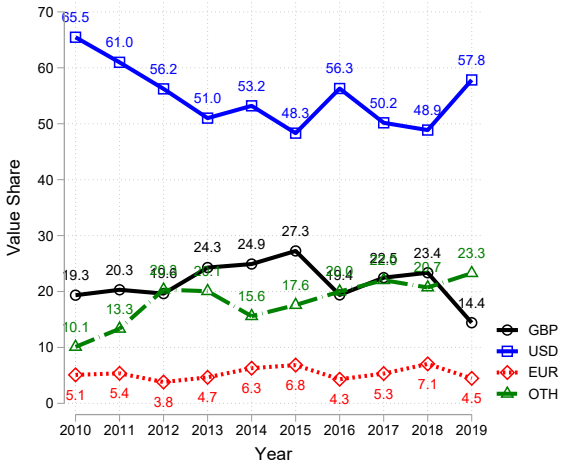
(a) Dollar peg: Trade value share



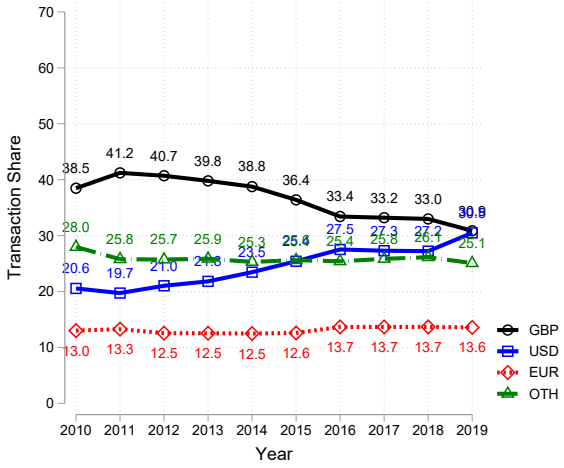
(b) Dollar peg: Transaction share



(c) Non-dollar peg: Trade value share



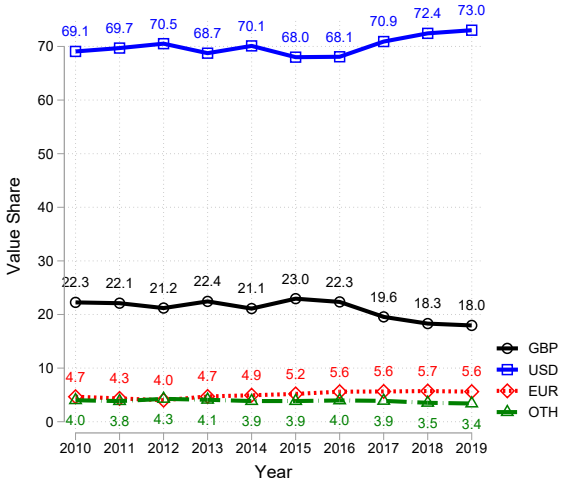
(d) Non-dollar peg: Transaction share



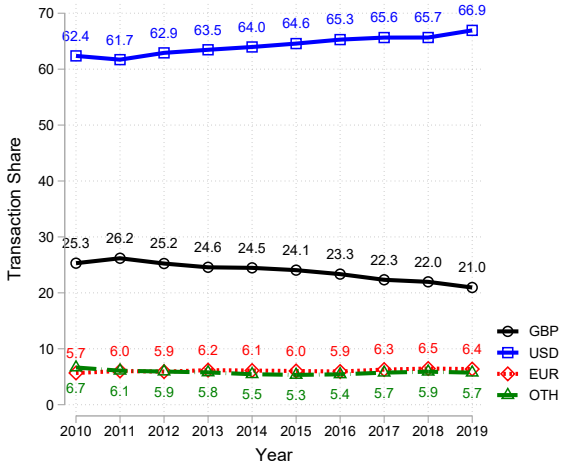
Note: The figure plots the shares of the UK's extra-EU imports invoiced in each currency by dollar-peg countries. Panels (a) and (c) are based on the value of imports and panels (b) and (d) are based on the number of import transactions. Data source: HMRC administrative datasets.

Figure OA1-8: Invoicing currencies in UK imports by product differentiation

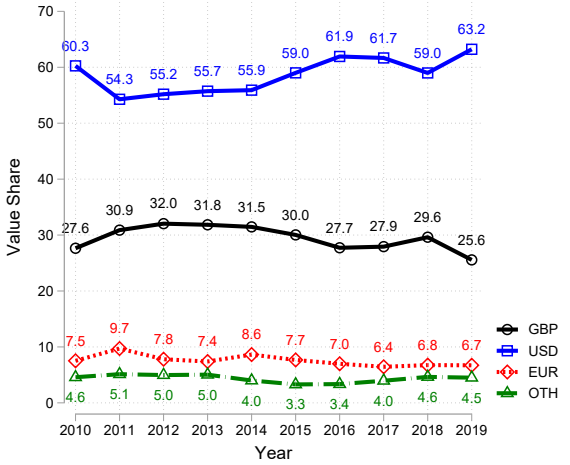
(a) Non-differentiated: Trade value share



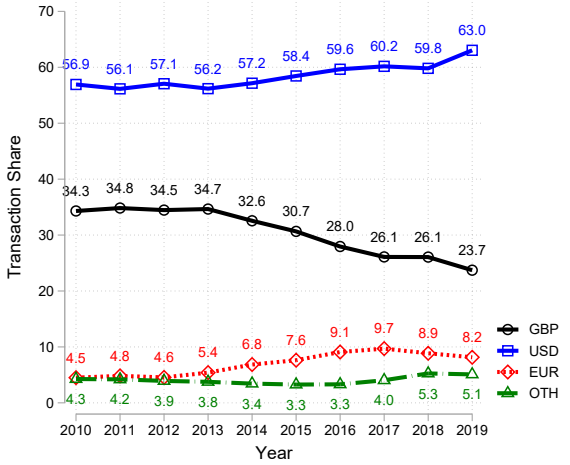
(b) Non-differentiated: Transaction share



(c) Differentiated: Trade value share



(d) Differentiated: Transaction share

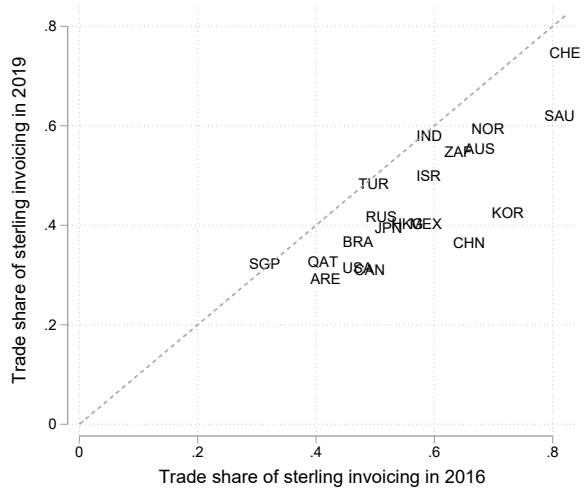


Note: The figure plots the shares of the UK's extra-EU imports invoiced in each currency by product differentiation using the methodology by Corsetti, Crowley, Han and Song (2018). Panels (a) and (c) are based on the value of imports and panels (b) and (d) are based on the number of import transactions. Data source: HMRC administrative datasets.

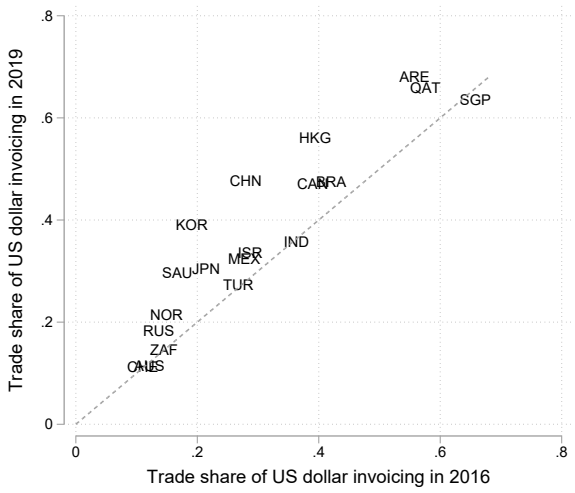
OA1.4 Invoicing currency changes across markets

Figure OA1-9: Invoicing currency for top 20 destinations: 2016 vs 2019
(Export value share)

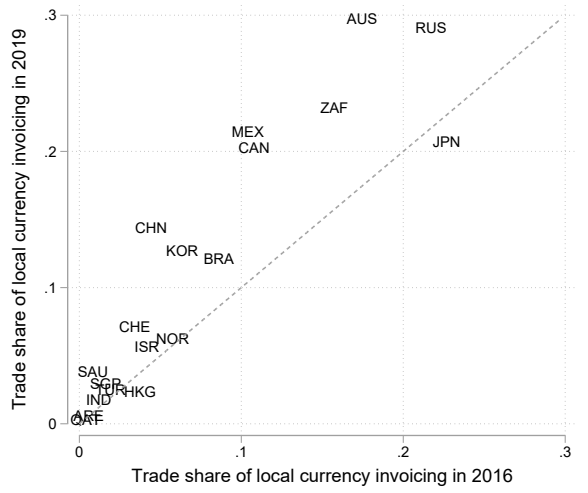
(a) Pound sterling



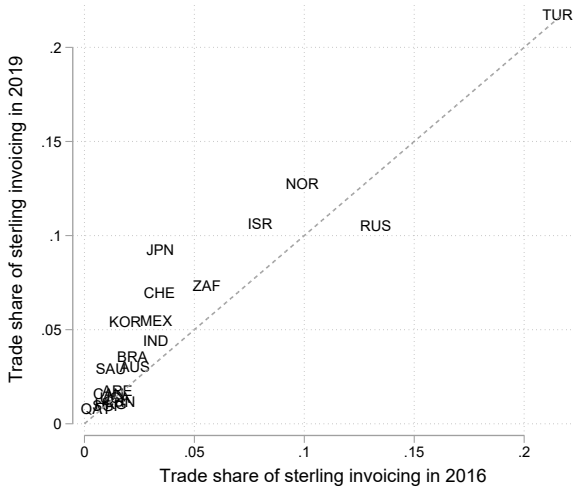
(b) US dollar



(c) Local currency



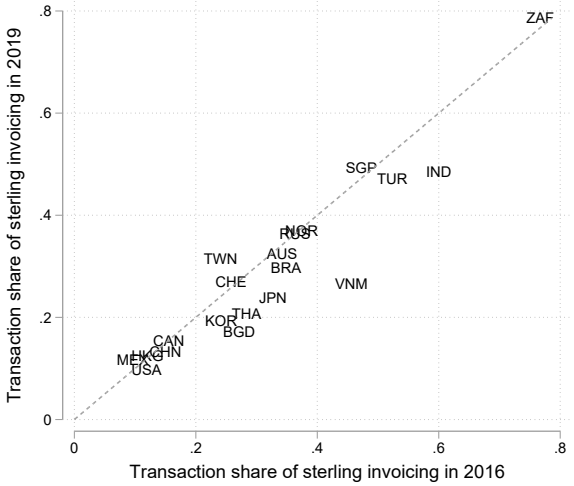
(d) Euro



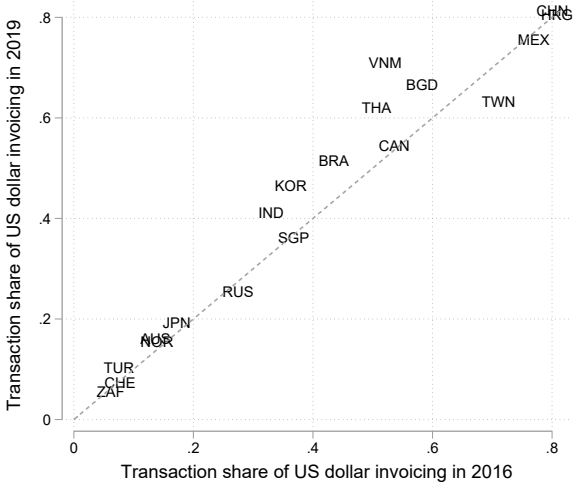
The figure plots the trade value shares of the UK's exports invoiced in each currency across top 20 non-EU destination countries in 2016 on the x-axis and 2019 on the y-axis. Data source: HMRC administrative datasets.

Figure OA1-10: Invoicing currency for top 20 origin countries: 2016 vs 2019
(Import transaction share)

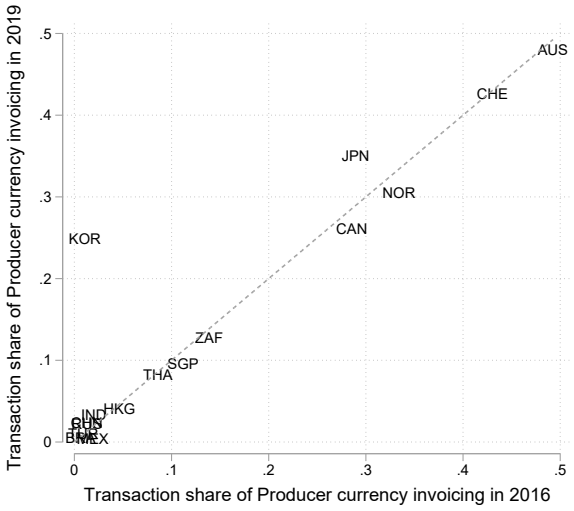
(a) Pound sterling



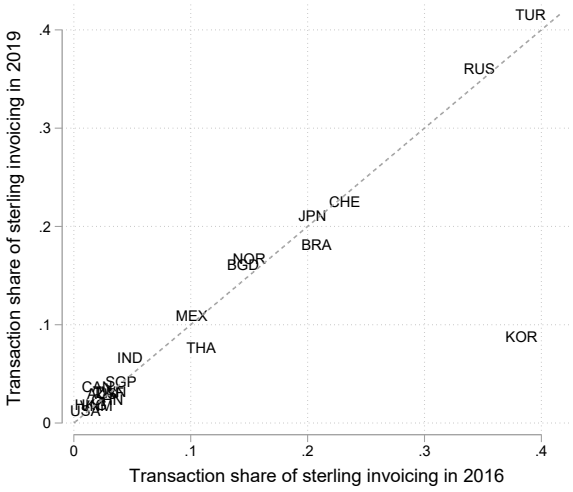
(b) US dollar



(c) Producer currency



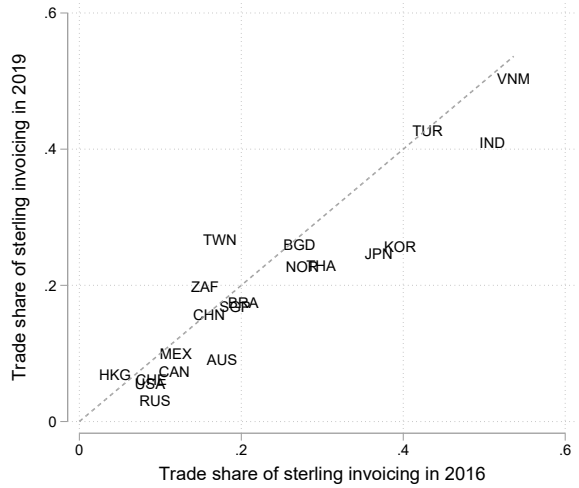
(d) Euro



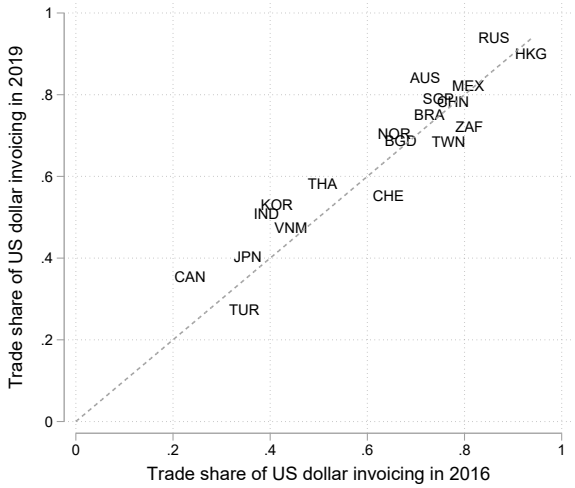
The figure plots the transaction shares of the UK's imports invoiced in each currency across top 20 non-EU origin countries in 2016 on the x-axis and 2019 on the y-axis. Data source: HMRC administrative datasets.

Figure OA1-11: Invoicing currency for top 20 origin countries: 2016 vs 2019
(Import value share)

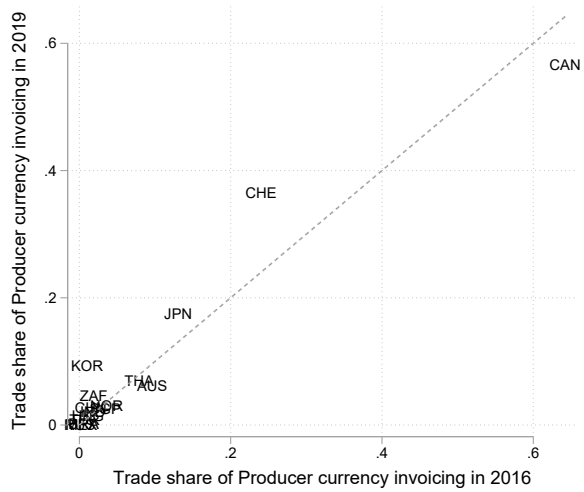
(a) Pound sterling



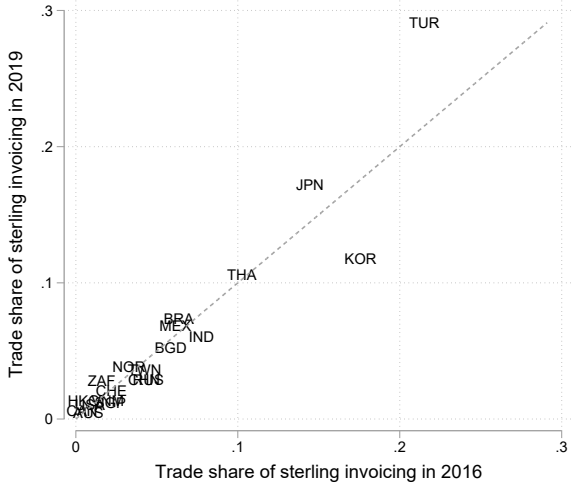
(b) US dollar



(c) Producer currency



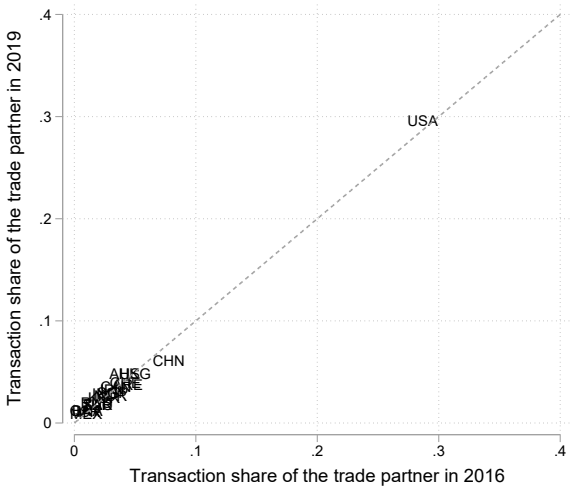
(d) Euro



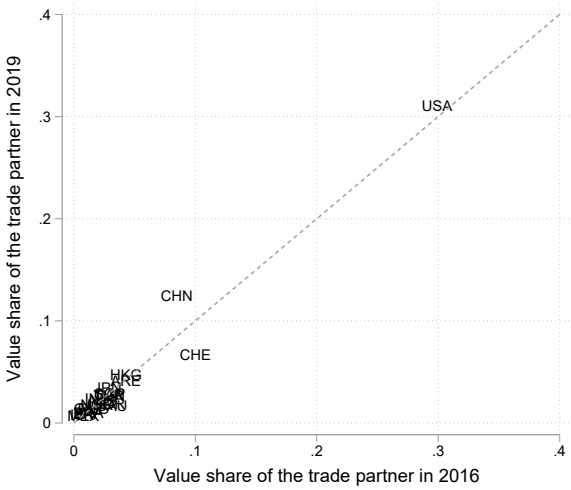
The figure plots the trade value share of the UK's imports invoiced in each currency across top 20 non-EU origin countries in 2016 on the x-axis and 2019 on the y-axis. Data source: HMRC administrative datasets.

Figure OA1-12: UK trade size for top 20 countries: 2016 vs 2019

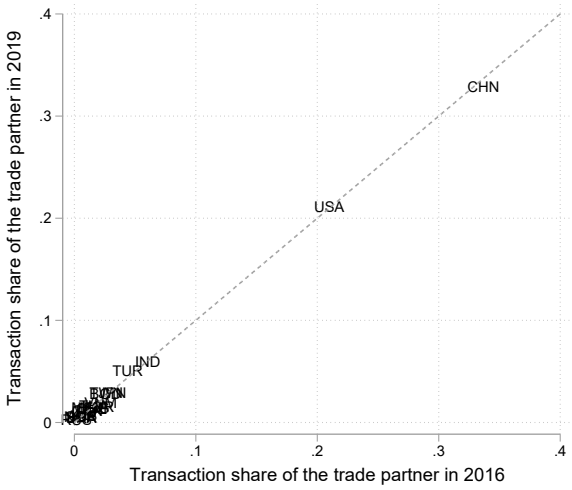
(a) Export transaction share



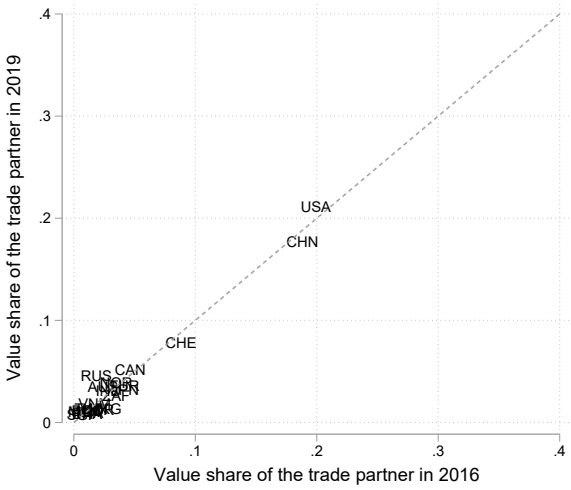
(b) Export value share



(c) Import transaction share



(d) Import value share



The figure plots the total trade shares of the top 20 non-EU countries for the UK's extra-EU trade in 2016 on the x-axis and 2019 on the y-axis. Panels (a) and (b) are based on the number of export transactions and the value of exports, respectively. Panels (c) and (d) are based on the number of import transactions and the value of imports, respectively. Data source: HMRC administrative datasets.

OA1.5 Decomposition based on trade value

Table OA1-1: Decomposition of currency changes by trade margin over 2016-2019 (Export value)

Margins	GBP	USD	EUR	Others	Total
Net firm entry	3,930 (68.5%)	1,505 (26.2%)	150 (2.6%)	154 (2.7%)	5,740 (100.0%)
Exporter entry	7,377 (60.1%)	3,953 (32.2%)	476 (3.9%)	460 (3.7%)	12,268 (100.0%)
Exporter exit	3,447 (52.8%)	2,448 (37.5%)	326 (5.0%)	306 (4.7%)	6,528 (100.0%)
Net market entry	-1,948 (-110.1%)	2,838 (160.3%)	320 (18.1%)	562 (31.8%)	1,770 (100.0%)
Market entry	5,227 (43.9%)	5,097 (42.8%)	815 (6.8%)	778 (6.5%)	11,917 (100.0%)
Market exit	7,175 (70.7%)	2,259 (22.3%)	495 (4.9%)	216 (2.1%)	10,147 (100.0%)
Net product entry	-2,373 (-52.7%)	6,542 (145.2%)	184 (4.1%)	153 (3.4%)	4,506 (100.0%)
Product added	9,685 (41.0%)	12,192 (51.6%)	1,015 (4.3%)	740 (3.1%)	23,633 (100.0%)
Product dropped	12,058 (63.0%)	5,650 (29.5%)	831 (4.3%)	587 (3.1%)	19,127 (100.0%)
Currency switch	-3,193 (-248.9%)	2,656 (207.0%)	380 (29.6%)	1,439 (112.2%)	1,283 (100.0%)
Currency added	2,584 (27.4%)	4,240 (44.9%)	828 (8.8%)	1,782 (18.9%)	9,436 (100.0%)
Currency dropped	5,777 (70.9%)	1,584 (19.4%)	448 (5.5%)	343 (4.2%)	8,153 (100.0%)
Within-currency	-6,412 (-33.7%)	20,311 (106.6%)	1,469 (7.7%)	3,679 (19.3%)	19,049 (100.0%)
Total changes	-9,995 (-30.9%)	33,852 (104.7%)	2,502 (7.7%)	5,987 (18.5%)	32,347 (100.0%)

Notes: This table presents the decomposition of the changes in value of the UK' extra-EU exports in million pounds by trade margin (rows) and by currency (columns) between 2016 and 2019. The numbers in parentheses represent the currency's percentage contribution to each margin, calculated as the change for that currency divided by the sum of all changes identified in this margin (i.e., the number in the Total column). Data source: HMRC administrative datasets.

OA2 Supplementary Estimation Results

OA2.1 Robustness: Regressions at the firm-year level

In this Appendix, we check the robustness of our regression results to an alternative level of aggregation. This is motivated by the findings in Amiti, Itskhoki and Konings (2022) that the bulk of the variation in invoicing currency can be traced to the behavior of firms within given export destinations.[4] Considering this, We employ a difference-in-difference specification at the firm-year level as follows:

$$S^k_{f,t} = \beta_1 \times (\overline{size_f} \times D_t) + \delta_1 \times (\overline{\psi^{\text{Local}}_f} \times D_t) + \delta_2 \times (\overline{\psi^{\text{USD}}_f} \times D_t) + \alpha_f + \nu_t + \epsilon_{f,t} \qquad (1)$$

where all observations are aggregated at the firm-year level. Note that firm variables on the right-hand side of the equation are averaged over the pre-sample period of 2010-2012 (denoted by '$\overline{X}$'), and then interacted with the post-2016 dummy (D_t). Therefore, the estimation period is from 2013 to 2019. This specification hinges on the assumption that the average firm characteristics over 2010-2012 are exogenous to the unanticipated outcome of the 2016 Brexit vote event and subsequent changes in invoicing currency. Table OA2-1 presents the estimation results.[5] Analogous to the previous regressions, we use the transaction shares of each invoicing currency as our baseline outcome. A notable difference from the previous regressions in the text lies in firm size. The coefficient on its interaction term, with its sign unchanged, is statistically significant for both GBP and USD at the 10% level. This suggests that, after the 2016 Brexit vote, larger UK firms had become more inclined to drop GBP and increase their use of both USD and local currencies. Although the estimated coefficients are relatively smaller, the results reaffirm our previous findings that larger UK exporters using more dollar-denominated imports more actively embraced foreign currencies in place of GBP following the 2016 Brexit vote event.

[4] Indeed, our regressions at the firm-year level exhibit higher explanatory power (R-squared) overall.
[5] Summary statistics is provided in Appendix Table OA2-4.

Table OA2-1: Difference-in-difference at the firm-year level

	GBP	USD	Local
	(1)	(2)	(3)
Firm size × post 2016	-0.07*	0.06*	0.03***
	(0.04)	(0.03)	(0.01)
Dollar import share × post 2016	-1.10***	0.87***	0.10
	(0.24)	(0.19)	(0.08)
Local currency import share × post 2016	0.10	0.24	-0.43
	(0.75)	(0.50)	(0.45)
Observations	245,094	245,094	245,094
R-squared	0.72	0.71	0.59
Firm FE	Y	Y	Y
Year FE	Y	Y	Y

Notes: The table reports the OLS estimates for equation (1) in terms of the transaction share of each invoicing currency in UK exports to non-EU countries at the firm-year level (multiplied by 100). Standard errors in parentheses are clustered by firms. Significance: *** p<0.01, ** p<0.05, * p<0.1. Data source: HMRC administrative datasets.

OA2.2 Robustness: trade value share specification at the firm-product-destination-year level

Table OA2-2: Regressions for invoicing currency in UK exports
(Trade value share)

	GBP	USD	Local
	(1)	(2)	(3)
Firm size × post 2016	-0.10	0.03	0.11**
	(0.08)	(0.05)	(0.05)
Local currency import share × post 2016	-1.52	-1.77	4.55
	(1.34)	(1.63)	(3.09)
Dollar import share × post 2016	-2.69***	2.84***	-0.12
	(0.39)	(0.28)	(0.22)
Euro import share × post 2016	-2.96***	-0.31	0.39
	(1.04)	(0.62)	(0.35)
Destination market size × post 2016	-0.08***	0.08***	0.02
	(0.03)	(0.02)	(0.02)
Observations	5,964,067	5,964,067	5,964,067
R-squared	0.471	0.493	0.289
Firm FE	Y	Y	Y
Country-Product FE	Y	Y	Y
Year FE	Y	Y	Y

Notes: The table reports the OLS estimates for equation (2) in the main text with the export *value* share of each invoicing currency as the dependent variable. Standard errors in parentheses are clustered by firms. Significance: *** p<0.01, ** p<0.05, * p<0.1. Data source: HMRC administrative datasets.

OA2.3 Summary statistics for regression variables

Table OA2-3: Summary statistics for regressions of (2) in the main text

variables	count	mean	sd	p1	p25	p50	p75	p99
LCI share of exports (vs)	5,964,067	0.02	0.14	0.00	0.00	0.00	0.00	1.00
LCI share of exports (ts)	5,964,067	0.02	0.14	0.00	0.00	0.00	0.00	1.00
GBP share of exports (vs)	5,964,067	0.71	0.44	0.00	0.00	1.00	1.00	1.00
GBP share of exports (ts)	5,964,067	0.71	0.44	0.00	0.02	1.00	1.00	1.00
USD share of exports (vs)	5,964,067	0.19	0.39	0.00	0.00	0.00	0.00	1.00
USD share of exports (ts)	5,964,067	0.19	0.38	0.00	0.00	0.00	0.00	1.00
EUR share of exports (vs)	5,964,067	0.07	0.24	0.00	0.00	0.00	0.00	1.00
EUR share of exports (ts)	5,964,067	0.07	0.24	0.00	0.00	0.00	0.00	1.00
Destination market size (log)	5,964,067	12.24	2.55	6.93	10.42	12.29	14.02	18.16
Firm size (log)	5,964,067	14.68	3.18	7.91	12.51	14.49	16.64	22.44
Local currency import share	5,964,067	0.01	0.07	0.00	0.00	0.00	0.00	0.24
Dollar import share	5,964,067	0.57	0.40	0.00	0.10	0.69	0.96	1.00
Euro import share	5,964,067	0.06	0.16	0.00	0.00	0.00	0.02	0.95

Notes: The table reports the summary statistics for regressions of (2) in the main text. Here, 'vs' ('ts') indicates the share in terms of trade value (the number of transactions), respectively. The unit of observations is at the firm-product-destination-year level. Data source: HMRC administrative datasets.

Table OA2-4: Summary statistics for regressions of (1) in the appendix

variables	count	mean	sd	p1	p25	p50	p75	p99
LCI share of exports (vs)	245,094	0.02	0.10	0.00	0.00	0.00	0.00	0.57
LCI share of exports (ts)	245,094	0.02	0.09	0.00	0.00	0.00	0.00	0.50
GBP share of exports (vs)	245,094	0.80	0.33	0.00	0.73	1.00	1.00	1.00
GBP share of exports (ts)	245,094	0.81	0.31	0.00	0.71	1.00	1.00	1.00
USD share of exports (vs)	245,094	0.12	0.27	0.00	0.00	0.00	0.05	1.00
USD share of exports (ts)	245,094	0.12	0.25	0.00	0.00	0.00	0.08	1.00
EUR share of exports (vs)	245,094	0.06	0.18	0.00	0.00	0.00	0.00	1.00
EUR share of exports (ts)	245,094	0.06	0.18	0.00	0.00	0.00	0.00	1.00
Firm size (log)	245,094	10.90	2.56	5.81	9.06	10.80	12.59	17.25
Local currency import share	245,094	0.03	0.14	0.00	0.00	0.00	0.00	0.88
Dollar import share	245,094	0.50	0.43	0.00	0.00	0.56	0.98	1.00
GBP exchange rate volatility	245,094	0.03	0.01	0.02	0.02	0.03	0.04	0.04

Notes: The table reports the summary statistics for regression (1) in this appendix. Here, 'vs' ('ts') indicates the share in terms of trade value (the number of transactions), respectively. The unit of observations is at the firm-year level. Data source: HMRC administrative datasets.

References

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