Dominant Currency Pricing Transition

Marco Garofalo* Giovanni Rosso† Roger Vicquéry‡

First draft: December 4, 2023
This draft: March 20, 2025

[NOT FOR CIRCULATION]

Abstract

We study a unique episode of the transition to dominant currency pricing: the "dollarisation" of UK exports following the 2016 Brexit referendum. After the pound's 2016 depreciation, the share of non-EU UK exports invoiced in the domestic currency fell by over 20 percentage points, with increases in invoicing in local currency, the euro, and the US dollar. By 2019, the US dollar had become the primary invoicing currency for non-EU exports, reflecting its established role in UK imports. Using transaction-level UK trade data and in line with the predictions of an analytical theoretical model, we show that significant, lasting shifts in currency risk can drive aggregate changes in invoicing practices. We find evidence for a "speculative currency switching" channel, where firms switch to currencies with higher expected returns, regardless of hedging needs or factors like strategic complementarities and market power. Finally, we estimate that this shift has important aggregate effects: a US dollar appreciation now reduces demand for UK exports by twice as much as before this transition.

JEL Codes: F14, F31, F41
Key Words: Invoicing currency of trade; Dominant currency pricing; Foreign-exchange mismatch; Firm-level data; Exchange-rate pass-through; Brexit.

*University of Oxford, Bank of England and CfM, email: marco.garofalo@economics.ox.ac.uk.
†University of Oxford, email: giovanni.rosso@economics.ox.ac.uk.
‡Bank of England and CfM, email: roger.vicquery@bankofengland.co.uk.

We are grateful to Kai Arvai (discussant), Kenza Benhima (discussant), Ambrogio Cesa-Bianchi, Andrea Ferrero, Robert Johnson, Isabelle Mejean (discussant), Thomas Prayer, Ricardo Reis, Hélène Rey and Liliana Varela for valuable comments and suggestions. We would also like to thank for helpful discussions the participants to the LSE-Oxford Workshop in International Macroeconomics and Finance, the Joint BIS-BoE-ECB-IMF Spillovers Conference, the BdF-BoE-BdI International Macroeconomics Workshop, the ESCB Research Cluster 2 Annual Workshop, the Macro-group seminar at University of Oxford, and the Brown-bag seminars at the Bank of England. All errors and omissions remain our own. The views expressed in this paper are those of the authors and not necessarily those of the Bank of England and its committees. HM Revenue & Customs (HMRC) agrees that the figures and descriptions of results in the attached document may be published. This does not imply HMRC's acceptance of the validity of the methods used to obtain these figures, or of any analysis of the results. This work contains statistical data from HMRC which is Crown Copyright. The research datasets used may not exactly reproduce HMRC aggregates. The use of HMRC statistical data in this work does not imply the endorsement of HMRC in relation to the interpretation or analysis of the information.

1 Introduction

What determines the currency of invoicing of international trade? This is a defining question in international macroeconomics. The fact that a large share of international transactions are denominated in US dollars is central to the understanding of the international propagation of shocks and the international financial system (Gopinath et al., 2010). This dollar Dominant Currency Paradigm (DCP) is underpinned by network effects and is consistent with remarkably stable patterns in invoicing currency choices (Boz et al., 2022). However, we know that discontinuities in the role of international currencies have occurred in the past. Our paper empirically contributes to the key question of which forces can generate changes in dominant currency equilibria. We offer three contributions.

First, we document, using transaction-level data, a unique episode of rapid aggregate shift in export pricing patterns in a large developed economy: the dollarisation of UK exports in the aftermath of the 2016 Brexit referendum. In the aftermath of the June 2016 Brexit referendum and the subsequent depreciation of the pound, the share of non-EU UK exports invoiced in pounds started to sharply decrease. It went from about 55% in 2015 to 35% in 2022. At the same time, as shown in Figure 1, US dollar (USD) invoicing has surged from around one third to nearly 55%.[1] While euro (EUR) and local currency pricing (LCP) have also increased (Figure 1), the majority of extra-EU UK exports is now invoiced in USD, the dominant vehicle currency of international trade (Boz et al., 2022): a *dominant currency pricing transition*.

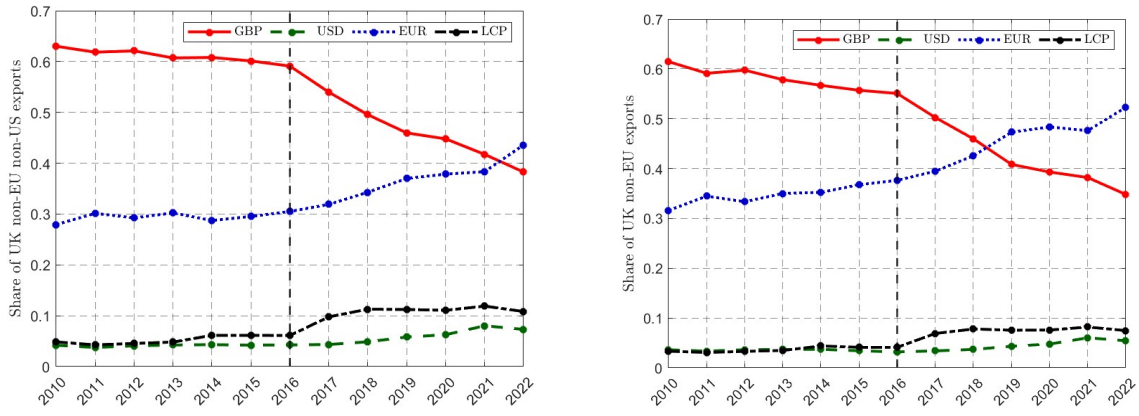
Second, guided by a simple theoretical framework, we provide causal evidence that large foreign-exchange shocks can endogenously determine invoicing currency decisions. Firstly and in line with the literature we find that *dynamic operational hedging* considerations matter. If a firm imports many inputs denominated in a particular currency, it is more likely to switch invoicing of its exports to the same currency, providing a natural hedge against domestic currency fluctuations. We then identify a new *speculative currency switching* channel, whereby firms can change the invoicing of their receivables instead of increasing the quoted price when the domestic currency is expected to depreciate. This regardless of their hedging needs to cover or other established drivers of invoicing decisions, such as strategic complementarities and market power.

Finally, we show that the aggregate macroeconomics impact of this Dominant Currency Pricing Transition: a US dollar appreciation under DCP (after 2016) depresses medium and long-rundemand for exports by twice more than under producer currency pricing (i.e. before 2016).

The conditions under which new equilibria in the use of international currencies might emerge are a key but relatively unexplored question in the DCP literature (Gopinath & Itskhoki, 2022) and one that is increasingly relevant as questions are raised on the sustainability of current levels of Dollar dominance in a more multi-polar world (Frankel, 2023).

Our study provides a unique empirical setting to study aggregate changes in international

[1] We also report headline results excluding the US as a non-EU destination to control for the fact that the USD is a producer rather than vehicle currency for that country. The invoicing change is similarly large when we exclude exports to the US: the GBP value share of UK exports to non-EU non-US countries has fallen from about 63% before 2015 to 38% by 2022, with USD invoicing increasing from one third to 45% (Figure 1).



(a) Including exports to US.

(b) Excluding exports to US.

Figure 1: Currency shares of UK non-EU exports.

Source: HMRC administrative datasets, UK non-EU exports, 2010–2022.

trade pricing paradigms, using granular firm-level data. Although we know from history that abrupt shifts in the international monetary system can occur (Eichengreen et al., 2018; Vicquéry, 2022), transitions such as the one we study in this paper have been remarkably rare in recent decades. The stability of aggregate invoicing patterns is apparent in the cross-country dataset compiled by Boz et al. (2022) and, *a fortiori*, in the existing firm-level data studies focusing on a selected group of countries. As an example, the transition we study is faster and either larger or comparable in magnitude to the one experienced by Eastern European countries that shifted their invoicing from dollars to euros as part of EU accession in the early 2000s (Mehl & Mlikota, 2023).

Why did this *Dominant Currency Pricing Transition* materialise? Two remarkable features set apart our empirical setting.

First, pre-Brexit UK trade invoicing exhibited remarkably high levels of producer currency pricing on the exports side, while imports were largely invoiced in US dollars: UK firms were running an operational USD-short position. Second, the unexpected result of the EU referendum resulted in a "currency crash"[2] of a magnitude that is unusual for a large advanced economy. We document, relying on text-based analysis, that it permanently increased currency risk as perceived by UK firms.

At the firm level, the interaction between the pre-Brexit lack of operational hedging with the post-Brexit shock to UK currency risk, gave rise to a large revaluation of firms' payables in foreign currency, in line with a currency invoicing version of "original sin". This drove a desire to increase dollar receivables and absorb the currency mismatch.

However, we document how the change in invoicing patterns was also driven by firms with little or no exposure to a (USD) payables revaluation. As the pound starts to be durably perceived as a "soft" currency, this is consistent with firms choosing to invoice their foreign receivables in currencies with positive expected returns in pound (i.e. for which the opportunity cost of continuing invoicing in pounds is higher).

[2]Consistent with the definition by Reinhart and Rogoff (2008).

We find strong evidence in favour of this novel "speculative invoicing" channel, whereby firms decrease pound invoicing more towards destinations with higher local currency appreciating potential. We show this channel responds to typical asset allocation risk factors, such as FX "momentum" and "value" (i.e. appreciating potential according to professional forecasters).

Finally, we document how this large transition in aggregate invoicing patterns has important macroeconomic consequences for export pass-through (ERPT) and the allocative effects of price rigidities. UK exports exhibit significantly higher elasticity to USD exchange rate movements after the Brexit referendum, with a US dollar appreciation estimated to depress demand for exports by twice as much than before this transition.

Related literature. This paper draws on and contributes to four main strands of the literature.

First, our study follows a flourishing literature on currency invoicing decisions and exchange-rate pass-through using disaggregated microdata (Auer et al., 2021; Barbiero, 2022; Chen et al., 2022; Chung, 2016; Crowley et al., 2022; Devereux et al., 2017; Goldberg & Tille, 2016). A distinguishing feature of our data setting is the presence of a large aggregate transition in invoicing patterns, driven by a large exogenous shock. This allows us to investigate the dynamics of currency invoicing choice. Previous studies, constrained by the remarkably stable nature of aggregate invoicing patterns they observe, looked at determinants of currency invoicing in a *static* framework. As a prominent example, Amiti et al. (2022), looking at Belgian trade micro-data, find evidence in favour of DCP being driven by strategic complementarities and the willingness of firms to match the currency of their inputs. In their sample, switches in invoicing represent only 2.6% of firm-product-destination-month observations over four years. Previous studies relying on UK micro-data up to the Brexit referendum paint a similar picture. In their analysis of ERPT around that event, Corsetti et al. (2022) report a slow-moving aggregate trend towards more USD pricing.[3]

Closely related to our study, Crowley et al. (2022) analyse the firm-level determinants of invoicing choice for UK exporters, looking at the pre-Brexit part of the sample we consider. They highlight prior experience in the use of the dollar, as well as strategic complementarities, as key determinants of DCP in the cross-section. Similarly to the empirical setting we examine, the work of Auer et al. (2021) relies on a large exogenous movement in exchange rates. They investigate the implications of invoicing in different currencies amid the de-pegging of the Swiss franc in 2015, which led to a sharp appreciation. In contrast with our study, only 2.5% of observations switch their invoicing pattern in the period considered. A study relying on the same CHF appreciation episode and transaction data is Bonadio et al. (2020). Our key finding that invoicing patterns can endogenously respond to foreign-exchange movements relates and borrows from some of the tools used in Barbiero (2022) to study the cash-flow effects of currency mismatches for French firms.

In line with previous literature, we also investigate the macroeconomic implications of invoicing in different currencies for export prices and quantities. Amiti et al. (2022) found a causal relationship between currency invoicing, prices and quantities of exports. We confirm in

[3]We show the pre-2016 trend towards USD pricing for export invoicing is entirely due to trade flows towards the US, while the share of USD invoicing towards non-EU, non-US destinations remained stable until 2016.

our study that changes in prices are allocative, but additionally show that, as the composition of the basket of invoicing currencies changes, aggregate quantities elasticity also changes. This is all but a forgone result given the ambiguous effect of dollarisation on price rigidities, as highlighted by McLeay and Tenreyro (2024).

Second, our study relates to the literature on endogenous currency choice. Mukhin (2022) provides a general equilibrium model of the international price system where dominant currencies arise endogenously as a result of input-output linkages, and variances and covariances of exchange rates. Furthermore, Amiti et al. (2022) draw on previous contributions from Engel (2006) and Gopinath et al. (2010) to provide a static framework for studying determinants of currency of invoicing.

Third, our study follows a large literature on "original sin" (Eichengreen & Hausmann, 1999) and the role of foreign-exchange mismatches and in international borrowing. The effect of currency mismatches in international trade has received comparatively less attention but recent contributions have examined the role of valuation effects (Barbiero, 2022) and the extent to which firms involved in international trade are able to rely on derivative instruments to hedge their currency risk (Alfaro et al., 2023; Berthou et al., 2022; Lyonnet et al., 2022). We further link to this literature connecting trade and corporate finance with our novel channel of endogenous invoicing driven by exports' speculative motives regarding their receivables in foreign currencies, and responding to typical asset allocation risk factors, such as FX momentum (Aloosh & Bekaert, 2022; Menkhoff et al., 2012; Zhang, 2022).

Finally, our paper speaks to the literature concerned with discontinuities in the international monetary system. An important body of historical work (Chiţu et al., 2014; Eichengreen & Flandreau, 2009; Vicquéry, 2022) has highlighted how shifts in past patterns of dominant currencies have not been gradual nor rare. As summarised by Eichengreen et al. (2018), network externalities have not prevented rapid shifts in dominant currency status in the past, nor can explain the transition from pound to dollar dominance that occurred as soon as the interwar period. This historical literature has inspired several theoretical frameworks, focusing on multiple equilibria in the international monetary system (Farhi & Maggiori, 2018; Krugman, 1980; Rey, 2001) or certain historical features of the global safe asset issuer (Arvai & Coimbra, 2023; Coppola et al., 2023). Our paper also relates to a debate on whether the euro or the renminbi might play a more prominent role in the future, and which policies are more likely to foster their use as vehicle currencies (Bahaj & Reis, 2022; Ito & Kawai, 2016). Recent geopolitical events have in particular raised the prospects of moves towards de-dollarisation of sanctioned countries, which Berthou (2023) and Chupilkin et al. (2023) find some evidence of looking at invoicing microdata. Closely related to our paper, Mehl and Mlikota (2023) consider rare episodes, related to the EU enlargement process in the early 2000s, of aggregate invoicing transitions from the dollar to the euro, and evaluate theoretical predictions on the relevant channels of dominant currency transition. In contrast to our study, they rely on cross-country evidence at the annual frequency.

The rest of the paper is organised as follows. Section 2 presents our data, while Section 3 highlights the unique features and novel facts on the Brexit 2016 depreciation, firm-level FX risk and currency management. Then in Section 4 we describe a simple analytical theoretical

model guiding our analysis. Section 5 documents the new channel of speculative invoicing and the role played by other channels established in the literature. In Section 6, we explore the question of aggregate ERPT using both empirical specifications described above. Finally, Section 7 concludes.

2 Data

In this section we describe our data. Our main source is transaction-level customs declaration of export and import flows for the UK, combined with firm-level information on tax returns from HMRC, as well as balance sheet and capital structure data from FAME-BvD and Capital IQ, respectively. We also collect aggregate product-country trade series from UN Comtrade, realised bilateral exchange rates from the BIS and exchange rate forecasts from Consensus Economics.

Customs data HMRC (His Majesty's Revenue and Customs) collects data on the universe of exports and imports recording the day (when the product enters or clears UK customs), the UK trader identifier, Combined Nomenclature (CN) 8-digits product, country of destination or origin, value in pound, quantity and, for non-EU transactions (from firms whose yearly exports are above the threshold of £100,000), the currency of invoicing. These data on currency of invoicing are available from January 2010 up to and including December 2022 (our latest data-point available), thus spanning an interval of six years on either side of the 2016 EU referendum. We follow Freeman et al. (2024) to set up and clean the dataset, in particular in aggregating HMRC trader identifiers at the level of VAT units, so as to have a clearer interpretation of what constitutes a "firm" in our data. Finally, since USD pricing considerations for exports towards the US represent a "special" case, as USD pricing should be classified as local currency pricing (LCP) for exports towards the US, we will always indicate and justify whether the empirical analysis includes or not exports/imports to/from the US. We give further details on our dataset in Appendix A.

VAT data The HMRC Value Added Tax (VAT) dataset sources information for all UK businesses with annual taxable turnover above a threshold directly from tax returns.[4] For every financial year, it includes details on VAT IDs' total sales and purchases. From this dataset we employ data on total firm-level output and inputs in 2015, the latest available pre-Brexit financial year in 2015. We then use this information to calculate different measures of firm-level exposure for our empirical analysis.

Balance sheets We match customs data with datasets including information on businesses' balance sheets from two main sources: FAME-BvD and Capital IQ. The former dataset provides detailed balance sheet data for UK firms. While the frequency of the observations is exclusively annual, the coverage of the dataset is large, including a large sample of private businesses. Furthermore, we source information on firm-level *outstanding* liabilities by currency and debt instrument from S&P Capital IQ.

[4]This threshold was £77,000 in 2012-2013 and then was increased to £85,000 in 2019-2020.

UN Comtrade dataset We retrieve data on HS6 product-origin-destination-month level exports and imports from UN Comtrade to create firm-specific measures of exporter's market shares within destinations. To clean the raw data, we exclude re-exports, re-imports, and trade with the UK. We then aggregate the data to the HS6 product-country-quarter level.

Exchange-rate data and forecast series We source bilateral spot daily exchange rates against the US dollar from the BIS, and monthly forecast for a select number of currencies from Consensus Economics.[5] The latter is a widely recognized survey of professional forecasters of exchange rates, including banks and market participants. It provides both short-term and long-term exchange rate forecasts across multiple currency pairs, e.g. at 3 month and 1 year ahead, which are the series we consider in our analysis. The Consensus Forecast dataset is particularly valuable for its reflection of market participants' expectations, which we assume are likely to be a good proxy for and broadly capturing also the expectations of non-financial businesses such as UK exporters and importers.

3 The Brexit currency crash and the permanent shift in firm-level expectations

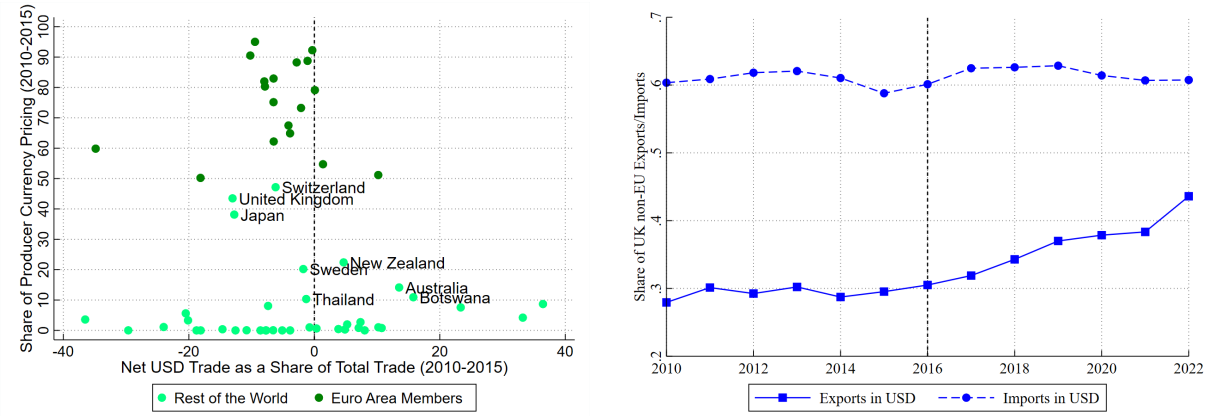
The context in which the UK dominant currency pricing transition unfolds presents two striking features, in terms of pre-Brexit invoicing patterns and characteristics of the Brexit FX shocks. In this section we examine them in turn and then highlight their implications for firm-level foreign-exchange valuation effects.

3.1 The British Pound as an Invoicing Currency

Looking at the cross-country data compiled by Boz et al. (2022), shares of Producer Currency Pricing (PCP) in exports are typically zero or very low, in line with the Dominant Currency Paradigm. Only a selected group of countries seem to be able to invoice exports in their domestic currency. This typically includes issuers of highly liquid, freely convertible currencies[6]. As shown in Figure 2a, over 2010-2015 this was particularly true for Switzerland, the UK and Japan, invoicing respectively 47%, 43% and 38% of their exports in their domestic currency. The three countries were also clear outliers in terms of their net transactions in dollars, registering a net deficit in USD denominated trade flows. In other words, exporters in Switzerland, the UK and Japan were uniquely able to issue receivables in their own currencies, while running an aggregate net short USD position from their operations.

[5]The economies whose currencies we have forecast data for are: Euro-Area, Argentina, Armenia, Australia, Azerbaijan, Bangladesh, Belarus, Bolivia, Brazil, Canada, Chile, China, Colombia, Costa Rica, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Georgia, Guatemala, Honduras, Hong Kong, India, Indonesia, Israel, Japan, Kazakhstan, Korea, Malaysia, Mexico, New Zealand, Nicaragua, Nigeria, Norway, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Russian Federation, Saudi Arabia, Singapore, South Africa, Sri Lanka, Sweden, Taiwan, Thailand, Turkey, Turkmenistan, Ukraine, United Kingdom, Uruguay, Uzbekistan, Venezuela, Vietnam.

[6]The same group of currencies is found to play a role in central banks reserve allocation strategies alongside the dollar and the euro. See Arslanalp et al. (2022) for a survey of recent trends in the role of small open economy currencies in reserve portfolios.



(a) Producer Currency Pricing vs. Net USD Trade. (b) USD Exports and Imports in the UK.

Figure 2: Export PCP and USD Invoicing in UK Trade.

Notes: Panel (a) compares the prevalence of export Producer Currency Pricing as a share of exports (vertical axis) to net trade flows invoiced in USD as a percentage of total trade (horizontal axis) across countries, relying on data compiled by Boz et al., 2022. Panel (b) shows the evolution of USD invoiced imports and exports in UK non-EU trade derived from HMRC administrative datasets.

As shown in both Figure 1 and 2b, this British pound "exceptionalism" in global invoicing patterns was partly called into question from 2016 onward. Indeed, the operational currency positioning of UK firms meant that they were particularly vulnerable to adverse movements in GBP-USD exchange rates[7]. An extreme such movement materialised in the aftermath of the Brexit referendum on the 23rd of June 2016. The eventual outcome of the vote was largely unexpected (O'Rourke, 2019), including by market participants. It resulted in the biggest one-day depreciation in a G4 currency since the 1971 Nixon shock[8]. The 2016 annual drop of the pound against the dollar is furthermore in line with the definition of a currency crash in the crisis classification by Reinhart and Rogoff (2008).

Invoicing patterns reacted swiftly in the aftermath of June 2016. UK firms reduced receivables issued in GBP to 35% of non-EU exports, while also reducing the mismatch between receivables and payables denominated in USD (driven by an increase in the share of USD export invoicing from 30% to 45%).

Invoicing patterns are well documented to be extremely persistent in both cross-sectional and firm-level data. This raises the question of why this particular currency crash would have permanently affected invoicing patterns. After all, the peculiar role of the pound as an international currency we highlighted above survived a larger "crash" in the not so distant past. In the unfolding of the Global Financial Crisis (GFC), the British pound went from a peak of 2.11 USD per GBP in November 2007, to about 1.40 USD per GBP, a fall of 35%. We are unable

[7]Financial hedging could of course have isolated them from adverse movements in the pound but is unlikely to meaningfully matter for our results. As highlighted by Alfaro et al. (2023) in a micro-data setting, financial hedging by NFCs is far from complete and limited to large firms and transactions. We are unable to observe financial hedging for firms in our sample. However, Hacioglu-Hoke et al. (2024) study how positioning in FX derivatives differs across types of market participants, looking at the universe of transactions in the London market. Reassuringly, they observe how the aggregate FX derivative position of UK NFCs does not change around the Brexit shock, confirming it was not a meaningful margin of adjustment for most firms.

[8]As described by Costa et al. (2024), the 4.7% drop in the pound that occurred in the twenty minutes following the reporting that Sunderland voted leave at 12.20am on the 24th of June 2016 was alone bigger in magnitude than the Black Wednesday pound crash of 1992.

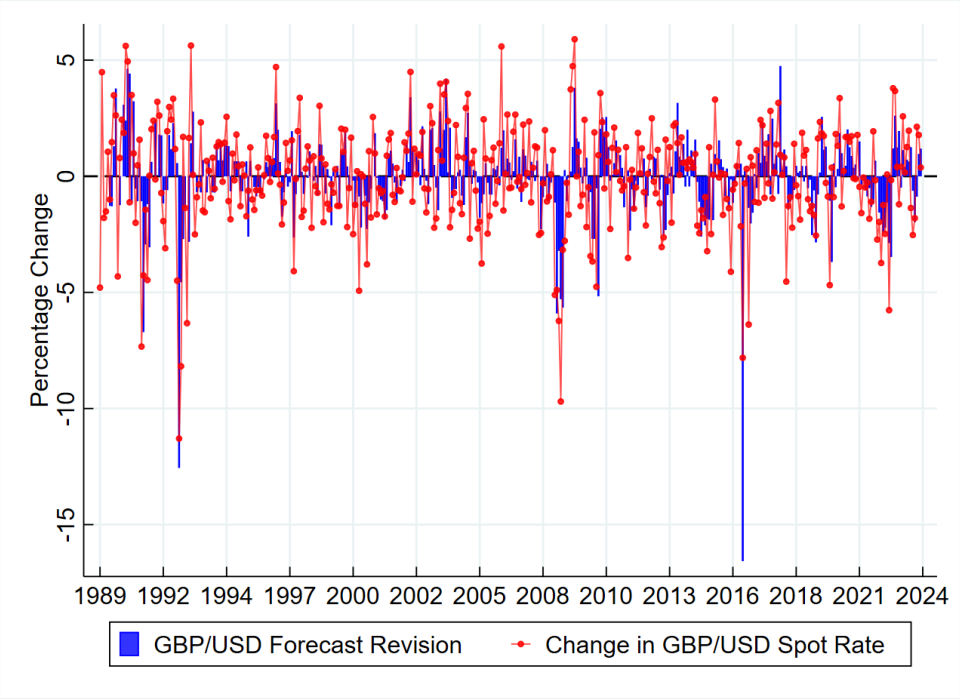


Figure 3: Revisions to 1-year ahead forecast of the GBP/USD exchange rate and realised spot monthly changes of GBP/USD.

Source: Consensus Economics and Bank of England.

to observe invoicing patterns in the UK before 2010 and are therefore not in a position to say whether the mechanisms we highlight were already at play in previous episodes of currency shocks in the UK.

Nevertheless, in what follow we show the 2016 pound crash was different from the 2008 one, along two key dimensions.

3.2 The 2016 Pound "Crash"

We argue that, compared to similar episodes such as the GFC, the 2016 pound crash implied a revision of agents expectations that was significantly more sudden and which permanently negatively shifted perceptions of UK currency risk.

3.2.1 A Uniquely Sudden Revision of Professional FX Forecasts

Firstly, while the *realised* drop in the exchange rate was smaller in magnitude than in 2007-2009, it unfolded in a matter of hours (Costa et al., 2024) rather than over several months. It implied a sudden radical update of expectations on the future path of the UK economy, which had meaningful economic implications (Dhingra & Sampson, 2022). Looking at professional forecast revisions we can show that the pound crash of June 2016 implied a much stronger signal to market participants than previous episodes of pound weakness, including during the GFC. Figure 3 shows the revision of the 1-year ahead Consensus Forecast expectations[9] for the GBP/USD exchange rate (the blue bars) alongside realised GBP/USD monthly changes

[9]The implications of the chart are robust to using other horizons for the forecasts (e.g. 3-month or 2-year).

(in red). Consider how, typically, forecasters tend to adjust their monthly forecast by roughly the amount of the observed appreciation/depreciation. This is in line with the view of the exchange rate as a random walk. In June 2016, however, we see that a realised drop of around 6% was met with a forecast revision that was three times as large. That is, given the size of the realised depreciation, agents adjusted their expectations of the path of the exchange rate significantly more in 2016 than they did in any other episode, suggesting that this episode was indeed different. As the invoicing decision is a forward-looking one, what matters is not the exchange rate realisation per se, but how it is incorporated in the way agents form expectations. The 2016 depreciation represents a clear outlier in this sense.

3.2.2 Permanently More Negative Perceptions of UK Currency Risk in Firms Earnings Calls

Secondly, this revision of expectations was not only very significant in magnitude but resulted in a permanent shift in agents' perception of UK currency risk. This is apparent from a simple text-based analysis of earning calls by UK listed firms[10], in line with similar measures pioneered by Hassan et al. (2019) to analyse firms perceptions of political risk.

In a nutshell, we identify how many times keywords related to UK currency risk, such as "weak gbp" or "pound depreciation", appear in the transcripts of these calls. We compute the number of sentences in which which mentions of these phrases of interest occur, normalised by the total number of sentences, to construct two indices, of GBP "risk" and GBP "negative sentiment" respectively. Following Hassan et al. (2019) the GBP "risk" index is constructed as:

$$GBP_{Risk_{i,t}} = \frac{1}{L_{i,t}} \sum_{l=1}^{L_{i,t}} \{l = "gbp", "depreciation", "pound", (...)\} \times 1[|l - r| < 10] \qquad (1)$$

where $L_{i,t}$ is the total number of words occurring in the earning call of firm i in quarter t, and r represents the location of the nearest word indicating risk or uncertainty.

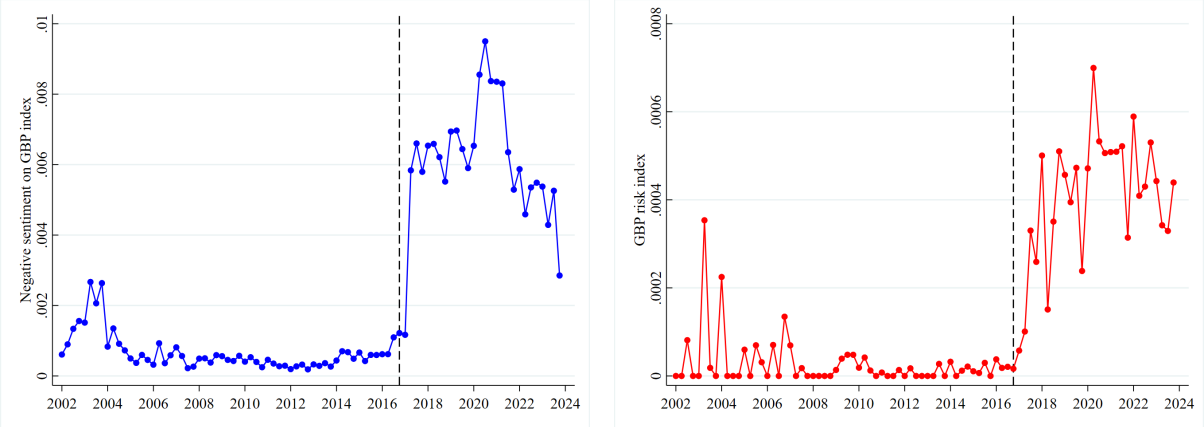
Similarly the GBP "sentiment" index as

$$GBP_{Sentiment_{i,t}} = \frac{1}{L_{i,t}} \sum_{l=1}^{L_{i,t}} \{l = "gbp", "depreciation", "pound", (...)\} \times \left(\sum_{c=l-10}^{l+10} S(c) \right) \qquad (2)$$

which conditions on proximity to positive or negative words and where S indicates sentiment, that is it takes on a different sign depending on whether the term has a positive, negative or neither connotation.

Figure 4 plots the quarterly average across firms of the two indices. We identify a clear structural break in the perception of currency risk by UK firms. Before 2016, except for modest uptick in 2003 and around the GFC, both risk and negative sentiment about the pound and UK currency risk remained at very low levels. Risk and negative sentiment spiked up in 2016

[10] We perform the analysis relying on NL Analytics, an automated tool that allow the extraction of data from transcripts of the universe of English-language earning calls.



(a) GBP Negative Sentiment Index.

(b) GBP Risk Index.

Figure 4: Quarterly averages across firms of text-analysis indices based on earning calls of listed UK companies.

Source: NL Analytics and authors' calculation.

and keep fluctuating around a permanently new higher mean. This suggests persistently higher levels of perceived currency risk in the UK following the Brexit referendum and the 2016 pound crash.

4 Dynamic channels of endogenous currency choice

In this section, we develop a stylized theoretical framework to guide the empirical identification of two dynamic channels influencing currency choice.

The first channel is *dynamic operational hedging*. Intutively, if a firm imports many inputs denominated in a particular currency, it is more likely to move its invoicing to the same currency, providing a natural hedge against fluctuations.In other words, firms with greater currency mismatches—particularly those importing relatively more inputs in USD—are more inclined to shift their invoicing currency to USD following significant downward revisions in expectations regarding GBP.

The second channel we introduce is novel and we dub it *speculative currency switching*. Its mechanism is intuitive. In the presence of sticky prices, think of an exporter who has been invoicing transactions in GBP and that suddendly expects a GBP depreciation. To avoid revenue losses due to currency devaluation, the exporter has two alternatives: raise the GBP-denominated price in the current period or maintain the existing GBP price and switch to a different invoicing currency. If short-run demand is relatively inelastic to exchange rate induced price changes, switching currencies is clearly advantageous for the exporter. Indeed, we demonstrate in the microdata that post-2016, exporters could increase revenues by shifting from producer currency pricing (PCP) to destination currency pricing (DCP), experiencing an insignificant impact on demand.

4.1 Baseline Model of Currency Choice

We focus on the two-period problem of a representative domestic exporting firm, which optimally chooses its price and optimal currency of invoicing. The firm can invoice either in its domestic currency (GBP) or a foreign currency (USD). The exchange rate between GBP and USD in the second period is S, while in the first period is normalised to 1. If $S > 1$ it means a depreciation of the domestic currency. Because of nominal rigidities the firm sets optimal price in Period 1 (before S is realized) and cannot adjust afterward. Therefore, while the firms knows the realisation of the exchange rate in period 1, it does not know S. The firm prefers DCP if

$$\Pi(P^*_{USD}) > \Pi(P^*_{GBP}) \tag{3}$$

that is

$$\Big[(1+S)P^*_{USD} - 2c\Big]Q(P^*_{USD}) > 2(P^*_{GBP} - c)Q(P^*_{GBP}) \tag{4}$$

where P^*_{USD} is the optimal price in USD P^*_{GBP} is the optimal price in GBP and $Q(\cdot)$ is a generic demand function. In order to determine what factors drive the above inequality it is crucial to adopt an empirically relevant notion of demand. We do this in the next subsection.

4.2 The shape of demand

As also highlighted by Corsetti et al., 2022, export prices responded to the Brexit depreciation in radically different ways across pricing regimes. As figures A.14 and A.15 in the appendix show, export prices measured in the domestic currency (GBP) moved one to one with the depreciation for transactions invoiced in USD or in local currency, while they barely moved on impact and only very slowly adjusted for transactions in GBP. This is a direct consequence of sticky prices in the currency of invoicing. Consequently, exporters using the GBP experienced a fall in their price (in domestic currency terms) and thus their revenues, while those invoicing in USD were sheltered from this. This comparison is however not totally meaningful as it could be affected by sample composition effects. We overcome this by exploiting the richness of the microdata. We identify firm-product-destination triplets in which more than on currency was employed before and through June 2016. We can then directly test whether a firm selling the same product to the same destination could have higher revenues by invoicing in USD instead of GBP. To do this we run the following specification on the sample of multi-invoicer triplets:

$$y^{USD/GBP}_{fpjt} = \alpha + \delta_{fpj} + \delta_t + u_{fpjt} \tag{5}$$

where the dependent variable is either the (logarithm of) ratio between the unit price (defined as nominal value over volume in net mass) in USD and in GBP of product p exported by firm f to destination country j in a given month t, or the equivalent ratio for the volume of these triplets for those invoiced in USD and in GBP. As we include a constant α and a set of firm-product-destination fixed effects δ_{fpj}, the estimated time fixed δ_t reflect the average evolution of deviations for the same 8-digit product within the same firm-destination relationship. These time fixed effect estimates are reported by the blue lines in Figure 5 and 6 for price and volume "gaps", respectively.

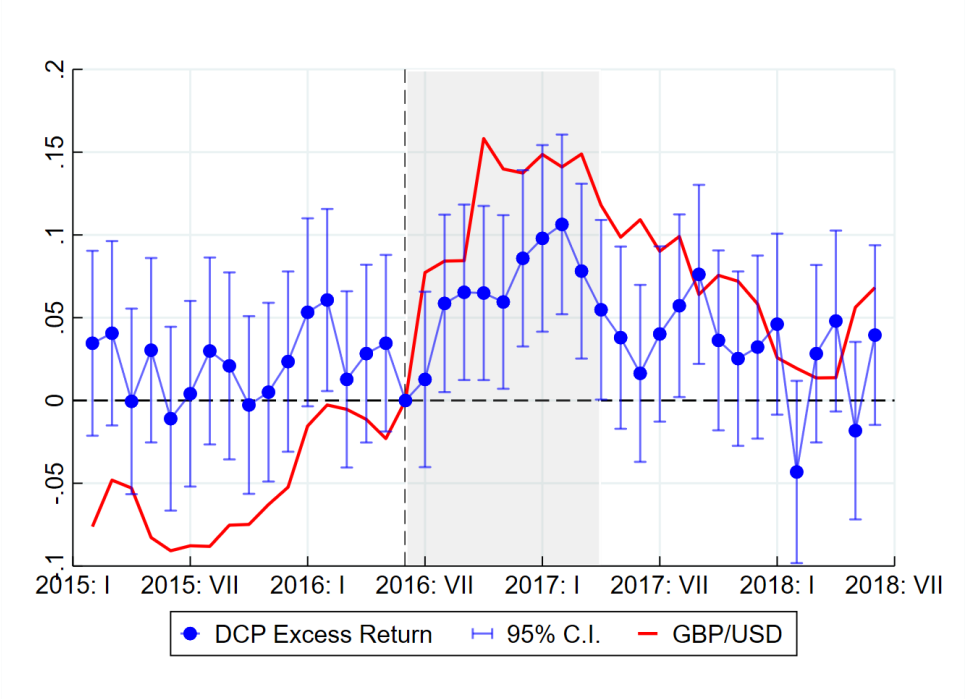


Figure 5: Realised Price Gap Between USD and GBP Pricing (Within Firm-Product-Destination)

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2022.

As the blue line price deviation tracks the depreciation of the GBP-USD exchange rate, Figure 5 shows that indeed for the period June 2016 to April 2017, firms could charge a significantly higher price to their customers just by switching to USD. Was this met by a corresponding significant difference in demand? Figure 6 shows that it wasn't. The blue line shows that the demand deviations for same products invoiced in USD and GBP is insignificantly different following the large depreciation of the pound. The simplest way to incorporate this result in the two-period model is a demand function that is inelastic to short run exchange rate induced price changes. That is, $Q = a - bP_i$ for $i = \{GBP, USD\}$.

4.3 Two propositions on dynamic currency choice

With the full environment spelt out, we can derive the following proposition about dynamic currency choice:

PROPOSITION 1 (Speculative Currency Switching) A larger expected depreciation (S increases) makes invoicing in USD more attractive.

$$f'(S) = a - \frac{\sqrt{2}(a - bc)}{2\sqrt{1+S}} > 0$$

for $S > 1$, $\sqrt{1+S} > \sqrt{2}$, making $f'(S) > 0$. □

That is, everything else equal, a larger expected depreciation makes a firm more likely to switch away from PCP into DCP. Importantly, this force acts above and beyond other mechanisms identified in the literature (hedging, strategic complementarities, currency of borrowing).

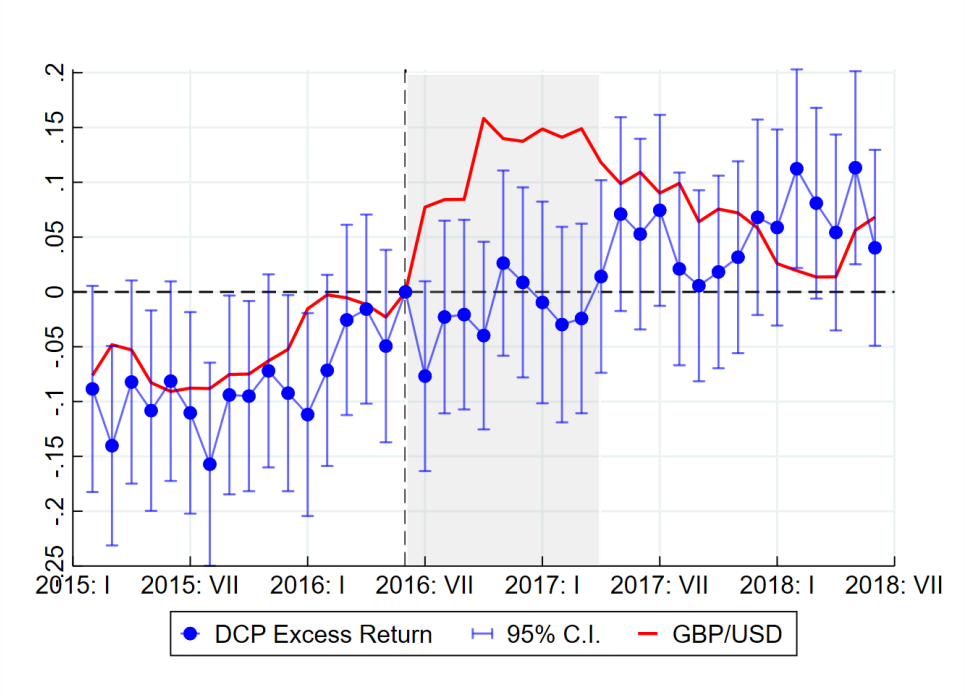


Figure 6: No Demand Gap Between USD and GBP Pricing (Within Firm-Product-Destination)

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2022.

Moving on, we showed empirically in the previous section that net exposure to USD due to imported inputs in foreign currency was an empirically relevant factor. We therefore specify that the firm has fraction α of inputs invoiced in USD , that is

$$c_2 = (1-\alpha)c + \alpha cS \tag{6}$$

The following proposition can be derived

PROPOSITION 2 (Dynamic Operational Hedging) A larger proportion of inputs imported in USD makes USD invoicing more attractive if a depreciation is expected.

$$f'(\alpha) = -Q'(p)c\,(1-S)\left[1-\sqrt{\frac{1+S}{2}}\right] > 0$$

for $S > 1$, $(1-S) < 0$ and $\sqrt{\frac{1+S}{2}} > 1$, making $f'(\alpha) > 0$. □

That is, a significant amount of inputs priced in USD, makes a firm more likely to invoice its exports in that same currency, which naturally protects it against exchange rate downside risk.

With proposition 1 and 2 at hand, we can now turn to the microdata and causally identify the dynamic channels of currency switching.

5 Causally identifying the channels in the microdata

5.1 Speculative currency switching

In this section we investigate a novel channel of currency invoicing driven by speculative motives, over and above the operational hedging channel from the previous section, and established determinants of

invoicing currency choice such as strategic complementarities and market power. In order to identify and provide evidence of this channel, as done for operational hedging, we first present results in a dynamic setting through an event study around 2016, in order to establish that this channel played a role in the post Brexit currency pricing transition. Then we turn to a static regression based on a shift-share identification strategy in order to show how this channel operates in a more general setting. Finally, we zoom in on the workings of speculative invoicing by focusing on the case of LCP invoicing.

5.1.1 Empirical Specification

We run the following specification at the firm-product-destination (fpj) level with monthly frequency:

$$y^c_{fpjt} = \sum_{m \neq Dec\ 2015} \left[\beta_m \ (s^{2016}_{fj,2015}) \times \mathbf{1}_{m=t}\right] + \delta_{fpj} + \delta_{fpt} + controls_{fpjt} + \epsilon_{fpjt} \tag{7}$$

where $y^c_{fpj,t}$ is again the share of exports by firm f of product p to destination j invoiced in currency c, δ_{fpj} are firm-product-destination fixed effect, δ_{fpt} are firm-product-time fixed effect, $\mathbf{1}_{m=t}$ is an indicator equal to 1 in month m and 0 otherwise. $s^{2016}_{fj,2016}$ is defined as

$$s^{2016}_{fj,2015} = Portfolio^{GBP}_{fj,2015} \times \Delta e^{GBP/j}_{j,2016} \tag{8}$$

where

$$Portfolio^{GBP}_{fj,2015} = \frac{\sum_p (\mathcal{E}^{GBP}_{fpj,2015} - \mathcal{I}^{GBP}_{fpj,2015})}{Total\ Trade_{fj,2015}} \tag{9}$$

where $\mathcal{E}^c_{fj,2015}$ are exports of firm f to country j invoiced in GBP, and $\mathcal{I}^{GBP}_{fj,2015}$ imports of firm f from country j in GBP in 2015, the latest pre-Brexit year. We normalise this measure by total trade (exports + imports) in order to make it comparable in the cross-section.[11] Notice we interact the portfolio position in GBP exports with the 2016 sterling depreciation *across* destinations. As FX movements took place already prior to the post-referendum depreciation, we take $\Delta e^{GBP/j}_{j,2016}$ to be the average of the monthly movements between January 2016 and June 2016, but results are robust to using only June 2016. Intuitively, $s^{2016}_{fj,2015}$ is a measure of the revaluation of GBP receivables in the destination currency (which represents the opportunity cost of continuing invoicing in GBP with sticky prices).

5.1.2 Identification

We aim to isolate the potential effects of the 2016 Brexit-related depreciation driven by speculative motives. Specifically, we examine the invoicing patterns of firms exporting in GBP to destinations where the destination currency appreciated more significantly against the pound. To ensure the exogeneity of the exchange-rate shock, we again leverage the unexpected outcome of the Brexit referendum. The treatment is determined by the varying impact of this shock on UK firms, based on their pre-shock opportunity cost of GBP invoicing, as reflected by higher and lower levels of $s^{2016}_{fj,2015}$.

We implement a restrictive set-up by including firm-product-destination and firm-product-time fixed effects, and concentrate on a narrow window for exchange-rate movements from January to June 2016. Finally, we include as controls market share, while notice how strategic complementarities are absorbed by the firm-product-time fixed effects. Crucially, the latter set of fixed effects would also control for the operational hedging channel which, as seen in section 5.2, exploits firm-time variation. Furthermore,

[11] As shown in Appendix , our results are robust to normalise these measures by total output rather than total trade.

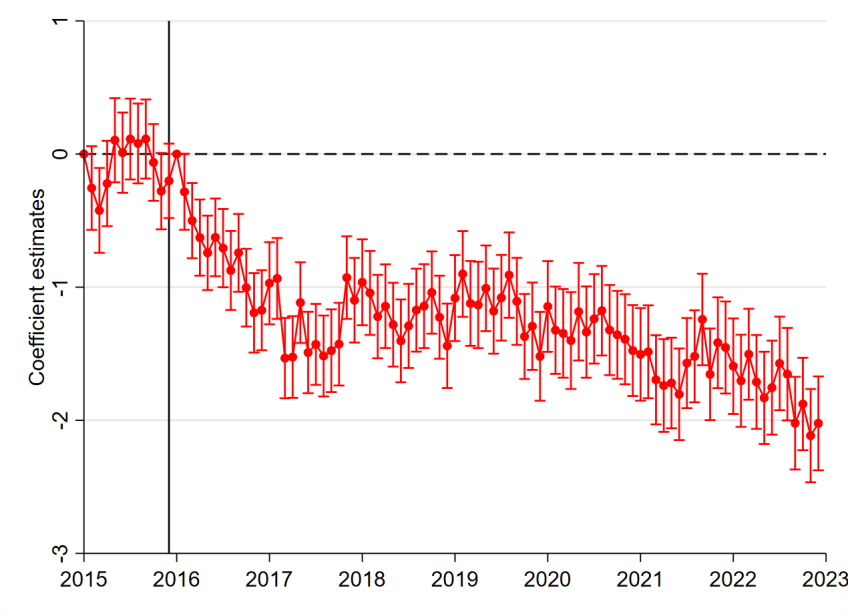


Figure 7: Event study - effect of speculative motives on GBP invoicing

Note.– The graph plots the coefficients β_m from dynamic specification 7 over time, capturing the differential reduction in GBP invoicing by treated (highly GBP exposed) firms.

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2022.

Crowley et al. (2022) introduce a new invoicing channel based on a firm's experience with using a currency with other destinations. This channel is also controlled for by our firm-product-time fixed effects.

5.1.3 Results

Figure 7 presents the result from the event-study set-up discussed above.

First, we detect no pre-trend or anticipation effect that could potentially undermine our empirical approach. Second, taking December 2015 as our reference point, we observe a marked reduction in GBP invoicing by more exposed firms relative to less exposed firms according to our measure $s^{2016}_{fj,2015}$. The response to the large depreciation in 2016 builds quickly over that year, to then assume a more gradual pace over the more recent part of the sample. Importantly though, it appears to be persistent and monotonically dragging on GBP invoicing shares.

In line with these results for GBP, Figure A.18, A.20 and A.19 in the Appendix suggest that this channel might have contributed to the increase in USD, EUR and LCP invoicing after the 2016 Brexit referendum.[12]

5.1.4 Portfolio Factors as Determinants of LCP invoicing

In the further exercise, we confirm the findings from the previous section by focusing on LCP invoicing and using an even more restrictive empirical set-up.

In this tighter setting we ask: does the same firm exporting the same product to a given destination respond over time to FX factors? That is, within the same firm-product is there more local invoicing in months where momentum or value factors signal upward potential for that local currency?

[12]In the Appendix we confirm these findings are robust to considering only gross exports in GBP rather than the net measure described in the main text.

To address these questions and better capture the (speculative) opportunity cost of continuing to invoice in GBP, we adjust the analysis above as follows.

We consider typical portfolio allocation factors, namely FX "momentum" and "value" vs. the GBP. We define the former as lagged log change of $t-1$ LCP against GBP FX (so positive changes indicate an appreciation of the local currency) versus $t-7$:[13]

$$\mu_{GBP} = \ln \varepsilon_{t-1}^{LCP/GBP} - \ln \varepsilon_{t-7}^{LCP/GBP} \tag{10}$$

The latter is defined as the log change in realised spot LCP against GBP FX in $t-1$ versus consensus forecast 3 months ahead at $t-1$:

$$\phi_{GBP} = \ln \varepsilon_{t-1}^{LCP/GBP,3m} - \ln \varepsilon_{t-1}^{LCP/GBP} \tag{11}$$

Similarly for USD, we have

$$\mu_{USD} = \ln \varepsilon_{t-1}^{LCP/USD} - \ln \varepsilon_{t-7}^{LCP/USD} \tag{12}$$

and

$$\phi_{USD} = \ln \varepsilon_{t-1}^{LCP/USD,3m} - \ln \varepsilon_{t-1}^{LCP/USD} \tag{13}$$

With these measures at hand, we run the following regression:

$$y_{fpjt}^{LCP} = \beta_{GBP} \times \rho_{f,j}^{GBP,2015} \mu_{GBP} + \gamma_{GBP} \times \rho_{fj}^{GBP,2015} \phi_{GBP} + \delta_{fpj} + \delta_{fpt} + u_{fpjt} \tag{14}$$

where y_{fpjt}^{LCP} is the share of exports[14] in LCP of firm f's exports of product p to destination j in month t. We saturate the regression including firm-product-destination and firm-product-time fixed effects, so that the coefficients are identified through the within-destination variation across time.

Importantly, we further restrict the sample to firm-product flows where LCP is used for invoicing together with either GBP or USD. This allows us to sharpen identification further, controlling for the potential confounding effects of multiple currency options. Specifically, we run (14) for instances of firm-product-destination-quarter whose currency set for the corresponding year includes only LCP or GBP, as well as for the whole sample available post Brexit for comparison.

Using this restrictive set-up improves identification along several dimensions. First, the expenditure switching channel of FX appreciation which would lead to higher demand for UK exports is turned off when it comes to UK exports invoiced in local currency. Second, prices in local currency of UK exports in local currency are sticky, as also showed by Corsetti et al. (2022). This means that it is not the case that those prices have been decreased in response to the FX appreciation to bring back markups to lower desired ones (markups in fact go up following the FX appreciation for firms as shown by Corsetti et al. (2022)) and thus the invoicing share increases mechanically because lower prices mean higher demand.

Table 1 report the results. While the value factor, both for the forecast at 3 months and 1 year, is never significant, the momentum factor is positive and significant for the whole sample; this means that as UK exporters increased their LCP invoicing across destinations as they saw the local currency of their destinations appreciate against the GBP. However, when focusing only on LCP-GBP export pairs, the coefficients become insignificant, suggesting that the speculative motive might act through comparison

[13] All momentum and value factors are winsorised at 1% and 99% prevent outliers in bilateral FX fluctuations to drive our results.

[14] Again, the mechanical increase in invoicing share following a GBP depreciation is controlled for as we use volumes (net mass) rather than values of exports.

Table 1: Results from specification 14.

	Volume share of exports in LCP			
	Whole	Whole	Pair	Pair
	(1)	(2)	(3)	(4)
Momentum	0.0124*	0.0119*	-0.00706	-0.00773
	(2.17)	(-2.09)	(-0.81)	(-0.89)
3-m forecast	-0.0140		-0.00243	
	(-1.14)		(-0.18)	
1-y forecast		-0.0077		0.00961
		(-0.62)		(-0.67)
Firm-Product-Dest. FE	✓	✓	✓	✓
Firm-Product-Time FE	✓	✓	✓	✓
Observations	336,910	336,008	152,003	151,621

Note. – The coefficients are the β and γ from the specification 14. Column 1 and 2 report estimates for the whole sample, while 3 and 4 consider only instances of firm-product-destination-quarter whose currency set for the corresponding year includes only LCP or GBP.

Source: HMRC administrative datasets, UK non-EU Non-US exports and imports, 2016–2019.

between local and other currencies.

Motivated by the results in Table 1, we run another regression, this time for instances of firm-product-destination-quarter whose currency set for the corresponding year includes only LCP or USD:

$$y_{fpjt}^{LCP} = \beta_{USD} \times \rho_{f,j}^{USD,2015}\mu_{USD} + \gamma_{USD} \times \rho_{fj}^{USD,2015}\phi_{USD} + \delta_{fpj} + \delta_{fpt} + u_{fpjt} \quad (15)$$

Again, as shown in table 2, the value factor is never significant. On the other hand, the momentum factor for the LCP-USD FX is always positive and significant, both in the whole sample and when looking at the selected pairs.

5.2 Dynamic Operational Hedging

In this section we explicitly test whether an operational hedging channel contributed to drive firm-level transitions from producer to dominant currency pricing, above and beyond the determinants of invoicing currency choice commonly considered by the literature. We identify this channel by comparing - at the firm-destination-product level - the invoicing decision of firms with high operational exposure to the Brexit-GBP shock, relative to firms with more operational hedging. We first employ an event-study approach performed around the date of the Brexit referendum and the ensuing devaluation of the GBP. Our results support the relevance of this operational hedging channel stemming from USD needs, while other currency needs such as for local currency do not appear to drive invoicing. We then present the corresponding difference-in-difference regression which confirms these results for the discontinuity around the Brexit 2016 referendum, as detected in Figure 3.

In the benchmark case of fully flexible import and export prices, the denomination of transactions should not matter (Gopinath & Stein, 2021). However, a large literature (Amiti et al., 2022; Auer et al., 2021; Corsetti et al., 2022) finds that international prices are sticky in general and, crucially, in the currency of denomination. That is, if a British company sells a good to Japan at a unit price of £2, they will not immediately adjust the sterling price when faced with a JPY/GBP exchange-rate

Table 2: Results from specification 15.

	Volume share of exports in LCP			
	Whole	Whole	Pair	Pair
	(1)	(2)	(3)	(4)
Momentum	0.0199***	0.0199***	0.0651***	0.0657***
	(-3.4)	(-3.42)	(-3.82)	(-3.88)
3-m forecast	-0.0101		-0.0176	
	(-0.82)		(-0.51)	
1-y forecast		-0.00366		-0.0382
		(-0.30)		(-0.98)
Firm-Product-Dest. FE	✓	✓	✓	✓
Firm-Product-Time FE	✓	✓	✓	✓
Observations	342,980	340,018	40,548	40,115

Note. – The coefficients are the β and γ from the specification 15. Column 1 and 2 report estimates for the whole sample, while 3 and 4 consider only instances of firm-product-destination-quarter whose currency set for the corresponding year includes only LCP or USD.

Source: HMRC administrative datasets, UK non-EU Non-US exports and imports, 2016–2019.

movement. Thus, if the GBP appreciates this will amount to an increase in the price observed by the foreign customer, and vice versa for a JPY appreciation. Specifically, for the case of the Brexit-related GBP depreciation, Corsetti et al. (2022) find that export prices for GBP-invoiced transactions went up gradually and converged to the rate of the sterling depreciation after about 72 weeks. The same holds on the import side. If a British firm is importing the inputs for its good in USD, bilateral movements in the USD/GBP exchange rate will have a direct effect on its marginal cost.

Accordingly, a firm might try to match the denomination of its imports and exports; in this case, it is said to be *operationally hedged*. In other words, the business is less exposed to exchange-rate movements. If instead a firm is exporting in its own currency more (less) than it is importing, we can say it is 'long' ('short') the domestic currency, i.e. set to lose (gain) money from a domestic depreciation. As shown by Figure 2 in our data, the UK economy before 2016 in the aggregate found itself in a 'long' position, with around 60% of exports invoiced in GBP and 60% of imports in USD.

5.2.1 Empirical Specification

We estimate the fine-grained dynamic effects of payables revaluation on invoicing decisions relying on the following specification at the fpj (firm-product-destination) level and at quarterly frequency:

$$y^c_{fpjt} = \sum_{q \neq 2016Q1} \beta_q \; p^{c,\mathbb{E}_{2016}}_{f,2015} \times \mathbf{1}_{q=t} + \delta_{fpj} + \delta_{pjt} + Controls_{fpjt} + \epsilon_{fpjt} \tag{16}$$

where y_{fpjt} is again the share of exports (volumes) by firm f of product p to destination j invoiced in currency c, δ_{fpj} and δ_{pjt} are firm-product-destination and product-destination-time fixed effect respectively, and $\mathbf{1}_{q=t}$ is an indicator equal to 1 in quarter q and 0 otherwise, with the first quarter of 2016 as reference point. $p^{c,\mathbb{E}_{2016}}_{f,2015}$ builds on **??** to provide a measure of the expected revaluation brought about by FX fluctuations:

$$p_{f,2015}^{c,\mathbb{E}_{2016}} = \frac{\sum_{pj}\left[(\mathcal{I}_{fpj,2015}^{c} - \mathcal{E}_{fpj,2015}^{c}) \times \mathbb{E}_{2016}\Delta e_{j}^{GBP/c}\right]}{Total\ Inputs_{f,2015}} \tag{17}$$

where we fix the exposure at the 2015 (pre-shock) level and interact it with the 2016 expected GBP depreciation sourced from Consensus. As FX movements took place already prior to the post-referendum depreciation, we take $\mathbb{E}_{2016}\Delta e_{j}^{GBP/c}$ to be the average of the quarterly difference from January 2016 and June 2016 between the forecast at 3 months and 1 year lagged by 4 quarters. For instance, a positive $\mathbb{E}_{2016}\Delta e_{CHE}^{GBP/CHF}$ indicates a depreciation of the GBP vis-a-vis the CHF. In sum, $p_{f,2015}^{c,\mathbb{E}_{2016}}$ captures the intensity of the unexpected shock suffered by a firm f around the event in 2016. For example, assume that a firm has a net exposure to the USD of 100% of its inputs. If a 10% depreciation of the GBP against the USD occurs, the firm makes a loss of 10% of total inputs in the absence of price adjustment. Finally, standard errors are clustered at firm-product-destination level.

5.2.2 Identification

We are interested in isolating the potential effects of the Brexit-related depreciation in 2016 through the hedging channel described above. We thus rely on the unexpected nature of the outcome of the referendum for the exogeneity of the exchange-rate shock considered. The (continuous) treatment is provided by the heterogeneous incidence of this shock on UK firms based on their pre-shock net exposure to USD, EUR and LCP, as captured by higher and lower levels of $p_{f,2015}^{c,\mathbb{E}_{2016}}$.

We sharpen this identification by saturating the regression with firm-product-destination and product-destination-time fixed effects, and by focusing on a narrow window for exchange-rate movement going from January to June in 2016. We thus check in the next section for any pre-trend and anticipation effects, although Brexit was a largely unexpected outcome.

Finally, we include as controls market share, while notice how strategic complementarities are absorbed by the product-destination-time fixed effects.[15]

5.2.3 Results

The coefficients of interest are the series of estimates for β_q for the different currencies considered. For example, negative (positive) estimates for these coefficients corresponding to GBP (USD) invoicing would imply that firms decreased (increased) GBP (USD) invoicing to cover an unexpected revaluation of their dollar needs. Indeed, this is what Figure 8 and 9 show.

First, notice how GBP invoicing decisions before 2016 appear to be similar for more and less USD exposed firms, leading us to assess that we do not seem to observe any pre-trend or anticipation effect that could potentially undermine our empirical approach.

Second, taking January 2016 as our reference point for the valuation shock, we observe a marked reduction in GBP invoicing by more exposed firms relative to less exposed firms. Importantly, its impact appears to be persistent and monotonically dragging on GBP invoicing shares.

In contrast, Figure A.16 and A.17 in the Appendix suggest that the operational hedging channel has not played a significant role in UK exporters' observed shift towards more EUR and local currency invoicing.

[15] In robustness checks we further include as control a firm's total imports from the EU — recall invoicing for EU imports is unavailable before 2022 — to account for a potential under-estimate of an exporter's currency needs, in particular EUR ones. Of course, to the extent that UK firms' invoicing pattern regarding trade with the EU has not changed substantially, as Figure A.5 seems to support for 2021 and 2022, the firm-product-destination fixed effects would be already capturing this.

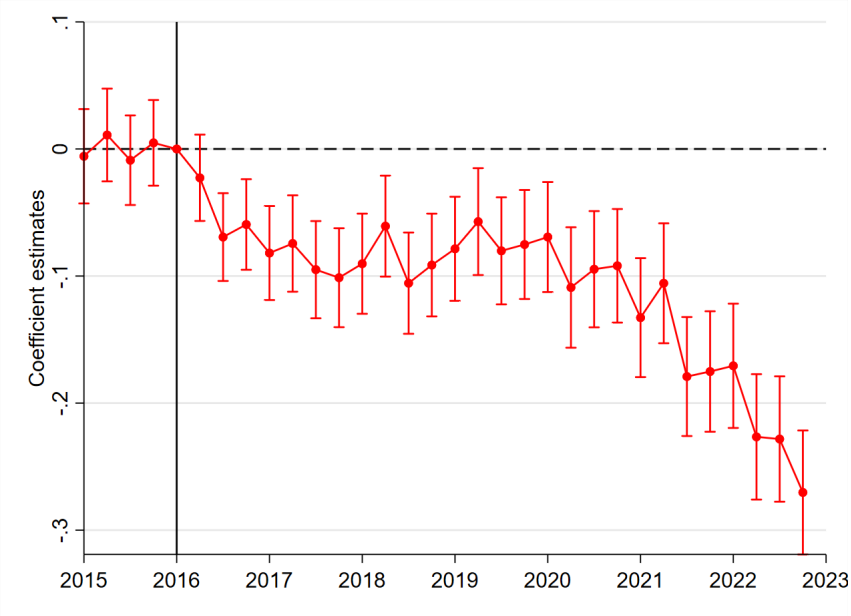


Figure 8: Event study: effect of USD payables revaluation on GBP invoicing

Note.– The graph plots the coefficients β_q from dynamic specification 16 over time, capturing the differential reduction in GBP invoicing by treated (highly USD exposed) firms.

Source: HMRC administrative datasets, UK non-EU non-US exports and imports, 2010–2022.

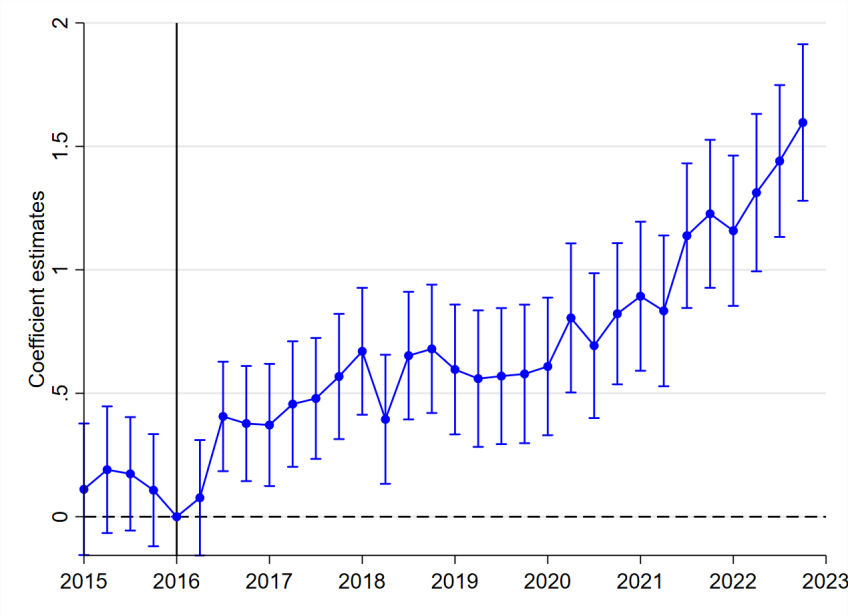


Figure 9: Event study: effect of USD payables revaluation on USD invoicing

Note.– The graph plots the coefficients β_q from dynamic specification 16 over time, capturing the differential increase in USD invoicing by treated (highly USD exposed) firms.

Source: HMRC administrative datasets, UK non-EU non-US exports and imports, 2010–2022.

6 Macroeconomic Implications of Dominant Currency Pricing Transition

Amiti et al. (2022) show that a firm's currency choice has a direct causal effect on the exchange rate pass-through into prices and quantities. Has the structural change in currency choice that we documented in section 3 and analysed empirically in sections 5.2 an 5 altered this causal link? Are UK exporters more exposed to the dollar cycle now than they were before 2016?

In order to shed light on these questions, we estimate the dynamic responses of exported quantities before and after the shift. In order to study how export quantities of UK firms respond to USD-destination exchange rate movements, we employ an econometric specification in the spirit of the work by Amiti et al. (2022). It is a a two-stage procedure, where a regression of export prices in foreign currency onto exchange rates represents the first stage, while a regression of quantities on (fitted) prices is the second stage. In both stages, we control for detailed firm, destination-product and time fixed effects. We capture the elasticity of quantities to price pass-through of USD exchange rate movements. We compute this dynamic measure for the pre 2016 sample and the post 2016 sample.

6.1 Have Allocative Properties of Export Price Rigidity Changed?

Exchange rate pass-through into export prices, or lack thereof, might have a sizeable impact on quantities. For example, suppose a firm exports components with a unit price set in GBP of £100. With full price rigidity, a 1% GBP depreciation vis-a-vis the destination currency will be equivalent to a 1% discount. The extent to which this affects quantities is not obvious, as import-export relationship tend to be recurrent and with long-established partners, so that short-run price changes might not be enough to drive significant shifts in quantities. Furthermore, if we look at aggregate exports, and we acknwoledge the shift in invoicing occurred out of the GBP and into the USD, it is interesting to explore whether this affected relative allocative properties of pass-through across the two currencies of invoicing. Namely, we would expect that quantitities respond via price rigidity more strongly to movements in the USD exchange rate than before 2016.

In order to test this hypothesis, we adopt a two stage empirical specification akin to Amiti et al. (2022), where the first stage is

$$p^*_{fpj,t+h} - p^*_{fpj,t-1} = \beta^h \Delta e_t^{\$/j} + \alpha_j + \delta_{pj} + \nu_t + u_{fpj,t} \tag{18}$$

where the dependent variable is the change in log unit prices expressed in foreign currency between period $t+h$ and $t-1$ for firm f selling product p to destination j and $\Delta e_t^{\$/j}$ is the change in the log exchange rate between the USD and the currency of destination j. We introduce firm, time, and product-destination fixed effects. Thus, the main source of variation are the time series changes in the USD/destination exchange rates. We could also introduce firm-destination-time fixed effects, which would absorb exchange rate fluctuations and would rely on cross-sectional difference (say, invoicing) as source of identification. But we have already tested this dimension in our previous econometric specification. Here, instead, we are interested in the dynamic change in elasticity and are thus interested in the variation at the firm-destination-time level. After estimating (18), we employ the fitted values in

$$q_{fpj,t+h} - q_{fpj,t-1} = \theta^h \Delta_{t-1} \hat{p}^*_{fpj,t+h} + \alpha_j + \delta_{pj} + \nu_t + u_{fpj,t} \tag{19}$$

where the dependent variable is the change in log quantities between period $t+h$ and $t-1$ for firm f selling product p to destination j, and $\Delta_{t-1}\hat{p}^*_{fpj,t+h}$ is the fitted value from the first stage. We estimate this specification for the pre-2016 and post-2016 period[16] and obtain the results in Figure 10, plotted

[16] Observations for the year 2016 are excluded from both samples.

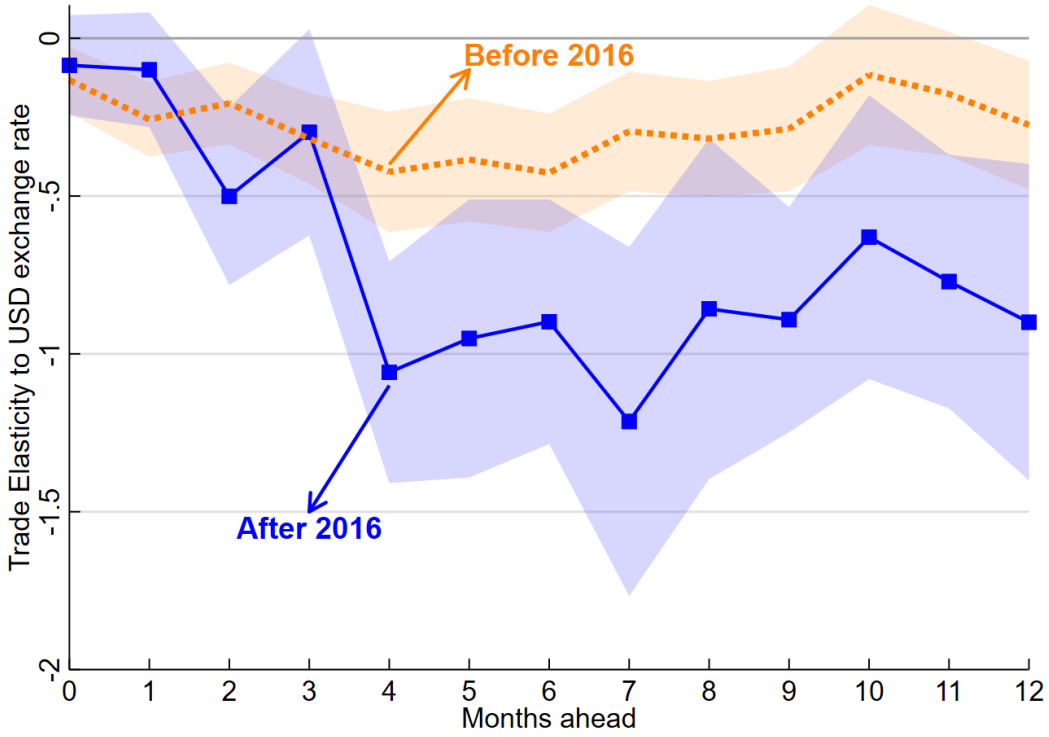


Figure 10: Dynamic elasticity of export quantities to appreciation of USD.

Note. – The two lines represent the dynamic elasticities of UK export quantities to movements in USD exchange rates, in blue for the pre-2016 (pre transition) period and in red for post-2016. The line in red is by month 4 almost twice as large in absolute value as the blue line, indicating that a USD appreciation depresses UK exports by more than twice than before 2016.

Source: HMRC administrative datasets, UK non-EU exports, 2010–2019.

alongside 95% confidence intervals, based on standard errors clustered at the firm-product-destination level. We find that, as intuition would suggest, the elasticity is always negative. This considerably increases in magnitude going from the pre-2016 period (blue line) to the post-2016 sample (red line), where after 4 months it stabilises around 1 in absolute value.

In conclusion, our additional empirical analyis finds that the elasticity of export quantities to USD exchange rate movements doubled from the pre-2016 to the post-2016 period, both in the short and medium run.

7 Conclusion

In conclusion, our study reveals that large foreign-exchange shocks can significantly reshape invoicing currency decisions, leading to a rapid shift toward dominant currency pricing. The dollarisation of UK exports following the Brexit referendum not only underscores the role of dynamic operational hedging—where firms align their export invoicing with the currency of their input costs—but also highlights a novel speculative currency switching channel. This channel shows that firms may opt for currencies with higher expected returns, independent of traditional drivers like market power or strategic complementarities. Finally, our findings demonstrate that under dominant currency pricing, the macroeconomic impact of currency fluctuations is amplified, with a US dollar appreciation now reducing export demand twice as much as under previous invoicing regimes. These results contribute to a deeper understanding of

the forces driving shifts in dominant currency equilibria and their broader implications for international trade and macroeconomic stability.

References

Alfaro, L., Calani, M., & Varela, L. (2023). Firms, Currency Hedging and Financial Derivatives. *Chapter prepared for the Handbook of Financial Integration*.

Aloosh, A., & Bekaert, G. (2022). Currency factors. *Management Science*, *68*(6), 4042–4064.

Amiti, M., Itskhoki, O., & Konings, J. (2022). Dominant Currencies: How Firms Choose Currency Invoicing and Why it Matters. *The Quarterly Journal of Economics*, *137*(3), 1435–1493.

Arslanalp, S., Eichengreen, B., & Simpson-Bell, C. (2022). The stealth erosion of dollar dominance and the rise of nontraditional reserve currencies. *Journal of International Economics*, *138*, 103656.

Arvai, K., & Coimbra, N. (2023). Privilege Lost? The Rise and Fall of a Dominant Global Currency.

Auer, R., Burstein, A., & Lein, S. M. (2021). Exchange Rates and Prices: Evidence from the 2015 Swiss Franc Appreciation. *American Economic Review*, *111*(2), 652–686.

Bahaj, S., & Reis, R. (2022). Central Bank Swap Lines: Evidence on the Effects of the Lender of Last Resort. *The Review of Economic Studies*, *89*(4), 1654–1693.

Barbiero, O. (2022). The Valuation Effects of Trade.

Berthou, A. (2023). International sanctions and the dollar: Evidence from trade invoicing. *Banque de France Working Paper*.

Berthou, A., Horny, G., & Mésonnier, J.-S. (2022). The real effects of invoicing exports in dollars. *Journal of International Economics*, *135*, 103569.

Bonadio, B., Fischer, A. M., & Sauré, P. (2020). The Speed of Exchange Rate Pass-Through. *Journal of the European Economic Association*, *18*(1), 506–538.

Boz, E., Casas, C., Georgiadis, G., Gopinath, G., Le Mezo, H., Mehl, A., & Nguyen, T. (2022). Patterns of invoicing currency in global trade: New evidence. *Journal of International Economics*, *136*, 103604.

Chen, N., Chung, W., & Novy, D. (2022). Vehicle Currency Pricing and Exchange Rate Pass-Through. *Journal of the European Economic Association*, *20*(1), 312–351.

Chiţu, L., Eichengreen, B., & Mehl, A. (2014). When did the dollar overtake sterling as the leading international currency? Evidence from the bond markets. *Journal of Development Economics*, *111*, 225–245.

Chung, W. (2016). Imported inputs and invoicing currency choice: Theory and evidence from UK transaction data. *Journal of International Economics*, *99*, 237–250.

Chupilkin, M., Javorcik, B., Peeva, A., & Plekhanov, A. (2023). Exorbitant Privilege and Economic Sanctions. *SSRN Electronic Journal*.

Coppola, A., Krishnamurthy, A., & Xu, C. (2023). Liquidity, Debt Denomination, and Currency Dominance.

Corsetti, G., Crowley, M., & Han, L. (2022). Invoicing and the dynamics of pricing-to-market: Evidence from UK export prices around the Brexit referendum. *Journal of International Economics*, *135*, 103570.

Costa, R., Dhingra, S., & Machin, S. (2024). New dawn fades: Trade, labour and the brexit exchange rate depreciation. *Journal of International Economics*, *152*, 103993.

Crowley, M., Han, L., & Prayer, T. (2023). The Pro-Competitive Effects of Trade Agreements. *Cabridge Working Papers in Economics Janeway Institute Working Papers*.

Crowley, M., Han, L., & Son, M. (2022). Dominant currency dynamics: Evidence on dollar-invoicing from UK exporters. *CEPR Discussion Papers 15493*.

Devereux, M. B., Dong, W., & Tomlin, B. (2017). Importers and exporters in exchange rate pass-through and currency invoicing. *Journal of International Economics*, *105*, 187–204.

Dhingra, S., & Sampson, T. (2022). Expecting brexit. *Annual Review of Economics*, *14*(1), 495–519.

Eichengreen, B., & Flandreau, M. (2009). The rise and fall of the dollar (or when did the dollar replace sterling as the leading reserve currency?) [Publisher: Cambridge University Press]. *European Review of Economic History*, *13*(3), 377–411.

Eichengreen, B., & Hausmann, R. (1999). *Exchange Rates and Financial Fragility* (tech. rep. No. w7418). National Bureau of Economic Research. Cambridge, MA.

Eichengreen, B., Mehl, A., & Chiţu, L. (2018). *How Global Currencies Work: Past, Present, and Future*. Princeton University Press.

Engel, C. (2006). Equivalence Results for Optimal Pass-through, Optimal Indexing to Exchange Rates, and Optimal Choice of Currency for Export Pricing. *Journal of the European Economic Association*, *4*(6), 1249–1260.

Farhi, E., & Maggiori, M. (2018). A Model of the International Monetary System. *The Quarterly Journal of Economics*, *133*(1), 295–355.

Frankel, J. A. (2023). Dollar Rivals. *NBER Working Paper Series*.

Freeman, R., Garofalo, M., Longoni, E., Mari, R., Manova, K., Prayer, T., & Sampson, T. (2024). Deep integration and trade: Uk firms in the wake of brexit.

Goldberg, L. S., & Tille, C. (2016). Micro, macro, and strategic forces in international trade invoicing: Synthesis and novel patterns. *Journal of International Economics*, *102*, 173–187.

Gopinath, G., & Itskhoki, O. (2022). Dominant Currency Paradigm: A review. In G. Gopinath, E. Helpman, & K. Rogoff (Eds.), *Handbook of International Economics* (pp. 45–90, Vol. 6). Elsevier.

Gopinath, G., Itskhoki, O., & Rigobon, R. (2010). Currency Choice and Exchange Rate Pass-Through. *American Economic Review*, *100*(1), 304–336.

Gopinath, G., & Stein, J. C. (2021). Banking, Trade, and the Making of a Dominant Currency. *The Quarterly Journal of Economics*, *136*(2), 783–830.

Hacioglu-Hoke, S., Ostry, D., Rey, H., Rousset Planat, A., Stavrakeva, V., & Tang, J. (2024). Topography of the fx derivatives market: A view from london. *Working Paper*.

Hassan, T. A., Hollander, S., van Lent, L., & Tahoun, A. (2019). Firm-Level Political Risk: Measurement and Effects*. *The Quarterly Journal of Economics*, *134*(4), 2135–2202.

Ito, H., & Kawai, M. (2016). Trade invoicing in major currencies in the 1970s–1990s: Lessons for renminbi internationalization. *Journal of the Japanese and International Economies*, *42*, 123–145.

Krugman, P. (1980). Vehicle Currencies and the Structure of International Exchange. *Journal of Money, Credit and Banking*, *12*(3), 513–526.

Lyonnet, V., Martin, J., & Mejean, I. (2022). Invoicing Currency and Financial Hedging. *Journal of Money, Credit and Banking*, *54*(8), 2411–2444.

McLeay, M., & Tenreyro, S. (2024). Dollar dominance and the export channel of monetary policy transmission. *Bank of England Staff Working Paper*.

Mehl, A., & Mlikota, M. (2023). How Does a Dominant Currency Replace Another? Evidence from European Trade.

Menkhoff, L., Sarno, L., Schmeling, M., & Schrimpf, A. (2012). Currency momentum strategies. *Journal of Financial Economics*, *106*(3), 660–684.

Mukhin, D. (2022). An Equilibrium Model of the International Price System. *American Economic Review*, *112*(2), 650–688.

O'Rourke, K. (2019). *A short history of brexit: From brentry to backstop*. Penguin UK.

Reinhart, C. M., & Rogoff, K. S. (2008). *This time is different: A panoramic view of eight centuries of financial crises* (tech. rep.). National Bureau of Economic Research.

Rey, H. (2001). International Trade and Currency Exchange. *The Review of Economic Studies*, *68*(2), 443–464.

Vicquéry, R. (2022). The Rise and Fall of Global Currencies over Two Centuries. *Banque de France Working Paper*.

Zhang, S. (2022). Dissecting currency momentum. *Journal of Financial Economics*, *144*(1), 154–173.

Online Appendix for:
Dominant Currency Pricing Transition

by Marco Garofalo, Giovanni Rosso and Roger Vicquery

A Data Appendix

A.1 HMRC Transaction-Level Customs Data: Summary Statistics

Year	Firms	Products	Countries	Firm-Product	Firm-Country	Product-Country	Firm-Product-Country
2010	48274	7953	192	263542	198888	149652	477489
2011	48985	7842	190	258510	202327	149463	474933
2012	48967	7837	190	266872	206190	153695	498471
2013	50241	7882	190	284149	216679	162145	543557
2014	50203	7885	189	284407	216366	163106	554732
2015	51276	7886	190	293045	223708	165699	577206
2016	53728	7943	191	321708	240759	172630	642223
2017	54627	8020	190	330714	245015	175787	656254
2018	54739	8016	190	336776	246450	177946	674418
2019	52733	7976	190	340441	246733	180310	695218
2020	48647	7861	189	306495	227597	168088	633182
2021	47905	7843	190	306829	234998	174199	657181
2022	47153	7993	190	315648	236950	179301	683218

Table A.1: Summary statistics (Count).

Source: HMRC administrative datasets, UK non-EU exports, 2010–2022.

B Additional Stylised Facts on Currency Pricing Transition

Fact 1. *The aggregate fall in the GBP invoicing is driven by the intensive rather than extensive margin at firm-product-destination level.*

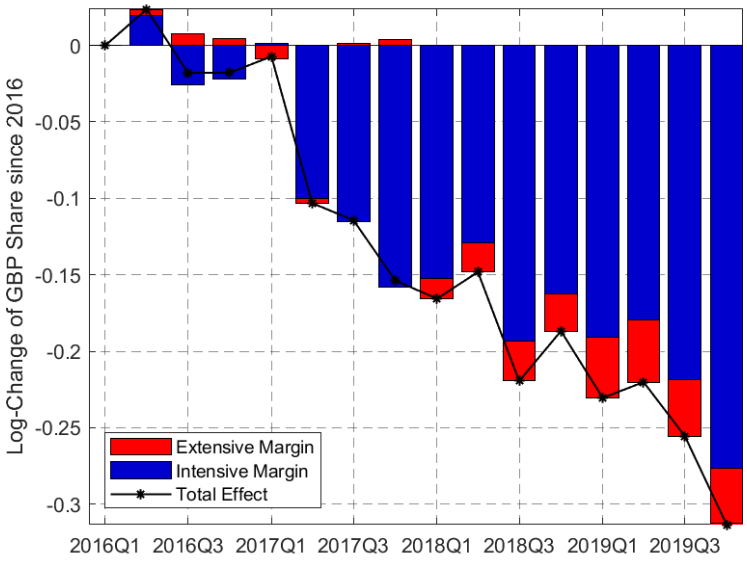


Figure A.1: Intensive/extensive margin decomposition of GBP invoicing shift.

Source: HMRC administrative datasets, UK non-EU exports, 2010–2019.

We investigate what the relevant margins of this change in GBP export invoicing are, that is whether the latter is due to compositional effects or rather it is broad-based across firms. We compute in Figure A.1 how much of the reduction in GBP invoicing share is due to the extensive margin (or *between* effects) at firm-product-destination level, and how much of it happened because of the intensive margin (or *within* effects). Using the definition of an average, we can define the total export value (in all currencies) in period t as

$$V_t = \bar{V}_t N_t^{fpj} \tag{20}$$

where N_t^{fpj} is the number of individual firm-product-destination triplets, the unit of observation of our dataset, and where $\bar{V}_t$ is the average export value per triplet. Similarly, total export value in GBP in period t is

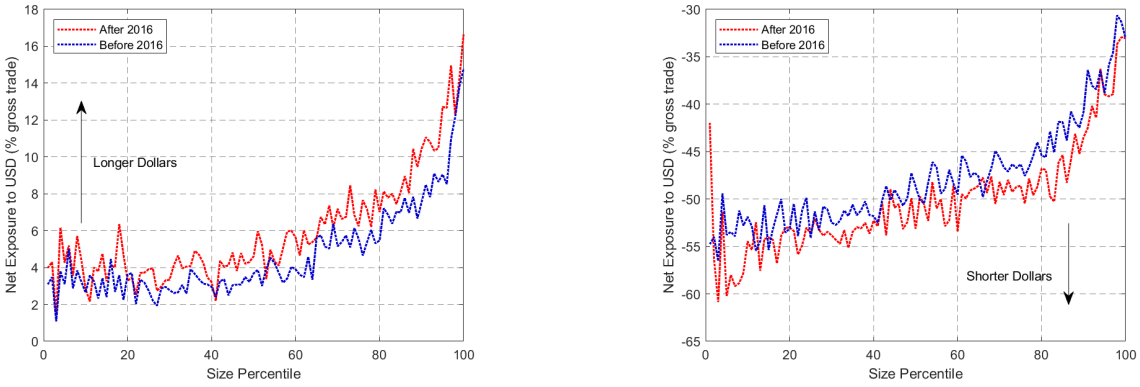
$$V_t^{£} = \bar{V}_t^{£} N_t^{fpj} \tag{21}$$

Taking logs and first differences on both sides yields the decomposition

$$\Delta \ln(V_t) = \underbrace{\Delta \ln(\bar{V}_t)}_{\text{Intensive}} + \overbrace{\Delta \ln(N_t^{fpj})}^{\text{Extensive}} \tag{22}$$

and similarly

$$\Delta \ln(V_t^{£}) = \Delta \ln(\bar{V}_t^{£}) + \Delta \ln(N_t^{fpj}) \tag{23}$$



(a) Firms whose exports > imports.

(b) Firms whose imports > exports.

Figure A.2: Net exposure to USD (in % of gross trade) by trade size distribution.

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2019.

We can further decompose the extensive component in its individual elements (change in destinations, change in product composition, firm entry/exits), but we find that these individual margins do not contribute much respectively. Therefore, for clarity of exposition we plot their aggregate version in Figure A.1, which presents the contribution of intensive and extensive margins to GBP value drop since 2016.

The main message from Figure A.1 is clear. The reduction in the share of GBP invoicing is a result of firm-product-destination triplet flows switching away from pounds, rather than a compositional artefact of our sample. This is important for our empirical identification strategy below which relies on firms actively deciding to change their currency of invoicing, as we will show in Section 5.2 and 5.

Fact 2. *The shift towards USD invoicing occurs along the entire firm size distribution, although bigger shifts are associated with larger firms and higher pre-2016 GBP exposure.*

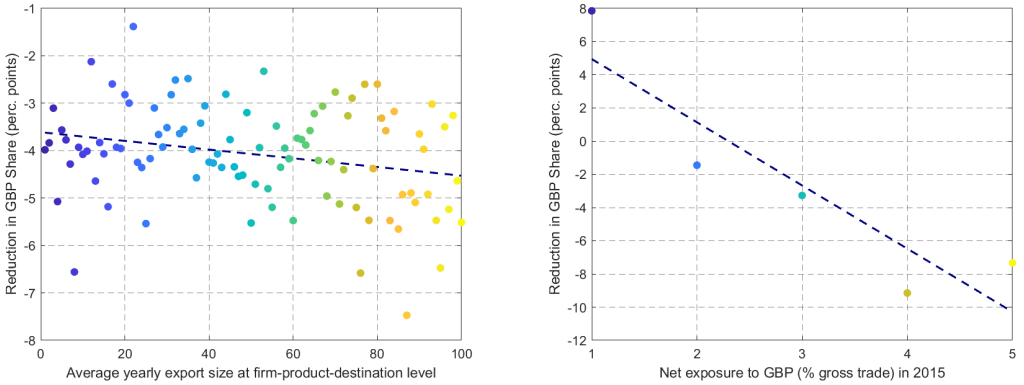
Let us define the net exposure of a firm to the USD as its exports in USD minus imports in USD in a period, as a proportion of total gross trade. Furthermore, let us dub as (mainly) exporters the firms whose exports in a given period exceed imports. Figure A.2 plots net exposure as a function of firm size (total export value) percentiles, separately for exporters and non-exporters. We see that, in general, the average exporter in each bin is positively exposed to the USD, meaning that its USD exports exceed imports. We also see that the bigger the exporter, the larger the exposure. Crucially, after 2016 (blue line) we observe an upward parallel shift of the distribution, as firms of all sizes have increased their exposure to the USD.

Interestingly, Figure A.2a paints a picture rather different compared to the case of France as described by Barbiero (2022). French exporters at the left tail of the size distribution tend to exhibit perfect hedging, with net exposure to the USD hovering around 0.

In contrast to the case of exporters, Figure A.2b shows very little change occurring for non-exporters, as they lack the margin of adjustment on the side of revenues, where a firm can exercise its currency decision, while on the inputs' side a firm is usually currency-taker. Furthermore, we see that net exposure is negative at every percentile of the distribution for

non-exporters. This follows from the fact that imports are predominantly invoiced in USD, and that for these firms imports exceed exports.

Finally, we ask how size and exposure correlate with the observed reduction in GBP share of invoicing. Is the shift more marked for larger or previously more exposed firms? Figure A.3a and A.3b shed light on this question. We can observe a clearly negative relationship between average size/GBP exposure in 2015 and GBP invoicing reduction.[17] Thus, leaders were the ones changing their invoicing away from GBP more markedly. Furthermore, firms exhibiting a more positive exposure to GBP in 2015, that is before the Brexit referendum and the consequent large pound depreciation, switched away from pound the most with respect to other exporters.



(a) Invoicing shift vs firm size. (b) Invoicing shift vs firm GBP exposure.

Figure A.3: Correlates of the invoicing shift.

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2019.

Fact 3. *The EUR value share of UK exports to non-EU countries increased from about 4% in 2015 to 8% in 2022.*

We report in Figure A.4 the shares of UK exports accounted by the euro. Over our whole sample, the role played by the euro as a vehicle currency is small compared to the USD. However, we observe a twofold increase in the euro share since 2016, from 4% to 8% towards non-EU destinations.

Fact 4. *Pattern of invoicing for EU exports and imports appear to have remained broadly stable since 2021 (when data becomes available). However, there is some tentative evidence of increased USD invoicing of UK imports from EU crowding out GBP and EUR invoicing.*

C The role of market power

We have so far analysed the fall in GBP share of UK exports only from the point of view of UK firms. Invoicing decisions, however, just like pricing ones, arise from the interaction of a buyer and a seller. While in the literature the invoicing decision is mainly thought to belong to the exporter, the role of a foreign importer on the UK transition could be ambiguous. On the one

[17] These findings are robust to adding one variable as a control for the other before plotting the residuals.

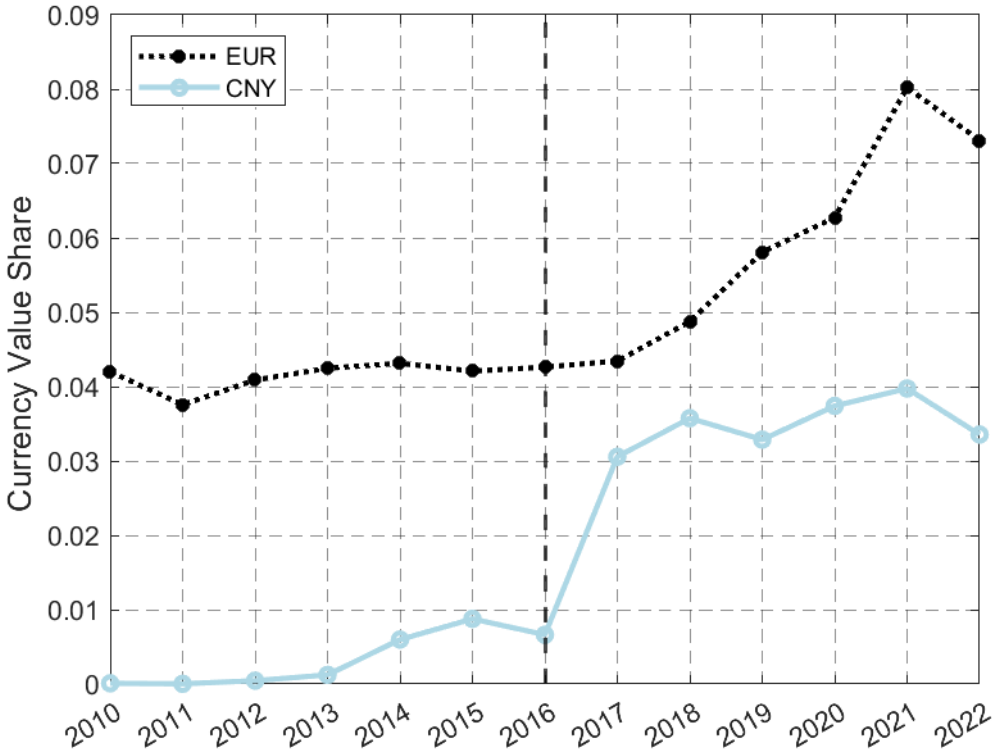
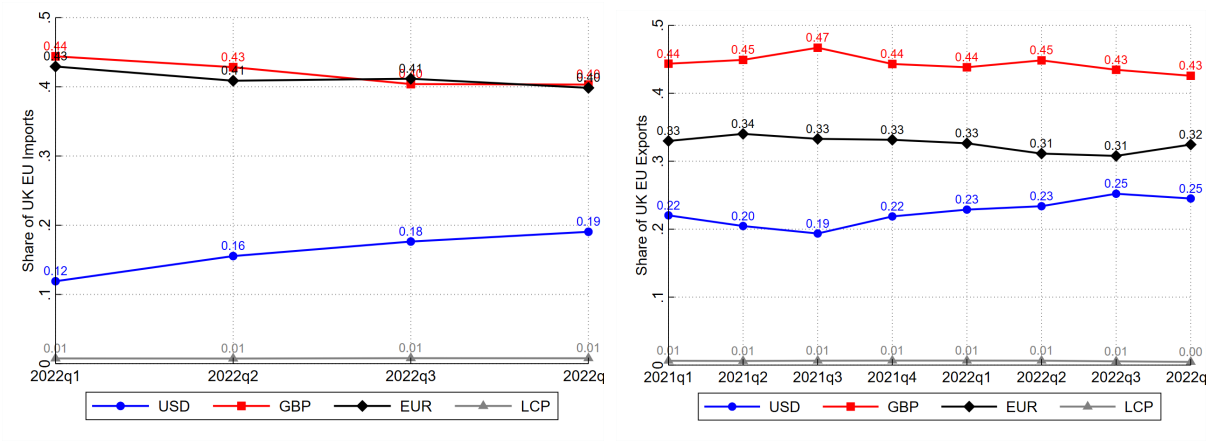


Figure A.4: Currency share of UK non-EU non-US exports.

Source: HMRC administrative datasets, UK non-EU non-US exports, 2010–2022.



(a) Imports from EU.

(b) Exports to EU.

Figure A.5: Currency shares of UK EU imports and exports.

Source: HMRC administrative datasets, UK EU imports and exports, 2021–2022.

hand, there is the convenience of using a vehicle currency given the network of international trade (Gopinath & Stein, 2021). This might mean that importers have a preference for goods being invoiced in USD. On the other hand, an importer's situation vis-a-vis the Brexit shock is the mirror image of that of its UK counterpart: as the GBP depreciates, this implies an immediate discount on the importer's purchases. As the GBP may be expected to weaken further, this might make GBP invoicing desirable in the eyes of foreign customers.We could expect that importers would at the margin prefer to continue being invoiced in GBP. If this was the case, the outcome we observe might be driven by firms with high market power succeeding in imposing a shift in invoicing patterns towards a 'harder' currency.

We thus investigate this channel by considering a simple measure for firm-level market power commonly used in the trade literature (Crowley et al., 2023), namely a firm's market share for a certain product in a given destination. We collect total imports by origin country, destination country and 6-digit product classification from UN Comtrade. We can compute destination j's UK share of imports for product p,

$$UK\ Share_{pj,t} = \frac{\mathcal{I}^{UK}_{pj,t}}{\sum_{all\ \ origins} \mathcal{I}^{i}_{pj,t}} \tag{24}$$

Similarly, from the microdata we can construct the UK market share of a firm for product p and destination j

$$Firm\ share_{fpj,t} = \frac{\mathcal{E}_{fpj,t}}{\sum_{all\ UK\ firms} \mathcal{E}_{fpj,t}} \tag{25}$$

where, of course, $\sum_{all\ UK\ firms} \mathcal{E}_{fpj,t} = \mathcal{I}^{UK}_{pj,t}$. We can then combine the two to obtain a firm's market share $\omega_{fpj,t}$ in a given destination and product market

$$\omega_{fpj,t} = Firm\ share_{fpj,t} \times UK\ Share_{pj,t} \tag{26}$$

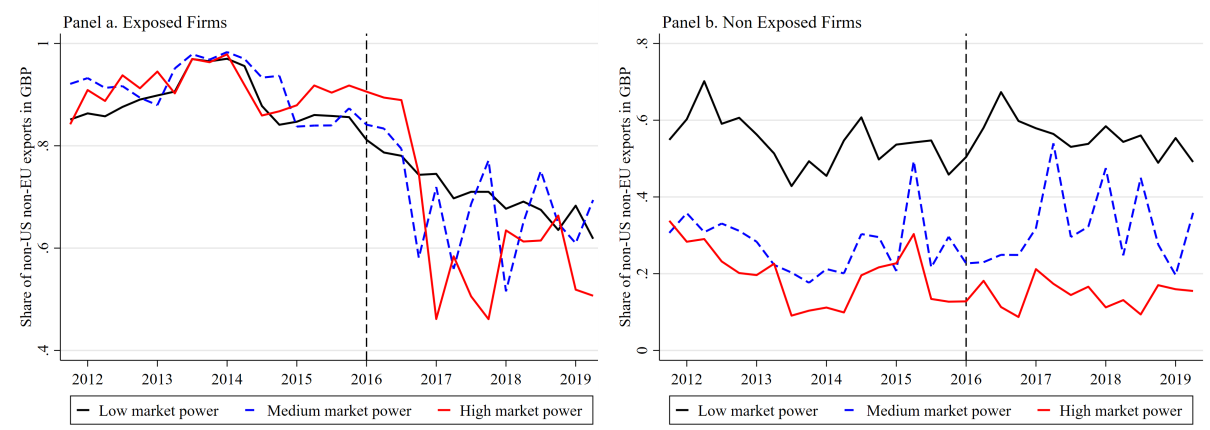


Figure A.6: GBP invoicing by GBP exposure and market power

Note. – Firms are divided into three market power quantiles based on their market share in each product-destination market. Then, aggregate GBP share of exports analogous to those in Fig.1 are plotted for each quantile. In red are firms with high market shares, in dashed blue medium, and in red firms with low market shares. This exercise is conducted separately, considering only firms with above the median (Panel a.) and below the median (Panel b.) $Exposure_{f,t}$.

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2022.

With these measures at hand, we can then divide firms by percentiles of market share to identify three groups: low (below the 75th percentile of the distribution of market shares), medium (between the 75th and 90th percentile) and high (above 90th percentile) market power firms.[18] Figure A.6 shows the evolution of GBP invoicing shares by these groupings, separately for exposed ($s_{f,t}$ above median) and non-exposed ($s_{f,t}$ below median) firms.

Two main considerations emerge from inspecting Figure A.6. First, if UK firms did not suffer from the 2016 valuation shock and therefore had no motive to shift away from the pound, we should not expect to see the significant change in GBP usage from the pre-shock period that we observe in panel a. Second, since we know UK businesses *did* suffer from the valuation shock, then we would expect their market power to matter at the margin to resolve the clash of the two opposing forces described above: (i.) the incentive for UK exporters to operationally hedge more and thus shift to the USD; and (ii.) the motive for foreign importers to keep GBP invoicing on their transactions with UK exports, as foreign buyers might perceive the GBP as a 'soft' currency after the large 2016 depreciation. Our results seem to support to some extent this enabling role played by market power, with panel a indeed showing that exposed firms did reduce their GBP invoicing, but to a somewhat larger extent for those with larger market shares.

In the light of this evidence, we test for the relevance of market power formally by estimating specification **??** enriched by our measure of market power $\omega_{fpj,t}$, as mentioned above already included in the control variables.

Table A.2 reveals a mixed picture on the role played by market power. On the one hand, as expected from the discussion above, our results suggest that higher market share leads to more GBP invoicing and less need to using vehicle currencies. On the other hand, the interaction with

[18] See Figure A.7 which reports the distribution of market shares of UK firms at pj (product-destination) level.

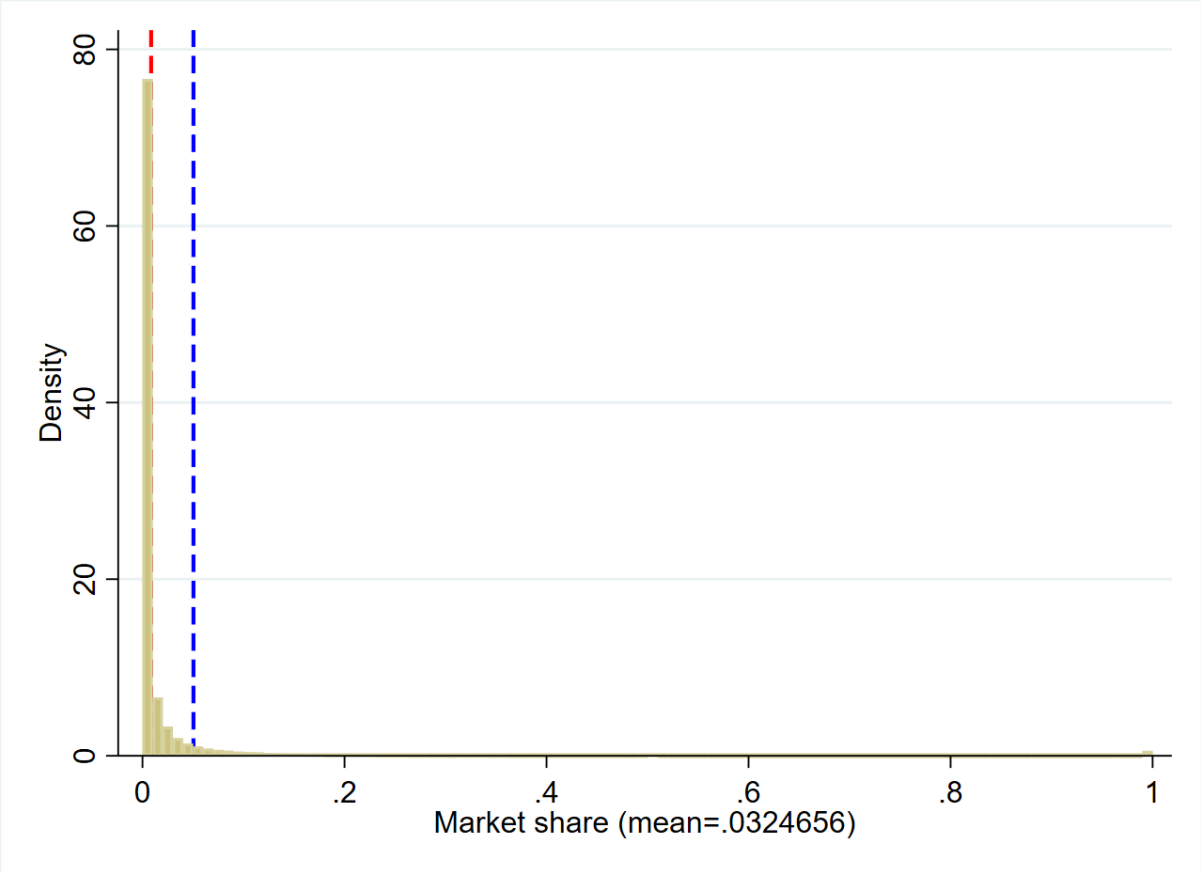


Figure A.7: Distribution market shares.

Source: UN Comtrade and HMRC administrative datasets, UK non-EU exports, 2010–2022.

the valuation shock is always insignificant, suggesting that during adjustments after valuation shocks the degree of market power might not exert effects over and above its average impact.

We further investigate the potential effects of market power on invoicing by adjusting our event study set-up to account for it in the following way:

$$y^h_{fpj,t} = \alpha_{fpj} + \delta_t + \omega_{fpj,t} + \sum_{m \neq Jan\ 2016} \gamma_m \ \omega_{fpj,t} \times \mathbf{1}_{m=t} + [\beta_m \ (\omega_{fpj,t} \times s_{f,t}) \times \mathbf{1}_{m=t}] + \epsilon_{fpj,t} \quad (27)$$

Figure A.8 shows the results of estimating equation 27 which exploits the potential variation between the behaviour of exposed firms with high market share vis-a-vis exposed firms with low market shares. The estimation for the coefficients of interest β_m is quarterly to more directly unpack the relationship estimated in the quarterly static regression **??**. As it is clear from the chart, only from 2019 onwards we start seeing a gradual and significant reduction in GBP usage by firms with stronger market power.

To conclude, we find mixed evidence on the role played by market power in the determination of invoicing currency. In particular, our results do not seem to consistently support the contribution of this additional channel in combination to operational hedging motive in response to the 2016 depreciation, to the large shift in invoicing away from the GBP that we documented

Table A.2: Relevance of market power.

	Value share of exports in					
	GBP	GBP	USD	USD	EUR	EUR
	(1)	(2)	(1)	(2)	(1)	(2)
Panel a. Baseline specification						
Valuation shock $s_{f,t}$	-0.01***	-0.01***	0.007***	0.01***	0.003***	0.003**
	(-6.37)	(-6.02)	(4.73)	(4.82)	(3.85)	(3.13)
Panel b. Strategic complementarities						
Invoicing of largest firm in HS4		0.02***		0.02***		0.02***
		(16.79)		(17.06)		(12.60)
Average invoicing in HS4		0.09***		0.09***		0.15***
		(10.64)		(17.06)		(8.94)
Panel c. Firm Market Power						
Market Power		0.04***		-0.05***		0.01
		(5.33)		(-7.67)		(1.95)
Market power × valuation shock		0.03		-0.04		0.03
		(0.46)		(-0.75)		(1.16)
Additional valuation controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time x Gap FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,322,378	724,482	1,322,378	724,482	1,322,378	724,482

Note. – The coefficients in Panel a. and in panel b. are analogous to those in the previous table. In panel c. are the coefficients on the market share variable $\omega_{fpj,t}$ and on the interaction of market share $\omega_{fpj,t}$ with exposure $s_{f,t}$.

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2019.

in Figure 1. Having documented and characterised the potential channels behind the sizable reduction in GBP invoicing, we now turn our attentions to the macroeconomic implications of this dominant currency pricing transition.

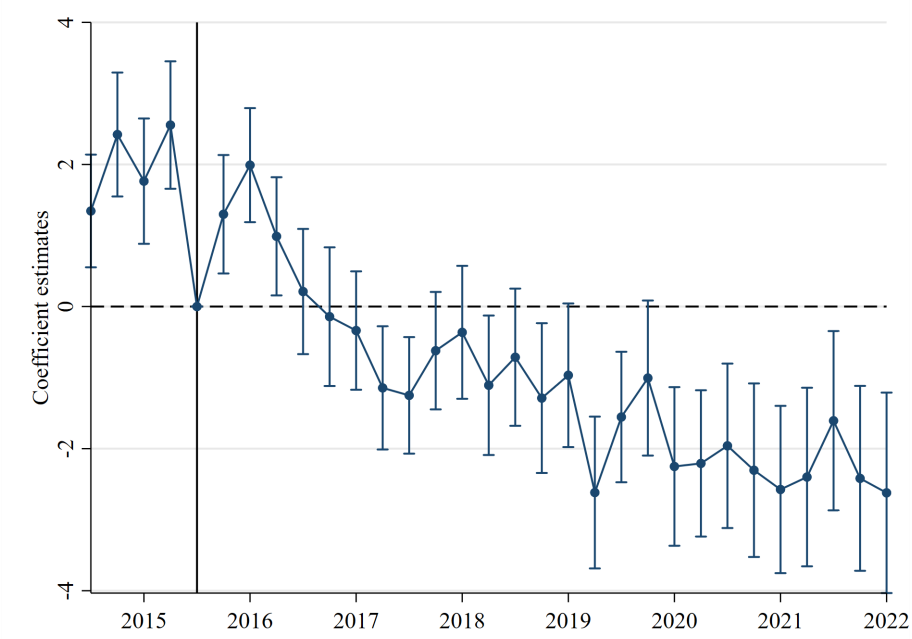


Figure A.8: Event study: effect of market power at the margin with high exposure to GBP depreciation.

Note. – The graph plots the coefficients β_m from dynamic specification enriched with market power $y^h_{fpj,t} = \alpha_{fpj} + \delta_t + \omega_{fpj,t} + \sum_{m \neq Jan\ 2016} \gamma_m\ \omega_{fpj,t} \times \mathbf{1}_{m=t} + \left[\beta_m\ (\omega_{fpj,t} \times s_{f,t}) \times \mathbf{1}_{m=t}\right] + \epsilon_{fpj,t}$ over time, capturing the differential reduction in GBP invoicing by treated (highly exposed) firms which have a relatively higher market share.

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2022.

D Additional Empirical Results and Robustness Checks

A.1 Additional exposure measures

We can construct additional exposure indeces looking at the difference between currencies other than GBP and/or GBP exchange rate with other currencies:

$$s^{j}_{ft} = \frac{\sum_j (exp^{j}_{fj,2015} - imp^{j}_{fj,2015}) \times \Delta e^{£/j}_{t}}{Total\ Trade_{f,2015}} \qquad (Local\ Weighted\ Index)$$

$$s^{\$}_{ft} = \frac{\sum_j (exp^{\$}_{fj,2015} - imp^{\$}_{fj,2015}) \times \Delta e^{£/\$}_{t}}{Total\ Trade_{f,2015}} \qquad (Dominant\ Weighted\ Index)$$

$$s^{\$j}_{ft} = \frac{\sum_j (exp^{\$}_{fj,2015} - imp^{\$}_{fj,2015}) \times \Delta e^{\$/j}_{t}}{Total\ Trade_{f,2015}} \qquad (Dominant\text{-}Local\ Weighted\ Index)$$

where $exp^{\$}_{fj}$ and $imp^{\$}_{fj}$ indicates respectively the exports and imports of firm f to destination j in 2015 denominated in USD, as a share of gross trade of that firm in that year. With a slight abuse of notation, a superscript j indicates the currency of the destination while a subscript j indicates the country itself. A positive $\Delta e^{£/\$}_{t}$ indicates a depreciation of the GBP vis-a-vis the USD. The indices capture the gains/losses from unhedged positions of firms vis-a-vis exchange rates movements. In order to obtain the indices we aggregate across all destination countries.

A.2 Empirics: robustness checks

All tables and figures in this section report robustness checks on the baseline specification presented in the body of the paper.

A.2.1 Static regressions

Table A.3: Baseline with controls spelt out.

	Value share of exports in					
	GBP	GBP	USD	USD	EUR	EUR
	(1)	(2)	(1)	(2)	(1)	(2)
Panel a. Baseline specification						
Valuation shock $s_{f,t}$	-0.01***	-0.01***	0.007***	0.01***	0.003***	0.003**
	(-6.37)	(-6.02)	(4.73)	(4.82)	(3.85)	(3.13)
Panel b. Strategic complementarities						
Invoicing of largest firm in HS4		0.02***		0.02***		0.02***
		(16.79)		(17.06)		(12.60)
Average invoicing in HS4		0.09***		0.09***		0.15***
		(10.64)		(17.06)		(8.94)
Panel c. Firm Market Power						
Market Power		0.04***		-0.05***		0.01
		(5.33)		(-7.67)		(1.95)
Market power × valuation shock		0.03		-0.04		0.03
		(0.46)		(-0.75)		(1.16)
Additional valuation controls						
Destination-weighted	0.04**	0.03	-0.01	0.001	0.002	0.006
	(2.92)	(1.44)	(-0.89)	(-0.04)	(0.29)	(0.74)
Dominant-weighted	-0.03***	-0.03***	0.04***	0.04***	-0.005*	-0.004
	(-5.04)	(-4.71)	(6.68)	(5.80)	(-2.32)	(-1.23)
Dominant-destination weighted	-0.04***	-0.04***	0.04***	0.05***	-0.001	-0.001
	(-8.08)	(-6.60)	(7.14)	(6.18)	(-0.57)	(-0.73)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time x Gap FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,322,378	724,482	1,322,378	724,482	1,322,378	724,482

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2019.

Table A.4: Baseline up to 2022

	Value share of exports in					
	GBP	GBP	USD	USD	EUR	EUR
	(1)	(2)	(1)	(2)	(1)	(2)
Panel a. Baseline specification						
Valuation shock $s_{f,t}$	-0.01***	-0.01***	0.007***	0.01***	0.001	0.0006
	(-4.76)	(-5.20)	(4.99)	(4.82)	(3.85)	(0.60)
Panel b. Strategic complementarities						
Invoicing of largest firm in HS4		0.02***		0.02***		0.02***
		(20.16)		(20.74)		(15.82)
Average invoicing in HS4		0.10***		0.09***		0.15***
		(12.03)		(12.92)		(9.82)
Panel c. Firm Market Power						
Market Power		0.05***		-0.06***		0.01*
		(5.33)		(-7.67)		(1.95)
Market power × valuation shock		-0.001		-0.01*		0.03
		(-0.02)		(-0.34)		(1.02)
Additional valuation controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time x Gap FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,751,049	1,015,652	1,751,049	1,015,652	1,751,049	1,015,652

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2019.

Table A.5: Baseline with quantity share instead of value share.

	Value share of exports in					
	GBP	GBP	USD	USD	EUR	EUR
	(1)	(2)	(1)	(2)	(1)	(2)
Panel a. Baseline specification						
Valuation shock $s_{f,t}$	-0.01***	-0.01***	0.004***	0.01***	0.003***	0.0006
	(-4.44)	(-5.20)	(2.71)	(4.82)	(3.95)	(0.60)
Panel b. Strategic complementarities						
Invoicing of largest firm in HS4		0.02***		0.02***		0.02***
		(14.92)		(14.99)		(11.74)
Average invoicing in HS4		0.09***		0.10***		0.14***
		(10.79)		(11.70)		(8.26)
Panel c. Firm Market Power						
Market Power		0.04***		-0.05***		0.01
		(5.22)		(-7.43)		(1.74)
Market power × valuation shock		0.03		0.02		0.01
		(0.43)		(-0.34)		(0.44)
Additional valuation controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time x Gap FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,301,000	714,229	1,301,000	714,229	1,751,049	714,229

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2019.

A.2.2 Macroeconomic implications (including years up to 2022)

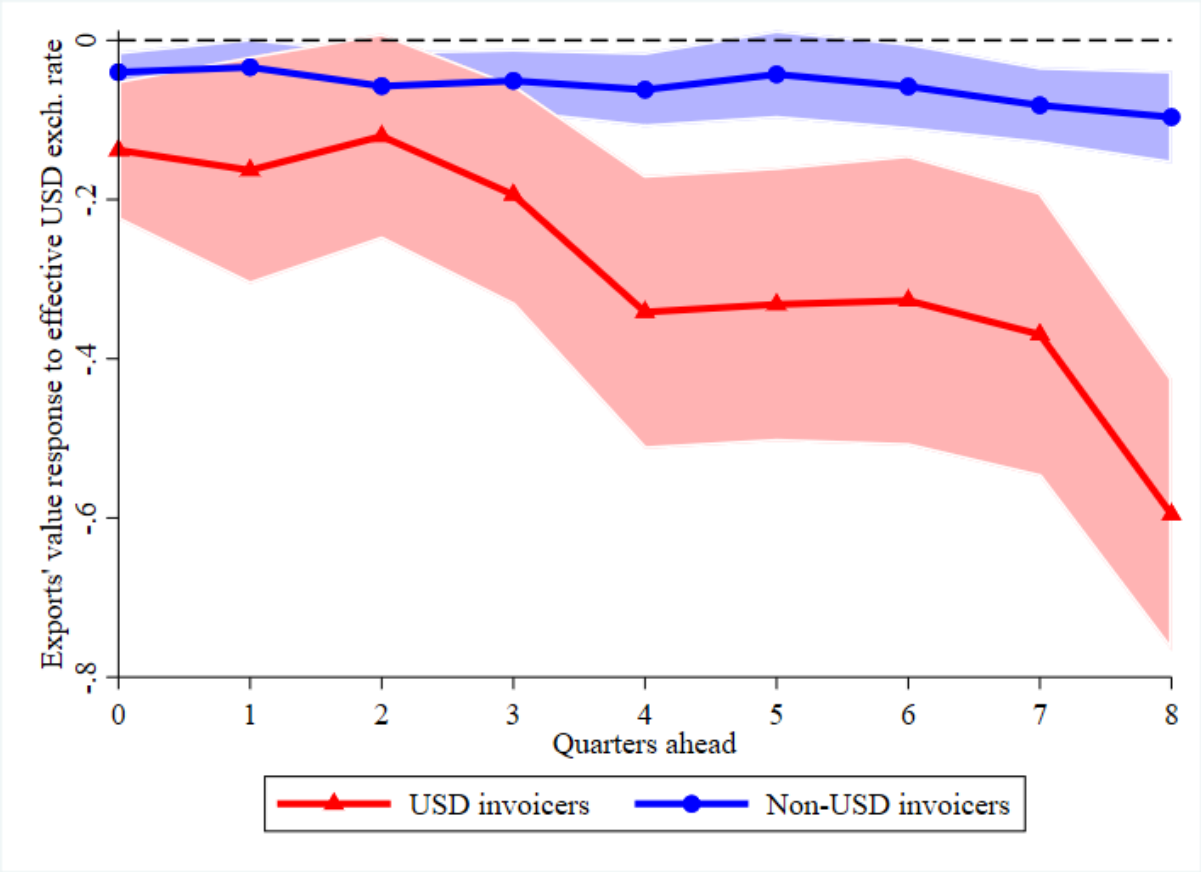


Figure A.9: Dynamic response of export value to appreciation of USD granular exchange rate.

Notes: We exclude US as destination here. **Source**: HMRC administrative datasets, UK non-EU exports, 2010–2022.

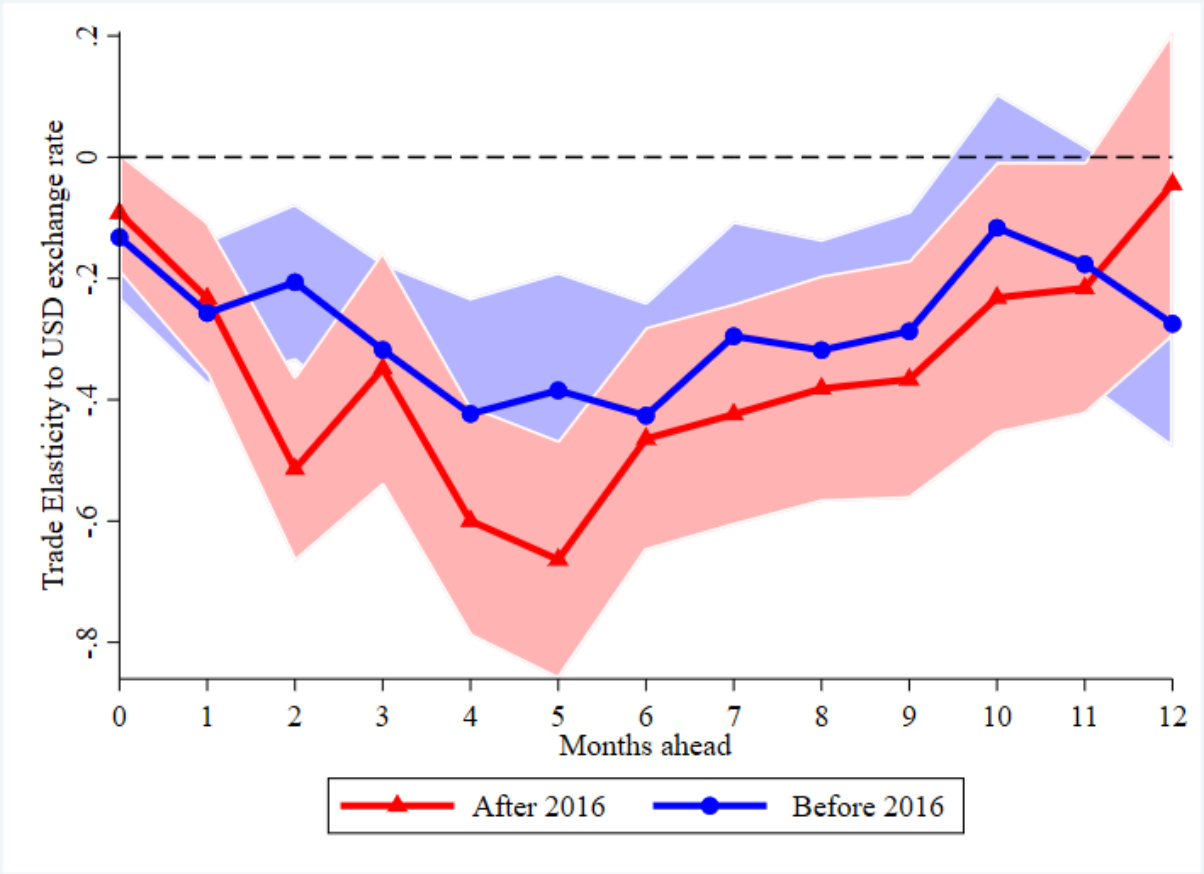


Figure A.10: Dynamic elasticity of export quantities to appreciation of USD.

Notes: We exclude US as destination here. **Source**: HMRC administrative datasets, UK non-EU exports, 2010–2022.

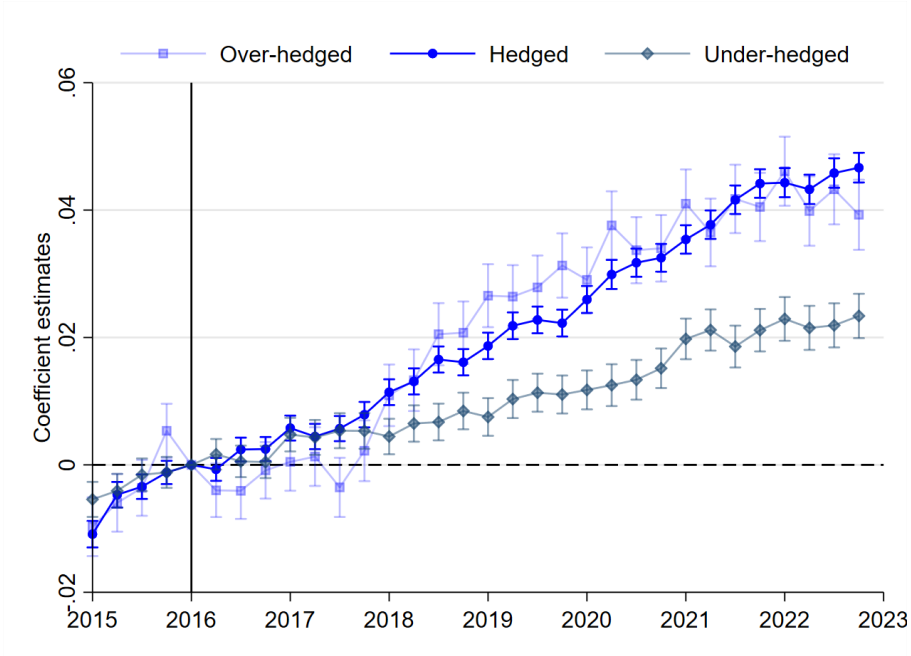


Figure A.11: Trends in USD invoicing post-Brexit by USD needs.

Note.– The graph plots the coefficients β_q from dynamic specification **??** over time, capturing the trend increase (in p.p.) in USD invoicing by USD hedging bucket, as defined in **??**. Firms are "under-hedged" if their USD net imports as a share of total inputs are above 1%, "over-hedged" if below −1%, and "hedged" in the remaining case.

Source: HMRC administrative datasets, UK non-EU non-US exports, 2010–2022.

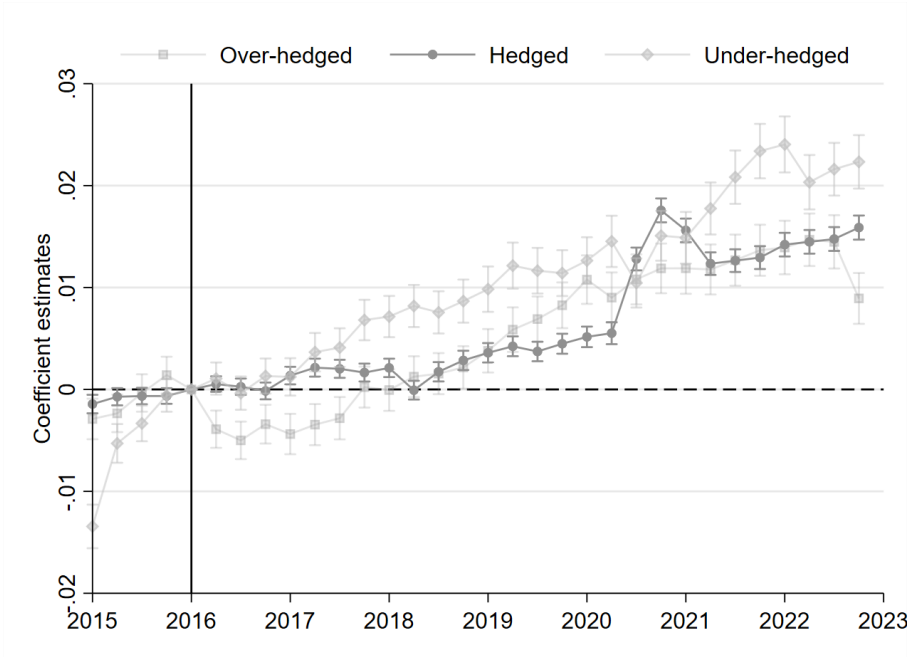


Figure A.12: Trends in LCP invoicing post-Brexit by USD needs.

Note.– The graph plots the coefficients β_q from dynamic specification **??** over time, capturing the trend increase (in p.p.) in LCP invoicing by USD hedging bucket, as defined in **??**. Firms are "under-hedged" if their USD net imports as a share of total inputs are above 1%, "over-hedged" if below −1%, and "hedged" in the remaining case.

Source: HMRC administrative datasets, UK non-EU non-US exports, 2010–2022.

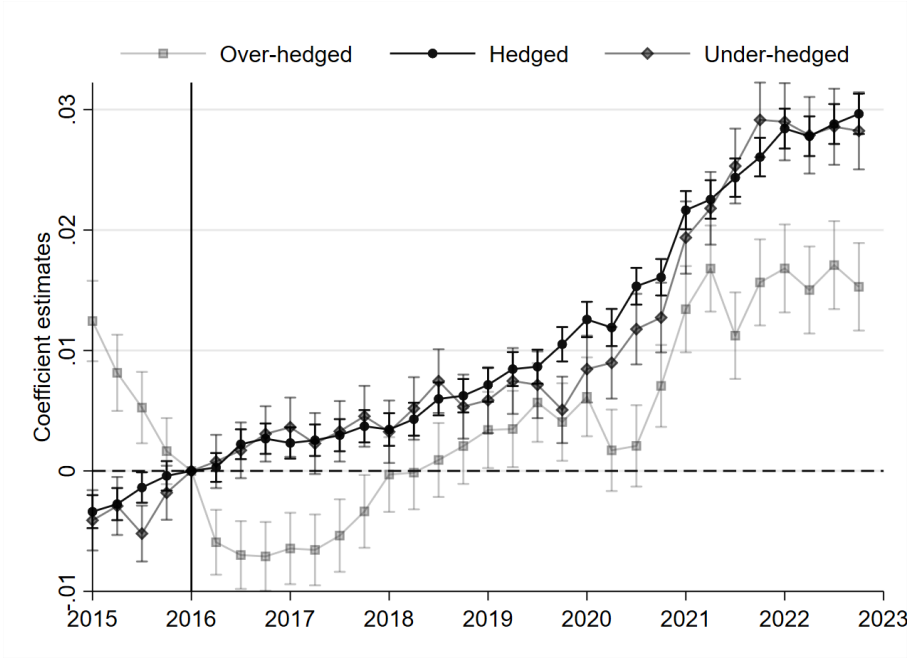


Figure A.13: Trends in EUR invoicing post-Brexit by USD needs.

Note.– The graph plots the coefficients β_q from dynamic specification **??** over time, capturing the trend increase (in p.p.) in GBP invoicing by USD hedging bucket, as defined in **??**. Firms are "under-hedged" if their USD net imports as a share of total inputs are above 1%, "over-hedged" if below −1%, and "hedged" in the remaining case.

Source: HMRC administrative datasets, UK non-EU non-US exports, 2010–2022.

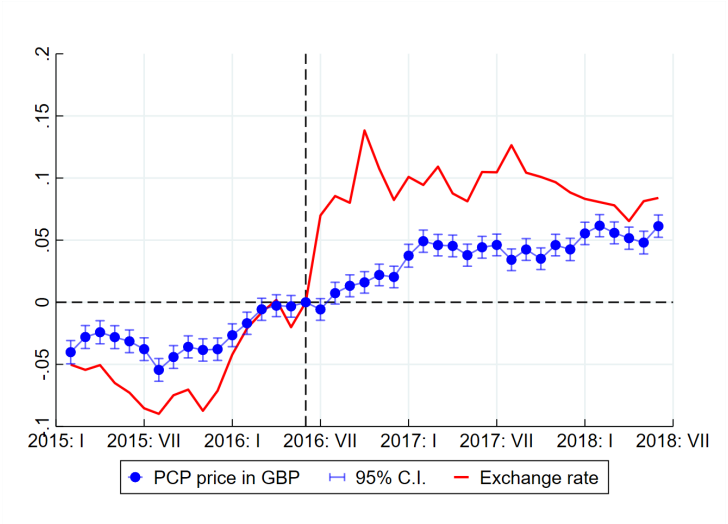


Figure A.14: Price Stickiness in the Currency of Invoicing - GBP

Source: HMRC administrative datasets, UK non-EU non-US exports, 2010–2022.

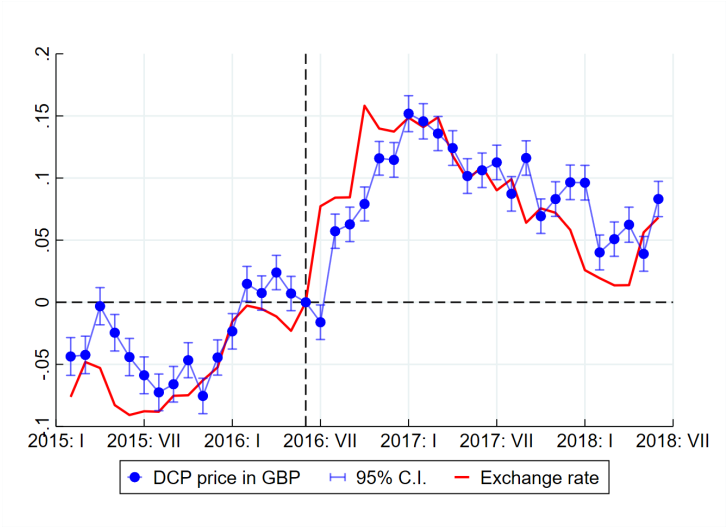


Figure A.15: Price Stickiness in the Currency of Invoicing - USD

Source: HMRC administrative datasets, UK non-EU non-US exports, 2010–2022.

TBU

Figure A.16: Event study: effect of EUR payable revaluation on EUR invoicing

Note.– The graph plots the coefficients β_q from dynamic specification 16 over time, capturing the differential increase in EUR invoicing by treated (highly EUR exposed) firms.

Source: HMRC administrative datasets, UK non-EU non-US exports and imports, 2010–2022.

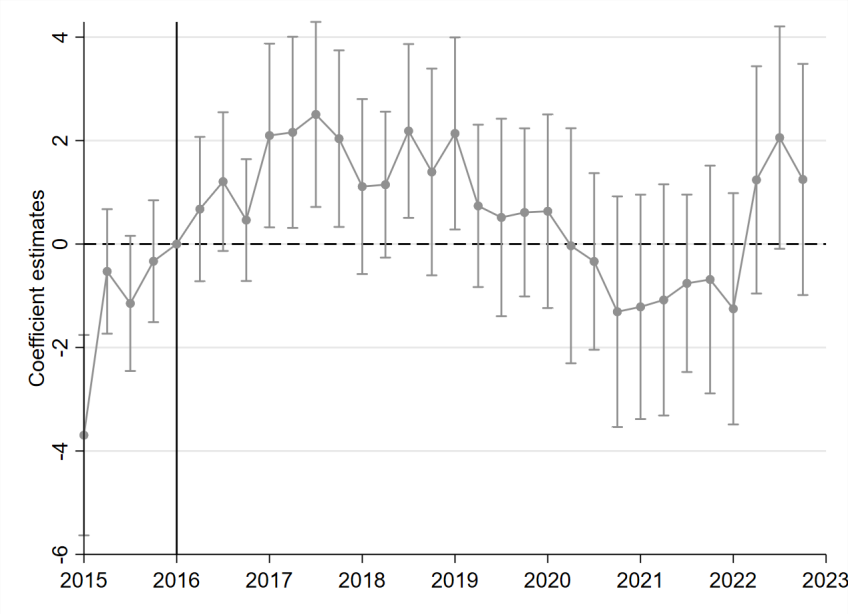


Figure A.17: Event study: effect of LCP payable revaluation on LCP invoicing

Note.– The graph plots the coefficients β_q from dynamic specification 16 over time, capturing the differential increase in LCP invoicing by treated (highly LCP exposed) firms.

Source: HMRC administrative datasets, UK non-EU non-US exports and imports, 2010–2022.

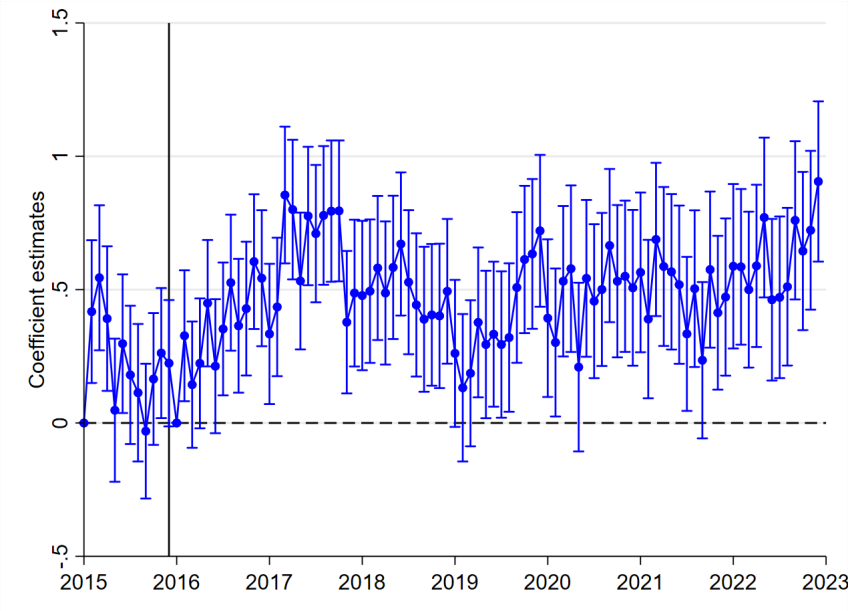


Figure A.18: Event study - effect of speculative motives on USD invoicing

Note.– The graph plots the coefficients β_m from dynamic specification 7 over time, capturing the differential reduction in GBP invoicing by treated (highly GBP exposed) firms.

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2022.

TBU

Figure A.19: Event study - effect of speculative motives on LCP invoicing

Note.– The graph plots the coefficients β_m from dynamic specification 7 over time, capturing the differential reduction in GBP invoicing by treated (highly GBP exposed) firms.

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2022.

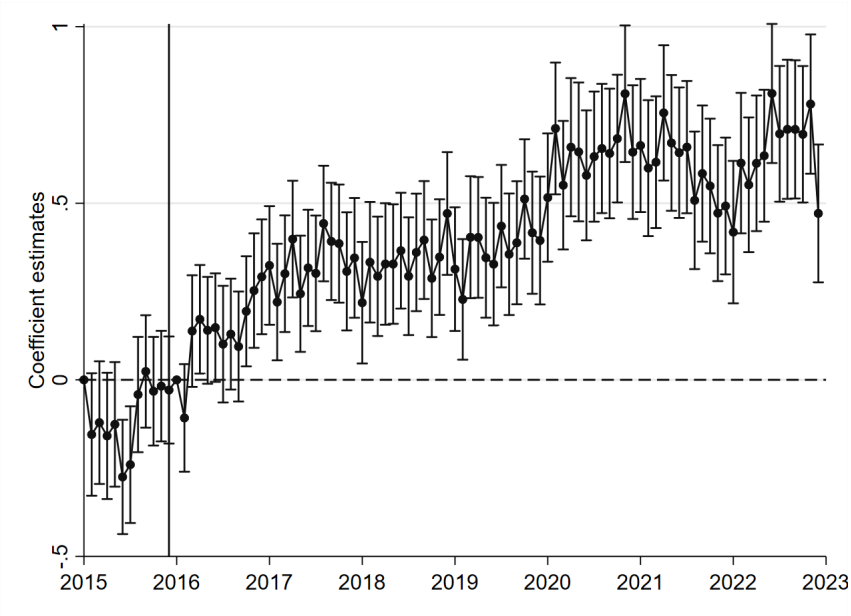


Figure A.20: Event study - effect of speculative motives on EUR invoicing

Note.– The graph plots the coefficients β_m from dynamic specification 7 over time, capturing the differential reduction in GBP invoicing by treated (highly GBP exposed) firms.

Source: HMRC administrative datasets, UK non-EU exports and imports, 2010–2022.