Department for
Business & Trade

Estimating UK Intra-firm Trade

An Approach Using Firm-level Data and Large Language Models

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Contents

Executive Summary

The fragmentation of global production through Global Value Chains (GVCs) in recent years has led to a rise in intra-firm trade. Intra-firm trade arises from the operations of Multinational Enterprises (MNEs) and is defined as cross-border transactions in goods and services between parent companies and their affiliates, or between affiliates themselves ('related parties'). Customs data from the US Census Bureau show that US intra-firm trade in goods has increased by 115% since 2005, whereas arm's-length trade in goods (cross-border trade between non-related parties) has increased by 92% over the same period (US Census Bureau, 2025).

Intra-firm trade has different economic implications compared to arm's-length trade. Understanding its nature and scale is important for informing policy - whether it is around trade and GVCs, taxes and tariffs, competition, industrial policy, or issues related to profit shifting and transfer pricing.

Despite its policy relevance, comprehensive statistics on intra-firm trade remain limited. Direct data collection is scarce globally, and there is a notable absence of detailed, transaction-level databases that capture corporate ownership structures and cross-border transactions between entities within the same corporate group.

Surveys of MNEs and administrative data collected by customs authorities have the potential to provide insights on intra-firm trade but have limitations.

- Most customs authorities do not capture intra-firm trade in their merchandise statistics. In the few cases where they do (e.g. US Census Bureau), these statistics do not provide a comprehensive picture of intra-firm trade as they only cover goods and exclude services. This omission leads to an underestimation of intra-firm trade.

- Business surveys can provide insights into intra-firm trade, but they are often costly to conduct and face challenges such as low response rates. These issues stem from factors like survey fatigue, confusion over the definition of 'related party' transactions, and respondents' reluctance to disclose sensitive information.

- In the UK - and most other countries - intra-firm trade statistics are not currently collected, either via customs declarations or business surveys. At the time of writing this report, the Office for National Statistics (ONS) had no concrete plans to produce statistics on intra-firm trade or to explore methodologies for developing such data.

In the absence of comprehensive official statistics on intra-firm trade, researchers have relied on firm-level data and empirical methods to estimate intra-firm activity. However, these approaches often rely on strong assumptions and incomplete data that compromise the quality of the estimates. Empirical findings from these studies suggest that intra-firm trade is more common in productive, capital and skill-intensive firms; less sensitive to macroeconomic shocks, and; more likely to occur when product contractibility is low.

None of the published studies explore intra-firm trade for the UK specifically. This paper aims to add to the literature by showcasing a novel methodology based on the use of Large Language Models (LLMs) and a range of firm-level datasets to develop an understanding of intra-firm trade for the UK. This approach offers a more refined and detailed way of identifying relationships between entities within the same corporate group compared to

existing methodologies, however it is experimental and relies on granular underlying data which are unavailable for most countries.

The paper first presents estimates of intra-firm trade in goods between the UK and the US, based on the limited official data available - such as the 'Related Parties' dataset published by the US Census Bureau (2025). It then presents the novel LLM-based methodology used to generate experimental estimates of intra-firm trade in goods between the UK and selected international trading partners using firm-level trade in goods data.

It is important to note that, due to the lack of comprehensive data covering all UK trading partners, our approach does not aim to – and indeed cannot - estimate the total value of UK intra-firm trade. Instead, the analysis focuses on selected countries and specific elements of intra-firm trade permitted by the available data. For example, we include data from relatively minor partners, such as Colombia - not because these trade flows are economically significant, but to demonstrate the method's potential. This example highlights our approach's potential to generate comprehensive estimates of UK intra-firm trade when granular, high quality, datasets become available.

Headline findings

The US Census Bureau is the only known producer of intra-firm trade statistics. These statistics cover goods only and are captured directly from customs declarations that identify transactions between 'related parties', defined based on ownership shares of over 10% for exports and over 5% for imports.

Using mirror statistics from this source, we can estimate the scale of intra-firm trade in goods between the US and the UK over time and by industry.

The latest statistics show that intra-firm trade accounts for a substantial share of goods trade between the United States and the UK; it is mainly prevalent in trade of Transportation Equipment (driven by Motor Vehicles); and it has increased over time:

- In 2024, 58% of all UK goods exports to the United States were intra-firm. Most of these intra-firm exports were exports of Transportation equipment (31% of total intra-firm goods exports), Chemicals (22%) and Machinery (15%) products.

- In 2024, 31% of all UK goods imports from the United States were intra-firm. Most of these intra-firm imports were imports of Transportation Equipment (21% of total intra-firm goods imports), Oil and Gas (18%) and Petroleum and Coal (16%) products.

- Intra-firm UK goods exports to the United States have grown 32% since 2005, marginally slower than arms'-length exports which have grown by 37% over the same period.

- Intra-firm UK goods imports from the Unites States have grown 105% since 2005, significantly faster than arm's-length imports which have grown by 89% over the same period.

The United States is a key trading partner for the UK, accounting for 12% of UK goods trade in 2024, so the figures above likely capture a sizable share of UK intra-firm trade in goods. However, intra-firm trade is not limited to UK-US flows. Since the UK does not currently collect intra-firm trade data through customs or business surveys, we have taken a multifaceted approach to identify firms involved in this type of trade in the UK, combining

LLM and a range of microdata sources from the UK, the United States, Canada and Colombia. These sources include administrative records of traders, international shipping records (Bills of Lading), trademark ownership data and company analytics.

Key findings include:

- Intra-firm trade represents a substantial share of total goods trade across all datasets analysed. We estimate that 49% of UK maritime exports to the United States and 38% of overall (maritime plus non-maritime) UK exports to Colombia were intra-firm in 2022. Regarding imports, UK Bill of Lading data and Colombian trade statistics support evidence from the US Census Bureau showing that the intra-firm share of UK imports is lower than that of exports.

- Intra-firm trade is dominated by a small number of companies. We estimate that just 10 companies accounted for 63% of all observed intra-firm maritime UK exports of goods to the United States in 2022.

- The likelihood of engaging in intra-firm trade increases with firm size (measured by employee count) across all datasets considered. Intra-firm trade is concentrated among a small number of large firms, which helps explain the clustering observed in products related to these large firms, such as beverages, vehicles, machinery, oil, chemicals and pharmaceuticals.

- When intra-firm trade occurs, it serves as the primary mode of trading for over 80% of companies across all the datasets we explore.

- Intra-firm trade is most common among corporate families headquartered in London and the South-East. This likely reflects the tendency of large global corporations to establish headquarters in these locations, as well as the greater availability of specific services that facilitate intra-firm transactions.

- Mode of transport plays an important role in analysing intra-firm trade. Colombian trade data demonstrate that the characteristics of air and maritime trade differ widely in relation to intra-firm trade. Therefore, a full understanding of intra-firm trade requires coverage beyond maritime trade alone. Datasets limited to maritime flows, such as the UK Bill of Lading and US Vessel Manifest data, should not be considered in isolation.

- Colombian trade data also provide evidence of price premiums and discounts in intra-firm trade relative to arm's-length trade. This suggests that relying on assumptions based on weight – such as applying a constant product price to the weight of goods, as done in the UK Bill of Lading and US Vessel Manifest data - may limit analysis of potential product differentiations.

The trading decisions of MNEs can significantly influence both intra-firm trade and overall trade levels. Traditional macro-level trade data are inadequate for capturing intra-firm trade dynamics and ownership structures. Firm-level microdata, which allow analysis at the company level, are necessary to derive meaningful intra-firm trade estimates.

Firm-level approaches have seen limited implementation because identifying all companies within a corporate family and performing accurate data matching is extremely challenging. In the Netherlands, an experimental method is being tested using the Euro Groups Register

(EGR). Participation in global initiatives like this could provide an avenue for obtaining estimates of intra-firm trade for the UK. In the absence of such data, this paper demonstrates that generative AI techniques offer a promising, low-cost, alternative for researchers, with the potential to produce robust and consistent estimates.

However, the UK currently lacks sufficient microdata to assess the scale and characteristics of intra-firm trade. The most comprehensive dataset - HMRC's raw customs data (CDAP) - is inadequate for research on this topic as essential partner information is removed during processing for official statistics. We recommend that HMRC either a) adapts customs declarations to include flags for related-party transactions (a-la US Census Bureau), b) modifies its data pipeline to make partner information available to researchers or c) applies the methodology proposed in this paper internally to produce measures of intra-firm trade. In practice, the resource burden for the first two options is significantly higher than for the third.

The suggestions above concern intra-firm trade in goods. Addressing the larger and more complex challenge of measuring intra-firm trade in services is essential for a complete understanding of the importance of intra-firm trade for the UK economy. While this paper introduces an experimental method using trademark data, this captures only a small subset of services trade.

Expanding existing business or trade surveys (e.g. ONS Annual Business Survey, ONS International Trade in Services) to include tailored questions on intra-firm trade in both goods and services would therefore be highly beneficial – particularly if targeted towards large MNEs most likely to engage in such trade. Large Case Units (LCUs) within National Statistical Offices (NSOs) could play a critical role here, given their close relationships with major MNEs. LCUs could test questions and run experimental modules before NSOs scale up the surveys nationally, helping refine questionnaire design.

Beyond surveys, alternative data sources - such as those explored in this study - can help identify firms engaged in intra-firm trade and improve sampling frames. NSOs could also consider leveraging firm-level data from Foreign Direct Investment (FDI) surveys, which capture ownership links between parent companies and affiliates. Integrating these with firm-level trade data could provide indicative estimates of intra-firm trade flows within MNE groups. Finally, applying experimental approaches like those proposed here to other firm-level business-to-business datasets - such as administrative tax records or commercial payments data - could offer further insights into the scale and nature of intra-firm trade. These steps would broaden coverage and deepen understanding beyond traditional survey-based methods.

1. Introduction

Intra-firm trade refers to transactions of goods and services between entities within the same multinational enterprise (MNE), such as between a parent company and its affiliates or among affiliates themselves (i.e. transactions between 'related parties').

This form of trade has grown significantly with the rise of Global Value Chains (GVCs) and the fragmentation of production processes across borders in recent years. For example, US Census Bureau data show that intra-firm trade in goods has increased by 115% since 2005, compared to a 92% increase in arm's-length trade (i.e. transactions between 'unrelated parties') over the same period. The same data show that intra-firm trade represents a substantial share of overall trade in goods, with roughly half of US goods imports and a third of US goods exports estimated to be intra-firm (US Census Bureau, 2025).

Intra-firm trade differs from arm's-length trade in its economic implications. Understanding its scale and characteristics is crucial for designing effective policies on trade, GVCs, competition and tax regulation.

MNEs utilise GVCs to optimise production processes and minimise costs by locating subsidiaries in various countries to take advantage of local resources, labour or expertise. Intra-firm trade statistics can reveal these dependencies and competitive advantages, helping policymakers to understand upstream and downstream linkages involving multinationals and their affiliates at home and abroad. Such insights are important for shaping effective tariff policies, reducing trade barriers and supporting strategic sectors.

Furthermore, intra-firm trade data can provide valuable insights for policymakers seeking to better understand corporate structures and inform strategies to address tax planning practices, including profit shifting. By inflating or deflating prices in intra-firm transactions, firms can move profits to jurisdictions with lower corporate tax rates. Understanding the scale and nature of these transactions helps designing effective anti-avoidance measures and ensuring fair taxation.

Bonturi and Fukasaku (1993) noted that intra-firm trade had received little attention in both academic and statistical research. More than three decades later, and despite its growing importance, data on intra-firm trade remain scarce. In the UK, statistics on intra-firm trade are not explicitly collected or available. Consequently, much of the literature has focused on examining the determinants and characteristics of intra-firm trade relative to arm's-length trade, often relying on case studies where data are available. Addressing this data gap is important for informed decision-making in an increasingly interconnected global economy.

This research seeks to contribute to the literature by introducing a novel approach that leverages Large Language Models (LLMs) alongside a range of granular, firm-level, datasets to estimate aspects of intra-firm trade for the UK. It extends previous firm-level approaches by removing assumptions about interlinked industries and instead applying a more nuanced methodology leveraging LLMs. The method allows granular estimates of intra-firm trade for the UK to be produced, delivering new insights into the role of intra-firm trade that were previously unavailable.

The paper is structured as follows: Section 2 provides an overview of existing methodological approaches for capturing intra-firm trade and highlights currently available

data with a UK perspective. Section 3 provides estimates of UK intra-firm trade using the LLM approach and a range of firm-level data sources. Section 4 concludes.

2. Existing approaches for capturing intra-firm trade

In theory, international trade in goods and services can be classified based on whether transactions occur between related parties (firms within the same enterprise group) or unrelated parties. As noted earlier, trade between related parties is defined as intra-firm trade, whereas trade between unrelated parties is referred to as arm's-length trade. In practice, however, most international trade statistics do not distinguish between these two types of trade.

A necessary condition for intra-firm trade is activity across multiple jurisdictions, meaning that, by definition, only MNEs engage in intra-firm trade. Cadestin and others (2018) highlight the central role of MNEs in GVCs, noting that they account for around a third of global output and half of global trade.

Lanz and Miroudot (2011) argue that intra-firm trade complicates trade policy analysis because a 'domestic company' may produce abroad through its affiliates or be foreign-owned. Policymakers therefore need more nuanced approaches than simply viewing exports as beneficial and imports as harmful, which requires detailed data on ownership structures to inform policy decisions.

Whilst the concept of intra-firm trade is relatively simple, producing relevant statistics requires transaction level data that identify the individual parties involved in the transaction, whether those parties belong to the same corporate family, and whether these transactions are cross-border.

Zeile (2003) notes that information which fulfils these criteria is typically available only through customs data (see section 2.1) or surveys of MNEs (see section 2.2) designed to capture the value of transactions between the foreign and domestic units of multinationals. Customs data cover trade in goods only while MNE surveys could, in principle, capture both goods and services. However, as discussed in the following sections, such data are largely unavailable.

In the absence of comprehensive intra-firm data from these sources, many researchers have relied on microdata approaches using company-level financials and ownership structures. These approaches are discussed in section 2.3. Most of them involve assumptions about industry linkages to infer intra-firm trade. However, as every firm is unique, wide adoption of industry-based assumptions risks introducing bias and omitting key information.

2.1 Using customs declarations to produce intra-firm trade statistics

Trade data collected via customs declarations cover goods but exclude services. In 2024, global trade in goods was valued at approximately USD 25 trillion, while services trade amounted to USD 8 trillion (UNCTAD, 2024), meaning that around a quarter of global trade (services) is not reflected in customs data. Intra-firm trade tends to be higher when an input in the production process is not easily contractable, and services contracts are typically more difficult to specify than goods contracts. As a result, the share of intra-firm trade in services is likely greater than the share of intra-firm trade in goods. This means that a significant and important component of intra-firm trade is not reflected due to the omission of services trade in customs data.

The International Merchandise Trade Statistics manual (IMTS; UN, 2010) does not explicitly recommend collecting intra-firm trade data through customs declarations alone. Rather, it encourages data producers to explore combining customs data with other data sources, such as business registers and enterprise surveys, to identify intra-firm relationships.

Although this recommendation was made over a decade ago, data availability remains extremely limited, with the United States being the only known country producing intra-firm trade statistics, albeit for goods only. Since 1991, the US Census Bureau (2025) has published intra-firm goods trade data, derived from a check question in export and import declarations asking traders to state whether the transaction is between related parties. A 'related party' is defined as having an ownership share exceeding 10% for exports and 5% for imports.

The latest figures from US Census Bureau's 'Related Party' trade dataset illustrate the importance of intra-firm goods trade (Figure 1). At the global level (partner=World), 50% of US goods imports[1] in 2024 were with related parties – a share that has remained relatively stable since 2005, ranging between 46% and 51%. US goods exports to related parties accounted for 34% of total US goods exports in 2024, up from 31% in 2005. In monetary terms, US imports from related parties totalled USD 1,611bn in 2024, while US exports to related parties totalled USD 583bn. The increase in US intra-firm trade between 2005 and 2024 was primarily driven by growth in intra-firm trade in the Oil and Gas, Pharmaceuticals and Motor Vehicles industries.

Figure 1. Evolution of US intra-firm trade in goods, in value ($bn) terms and as a share (%) of total US goods exports and imports, 2005-2024
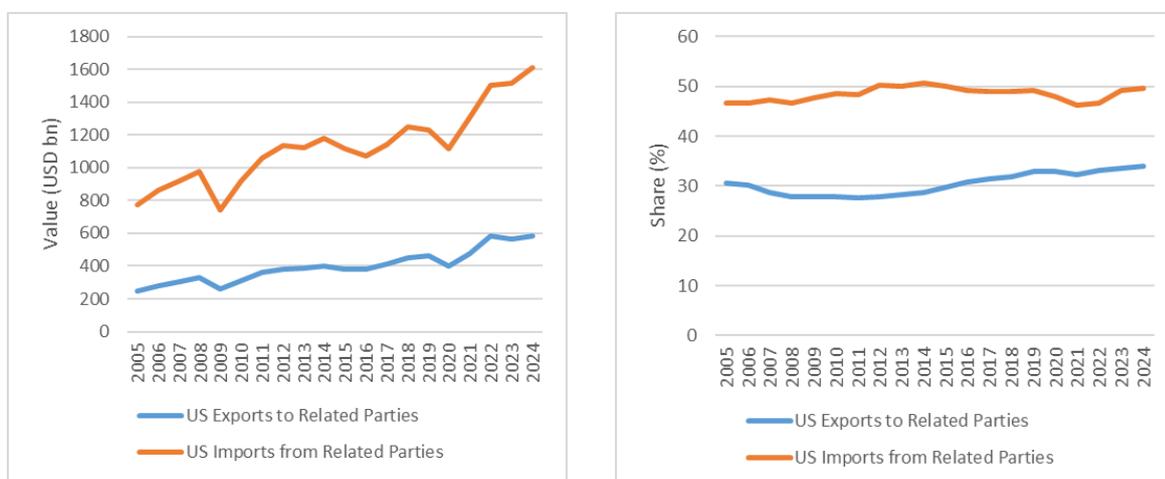
Source: US Census Bureau Related Party Goods Trade (2025), https://www.census.gov/foreign-trade/Press-Release/related_party/index.html.

On a bilateral basis, the share of intra-firm trade in total US goods trade varies significantly across the top US trading partners in 2024 (Figure 2). For imports, the share is particularly high for Japan (78% of all US goods imports from Japan were intra-firm in 2024), Germany (66%) and Mexico (65%), while the share for China is much lower at 19%. In general, the

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[1] The import data reported by US Census Bureau in the Related-Parties database are imports for consumption only.

share of exports involving related parties is smaller than that for imports, with China being a notable exception. For exports, Canada (42% of all US goods exports to Canada were intra-firm in 2024), Mexico (39%) and Germany (38%) show the highest shares, whereas the share for India is much lower (19%).

US imports from the UK involving related-parties represented 58% of all US goods imports from the UK in 2024, while related-party US exports to the UK accounted for 31% of all US goods exports to the UK - moderate compared to other major partners.

Figure 2. Share of US intra-firm goods trade with selected partners, 2024
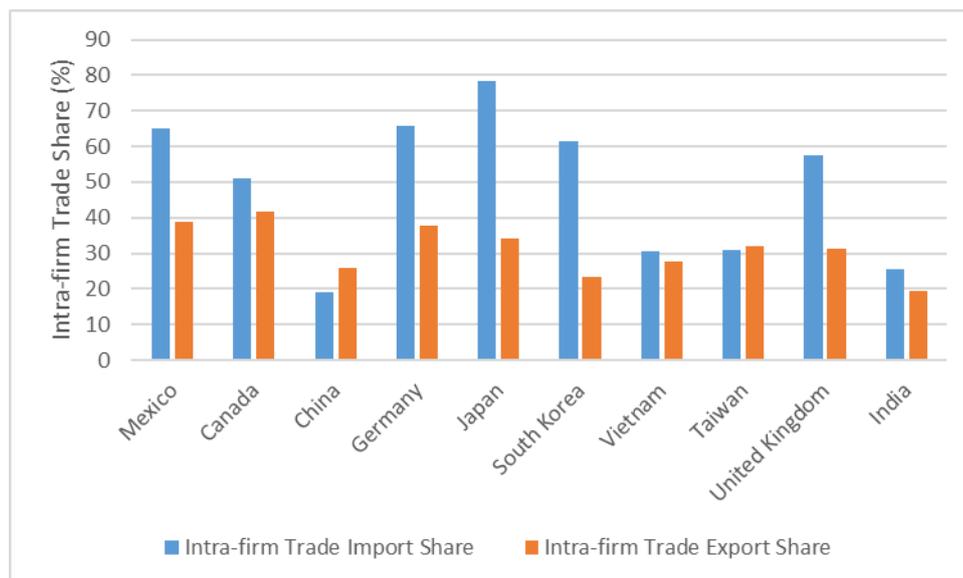
The share of trade involving related parties also differs significantly on a sector basis. Figure 3 illustrates this for several key US sectors in 2024. Capital intensive sectors tend to exhibit higher shares of intra-firm trade, with Motor Vehicles being a notable example where 96% of US imports and 67% of US exports involve related parties. In contrast, sectors that export or import products that can be more easily contracted to external parties show lower intra-firm shares. For example, 52% of US imports of Motor Vehicle Parts and 47% of US exports in the same category are intra-firm – significantly lower than the shares observed for the finished product (Motor Vehicles).

Figure 3. Share of US intra-firm goods trade for selected sectors, 2024

Whilst US Census Bureau data demonstrate the value of capturing intra-firm trade through customs declarations, significant challenges remain for broader international adoption of this approach. Without adopting the US approach, customs authorities would require detailed knowledge of corporate structures and developing methods to link this information to trade records. Although information on corporate structures is available from sources such as Bureau Van Dijk (ORBIS) and Dun & Bradstreet, these datasets are often prohibitively expensive, particularly given that customs authorities and statistical agencies typically prioritise other objectives.

Open-source initiatives such as the OECD-UNSD Multinational Enterprise Information Platform (MEIP), described in Pilgrim and Ang (2024), could provide a partial solution. However, because this platform covers only the largest MNEs, it lacks the depth and coverage required for the development of comprehensive intra-firm trade statistics internationally.

Bill of Lading data is another promising source, yet insufficient on its own. It provides detailed information about a vessel's cargo, often including the parties involved, product descriptions, weights and values. This makes it useful for analysing intra-firm trade. However, its main limitation is that it only captures global maritime goods trade. While maritime transport is estimated to account for roughly 80% of global goods trade by volume and 70% by value (UNCTAD, 2022), these figures can vary significantly depending on country-specific characteristics. For example, if viable alternative trading routes (such as road, pipeline or rail) exist, then these shares may be considerably lower.

Furthermore, Bill of Lading data coverage varies by jurisdiction. In the US, all records are publicly available for researchers, whereas in other jurisdictions, coverage is incomplete and data accessibility often depends on agreements with individual shipping companies. For example, in the UK, Bill of Lading data acquired by the Department for Business and Trade

and Department for Transport (2023) cover approximately 50% of containers passing through Felixstowe, London Gateway and Southampton – three ports which together handle around 70% of UK container traffic.

2.2 Obtaining information on intra-firm trade directly from MNEs

Several approaches have been explored to obtain information on intra-firm transactions directly from MNEs.

Verma (2023), for example, analysed a sample of 583 foreign-affiliated manufacturing firms in India by accessing audited financial statements from the Ministry of Corporate Affairs (MCA). By compiling related-party transaction data for 2015/16, the study estimated that 57% of goods exports and 78% services exports were intra-firm. On the import side, 73% of goods imports were intra firm, while services were split into 'Royalty or technical fee payments' and 'Payments for services or other expenses', with intra-firm shares of 96% and 60%, respectively. For the UK, the results suggest that intra-firm trade in 'Royalty or technical fee payments' services was particularly significant.

Nguyen and others (2022) examined intra-firm loans using Dun & Bradstreet data to identify subsidiaries of large UK MNEs operating in Southeast Asia. They cross-checked this information against annual accounts and Chamber of Commerce websites to verify its robustness, resulting in a list of 504 subsidiaries. A 40-question survey was then distributed to these subsidiaries, with eight months spent encouraging participation. Ultimately, only 101 usable responses were received - a response rate of about 20%. Such methods are highly resource-intensive, and independent researchers have found them challenging to implement beyond narrowly focused studies.

These challenges highlight the complexity faced by National Statistical Offices (NSOs) when collecting information on intra-firm trade through foreign affiliate surveys, such as those focusing on the Activity of Multinational Enterprises (AMNE). NSOs operate under resource constraints and must carefully balance sample sizes. Intra-firm trade is typically concentrated among a small number of large firms, so identifying or sampling these key firms is critical. However, limited information on firms' activities at the sample design stage makes this task extremely difficult. Poor response rates complicate matters, with survey fatigue, confusion, and reluctance to share sensitive data cited as common reasons for non-response.

To mitigate survey fatigue, NSOs aim to minimise the respondent burden on companies. For example, firms receiving AMNE questionnaires are also likely to receive International Trade in Services (ITIS) questionnaires. AMNE surveys cover broader topics such as MNE employment and turnover, meaning questions on intra-firm trade may be deprioritised or not included at all in the questionnaires. In some jurisdictions, such as the US, legislation mandates survey participation which improves response rates but does not eliminate survey confusion.

Survey confusion is particularly relevant for intra-firm trade as respondents often apply corporate accounting principles that differ from statistical concepts, creating potential misalignment. This issue is well-documented, prompting some jurisdictions to establish Large Case Units (LCUs, see Box 1) which liaise directly with MNEs to understand their

structure and clarify data discrepancies. However, these interactions are generally voluntary and require significant resources from both MNEs and NSOs. As a result, they typically involve only a small number of the largest MNEs, with efforts focused on resolving issues related to headline statistics. To date, there are no known cases where LCUs have driven the development of intra-firm trade statistics.

Box 1. An example of the operation of an LCU in the UK

The ONS (2023) established a large case unit in 2019 to improve understanding of the behaviour of MNEs. Through a process of direct communication with MNEs, a number of adjustments have been made to National Accounts aggregates to correct misreporting.

One notable example involved survey confusion in the International Trade in Services Survey (ITIS). MNEs acting as global service centres within their group were examined. These MNEs commonly exported corporate services such as computer, research and development (R&D) and legal services. Royalties for the use of intellectual property also represented a significant share of both exports and imports for these firms.

ONS (2023) reported that, by working closely with these companies, they improved the interpretation of ITIS questions, resulting in the delivery of more accurate and comprehensive data. For 2018-20, this collaboration led to an annual upward revision of £0.8bn for services exports and £1.0bn for services imports, on average. These improvements will continue to be reflected in future statistics thanks to the efforts of the LCU and the MNEs involved.

International Accounting Standards (IAS) provide guidance for 'related party disclosures' in Chapter 24 (IFRS, 2024). The aim of these standards is to ensure that financial reports include sufficient disclosures for analysts to assess whether a company's financial position is significantly impacted by transactions with related parties. This objective differs from that of NSOs which seek to quantify intra-firm trade by understanding the flow of goods and services between related parties.

This issue becomes clear in a simple example: Company A controls Company B, and Company B sells products to Company A. For statisticians, the focus is solely on transactions between the two companies. Under IAS principles, however, Company A would not be required to disclose these intra-firm transactions because it fully consolidates the information of Company B within its financial statements, treating the group as one entity [2]. However, Company B would be required to disclose the transactions in its financial statements, as understanding its profitability requires insight into the nature of its relationship with Company A. These differing perspectives can easily cause confusion.

Further confusion arises from differences in the definition of 'related parties'. Accounting principles classify holdings in other companies as subsidiaries, joint ventures, associates or equity holdings, based on the voting share of the parent company (Table 1).

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[2] When company A consolidates its financial statements, it treats itself and company B as one entity, which means intra-firm transactions are eliminated. For example, if company B sells goods worth £100 to company A, the consolidated entity is both paying and receiving £100, which is recorded as an internal transfer of goods.

Table 1. Holding of voting share and accounting treatment under IAS principles

Accounting Treatment	Voting Share
Subsidiary	50%+
Joint Venture	50%
Associate	20-50%
Equity	0-20%

Source: Authors representation.

Under IAS principles, 'related parties' are defined as entities with a significant control relationship, which includes associates, joint ventures and subsidiaries. In compiling AMNE statistics, however, a control-based perspective (ownership share of 50% or higher) is typically applied, meaning that only joint ventures and subsidiaries are included.

Differences in definitions create two main issues. First, if companies adopt the accounting perspective, they may over-report intra-firm transactions relative to what AMNE statistics aim to measure. Second, under any definition, situations can arise where two parties share a control relationship with the same company, leading to potential double counting.

In addition, corporate accounting principles are not designed to measure global trade. Challenges such as handling re-exports or factory-less goods producers fall outside the expertise of most accounting professionals, as evidenced by the adjustments detailed in Box 1 and ONS (2023).

Finally, companies are constantly evolving and changing structure. Transactions such as intra-period Mergers and Acquisitions (M&A), especially strategic acquisitions, can make it difficult to distinguish trade before and after a subsidiary comes under a firm's control.

Datasets such as the OECD's Activity of Multinational Enterprises (AMNE) and Eurostat's Foreign Affiliate Statistics (FATS) provide statistics compiled by NSOs on both Inward AMNE - activities of foreign-owned affiliates within the domestic economy - and Outward AMNE - activities of domestically-owned affiliates operating abroad. However, most NSOs are able to collect information on core variables only, such as employment, turnover and enterprise counts. Data on intra-firm trade data are very limited, largely reflecting survey respondents' inability to provide the necessary details.

The current OECD AMNE database (accessed in November 2025) contains only comprehensive intra-firm trade estimates for the US, with partial data also available for Israel and Slovenia. Lanz and Miroudot (2011) noted that, in the EU, poor data quality and low response rates in pilot AMNE surveys led to the conclusion that collecting intra-firm trade data through these surveys is largely infeasible for most countries, and therefore not a mandatory element in Eurostat surveys. The current FATS statistics published by Eurostat do not include any estimates of intra-firm trade for EU member states.

In the UK, the ONS publishes inward and outward FATS statistics infrequently. These are considered 'statistics in development' and are not very timely. For example, the latest ONS inward foreign affiliate statistics (ONS, 2025) release contains estimates for the 2018-2022 period, while the outward foreign affiliate statistics (ONS, 2022b) release covers 2018-19

only. Neither contain any information on intra-firm transactions. At the time of writing this report, the ONS had no plans to produce intra-firm trade statistics or to explore methods for developing such statistics.

2.3 Approaches using firm-level data

In the absence of comprehensive official statistics on intra-firm trade, researchers have relied on approaches using firm-level data to understand the determinants and characteristics of intra-firm trade and produce relevant estimates. However, relying only on firm-level data requires assumptions and simplifications, as information on both parties involved in a transaction is limited.

One approach, applied in Irish data by Leitner and others (2016) defined intra-firm trade as all transactions between foreign affiliates in Ireland and the country where the parent company's headquarters are located. This study combined detailed firm-level merchandise trade data by product and country of origin and destination (Intrastat, Extrastat) with ownership data from the Census of Industrial Production survey to assess the importance of Ireland's intra-firm trade in goods over the period 1994-2015. Using this approach, it was estimated that intra-firm imports accounted for 26% of Ireland's total goods imports and intra-firm exports for 30% of total goods exports in 2015.

The richness of the linked datasets also enabled time-series analysis of intra-firm trade by various characteristics such as industry, product traded and partner country. The findings showed that chemicals, pharmaceuticals, and electronic products dominated Ireland's intra-firm trade, with the US as the largest partner - reflecting the strong presence of US MNEs in Ireland - followed by Germany and the UK.

However, this method has limitations, the most significant being its assumption that all trade with the parent company's home country is intra-firm. This can lead to inaccuracies - intermediate goods sourced from unrelated parties in the parent's economy may be incorrectly counted as intra-firm, while genuine intra-firm transactions with affiliates in other countries may be excluded.

Alfaro and Charlton (2009) proposed an alternative approach using company level microdata from Dun & Bradstreet by: a) identifying all subsidiaries owned by a parent company, b) comparing the industries of the parent and its subsidiaries to classify relationships as vertical, horizontal or complex. Their analysis focused on the determinants of relationship decisions made by MNEs.

More recently, Alfaro and others (2025) combined administrative customs data from the US Census Bureau's Longitudinal Firm Trade Transactions Database with comprehensive US MNE data from the US Bureau of Economic Analysis (BEA) to assess the prevalence of intra-firm trade in the US and assess the impact of potential trade barriers on these flows. Their analysis yields two key findings. First, replacing survey data on intra-firm trade with administrative data helps correct for measurement error - "*some* [intra-firm] *transactions may not be recorded in the BEA's survey e.g., due to interviewer's or respondent's error or imperfect recall*". Second, they provide strong empirical evidence of substantial intra-firm trade between US parents and their North American affiliates. Specifically, they estimate that more than half (59%) of all foreign affiliates engaged in intra-firm trade with their US parents in 2019, an estimate that rises to 73% when focusing on North American trade alone.

The finding that nearly three-quarters of affiliates in North America trade with their parent supports the notion that MNEs organise production along regional supply chains, often referred to as "*Factory North America*", "*Factory Europe*" or "*Factory Asia*" in literature (Baldwin, 2013). The strong prevalence of intra-firm trade in the US suggests that trade barriers (e.g. tariffs) can be highly disruptive for US MNEs, particularly when applied to regional partners.

Lanz and Miroudot (2011) scaled Alfaro and Charlton (2009)'s methodology using firm-level data from ORBIS, and employing 'sales of vertical affiliates' as a proxy for intra-firm trade. The method proposed by Lanz and Miroudot (2011) offers potential for generating country-level estimates of intra-firm trade. However, it has an important limitation: it relies on macro level assumptions to classify industries, categorising them as either 'upstream' or 'downstream' in the production process. In reality, production processes are highly diverse, and such assumptions may fail to adequately capture the complex and nuanced nature of MNE operations.

A broad range of studies provide empirical evidence on the determinants and characteristics of intra-firm trade. For example, using the US Bureau of Economic Analysis (BEA) benchmark survey of direct investments abroad, Borga and Zeile (2004) demonstrated that firms are more likely to source intermediate goods from their US parent when the parent invests heavily in R&D and when the host country offers factor cost advantages. Corcos and others (2013), analysing French firm-level import data from 1999, found that intra-firm sourcing is more prevalent among more productive, capital-intensive and skill-intensive firms. Bernard and others (2013), using the US Linked Longitudinal Firm Trade Transaction Database (LFTTD), showed that greater product contractibility is associated with lower levels of intra-firm trade, and that stronger governance is associated with reduced intra-firm trade.

Evidence also suggests that intra-firm trade is less susceptible to macro-economic shocks. Bernard and others (2009) assessed the impact of the 1997 Asian Financial Crisis on US trade and found that intra-firm exports fell by only 4% in value terms, compared to a 26% drop in arm's-length trade. Similarly, the number of exporting firms fell by 7% for intra-firm trade, compared to a 16% fall for arm's-length transactions.

A concept relevant to intra-firm trade is transfer pricing which refers to the pricing of goods, services or other assets in transactions between related parties. Transfer pricing has significant tax implications, as MNEs may manipulate prices internally to minimise their overall tax burden and maximise profits. Bernard and others (2008), analysing US export data from customs documents over the 1993-2000 period, found a wedge between arm's-length and related-party prices. This price gap is negatively correlated with the destination country's corporate tax rate and positively correlated with its import tariffs. Specifically, it was estimated that a 1% reduction in foreign tax rates increased the price gap by 0.56-0.66%, while a 1% increase in foreign customs duties increased it by 0.56-0.60%.

2.4 Currently available data for the UK

The previous sections highlight the limited data available on intra-firm trade for the UK. A notable exception is the US Census Bureau data which contain information on US intra-firm trade in goods by partner country and North American Industry Classification System

(NAICS). Using the mirror statistics from this source we can estimate the scale of intra-firm trade in goods between the US and the UK over time by industry.

UK intra-firm exports of goods to the US have grown by 32% since 2005 to USD 39.2bn in 2024 (figure 4), slightly slower than arm's-length trade which has grown by 37% over the same period. The increase in UK intra-firm exports to the US since 2005 was largely driven by Motor Vehicles. In comparison, intra-firm UK goods imports from the US have grown by 105% since 2005 to USD 20.6bn in 2024, significantly outpacing the 89% growth in arm's-length trade over the same period. The growth in UK intra-firm imports from the US over this period primarily reflected increases in intra-firm imports of Oil and Gas, Petroleum and Coal and Aerospace products.

Figure 4. Evolution of UK intra-firm trade in goods with the US, 2005-2024
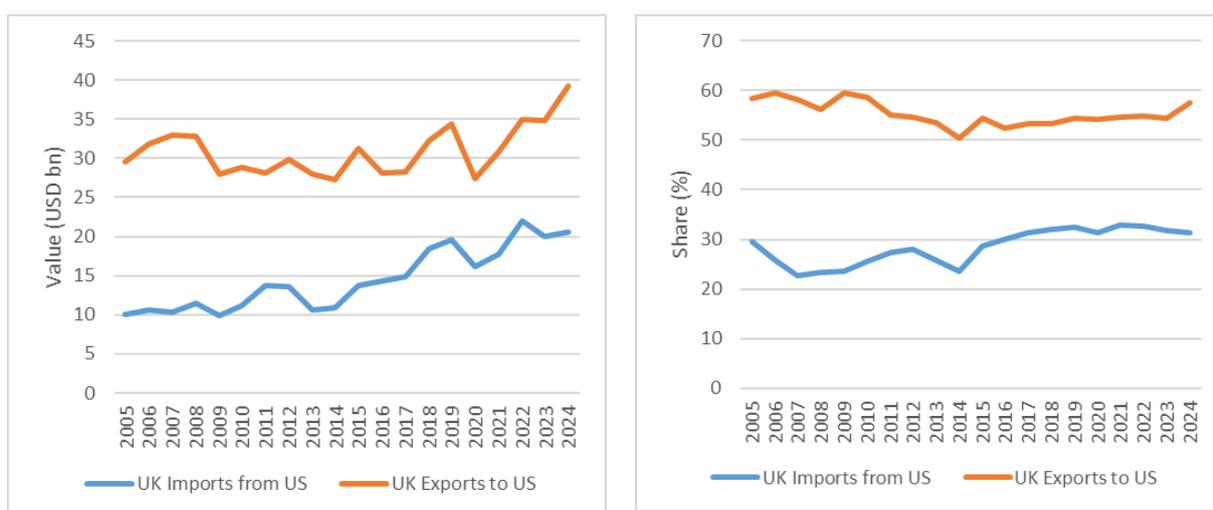
Source: US Census Bureau Related Party Goods Trade (2025), https://www.census.gov/foreign-trade/Press-Release/related_party/index.html.

In 2024, 58% of all UK goods exports to the US were intra-firm. Most of these intra-firm exports were exports of Transportation Equipment (31% of total intra-firm goods exports) - largely Motor Vehicles -Chemicals (22%) and Machinery (15%) – see Table 2. Intra-firm shares within these sectors were notably higher than average – 69% of Transportation Equipment, 73% of Chemicals and 64% of Machinery exports were intra-firm in 2024.

Table 2. Breakdown of UK intra-firm exports to the US at NAICS 3-digit level, 2024

NAICS	UK goods exports to US			
	Total UK exports (USD bn)	UK intra-firm exports (USD bn)	Intra-firm share (% of total UK intra-firm exports)	Intra-firm share (% of total intra-firm exports of UK sector)
336 TRANSPORTATION EQUIPMENT	17.8	12.2	31.1	68.5
325 CHEMICALS	11.9	8.7	22.2	73.2
333 MACHINERY, EXCEPT ELECTRICAL	9.1	5.8	14.9	64.3
980 GOODS RETURNED (EXPORTS FOR CANADA ONLY)	5.2	2.4	6.1	46.2
334 COMPUTER AND ELECTRONIC PRODUCTS	4.3	1.8	4.5	41.4
324 PETROLEUM AND COAL PRODUCTS	2.1	1.2	3.0	54.4
339 MISCELLANEOUS MANUFACTURED COMMODITIES	2.4	1.0	2.6	43.8
335 ELECTRICAL EQUIPMENT, APPLIANCES AND COMPONENTS	2.2	0.9	2.3	41.0
332 FABRICATED METAL PRODUCTS, NESOI	2.0	0.8	2.2	42.4
331 PRIMARY METAL MFG	1.4	0.8	2.1	59.8
211 OIL AND GAS	1.0	0.6	1.5	57.8
312 BEVERAGES AND TOBACCO PRODUCTS	1.7	0.6	1.5	35.0
326 PLASTICS AND RUBBER PRODUCTS	0.8	0.4	1.1	50.9
930 USED OR SECOND-HAND MERCHANDISE	1.9	0.4	1.0	20.5
311 FOOD AND KINDRED PRODUCTS	0.8	0.3	0.8	38.9
910 WASTE AND SCRAP	0.5	0.2	0.6	47.9
337 FURNITURE AND FIXTURES	0.4	0.2	0.5	45.4
322 PAPER	0.3	0.2	0.4	48.9
323 PRINTED MATTER AND RELATED PRODUCTS, NESOI	0.4	0.1	0.4	30.9
990 SPECIAL CLASSIFICATION PROVISIONS, NESOI	0.8	0.1	0.3	16.4
327 NONMETALLIC MINERAL PRODUCTS	0.3	0.1	0.3	45.1
112 LIVESTOCK AND LIVESTOCK PRODUCTS	0.3	0.1	0.2	24.5
313 TEXTILES AND FABRICS	0.2	0.1	0.2	37.4
314 TEXTILE MILL PRODUCTS	0.1	0.1	0.1	40.4
315 APPAREL AND ACCESSORIES	0.2	0.0	0.1	33.0
316 LEATHER AND ALLIED PRODUCTS	0.1	0.0	0.1	28.2
321 WOOD PRODUCTS	0.0	0.0	0.0	35.6
212 MINERALS AND ORES	0.0	0.0	0.0	11.5
113 FORESTRY PRODUCTS, NESOI	0.0	0.0	0.0	61.2
111 AGRICULTURAL PRODUCTS	0.0	0.0	0.0	8.7
115 PRODUCTS SUPPORTING AGRICULTURE AND FORESTRY	0.0	0.0	0.0	49.9
114 FISH, FRESH/CHILLED/FROZEN AND OTHER MARINE PRODUCTS	0.0	0.0	0.0	3.5
Total	**68.2**	**39.2**	**100.0**	**57.5**

Source: US Census Bureau Related Party Goods Trade (2025), https://www.census.gov/foreign-trade/Press-Release/related_party/index.html.

On the import side, 31% of all UK goods imports from the US were intra-firm in 2024. Most of these intra-firm imports were imports of Transportation Equipment (21% of total intra-firm

goods imports), Oil and Gas (18%) and Petroleum and Coal (16%) – see Table 3. These sectors also exhibit above-average intra-firm import shares – 44% for Transportation Equipment, 37% for Oil and Gas and 84% for Petroleum and Coal.

Table 3. Breakdown of UK intra-firm imports from the US at NAICS 3-digit level, 2024

| NAICS | UK goods imports from US | | | |
	Total UK imports (USD bn)	UK intra-firm imports (USD bn)	Intra-firm share (% of total UK intra-firm imports)	Intra-firm share (% of total intra-firm imports of UK sector)
336 TRANSPORTATION EQUIPMENT	9.8	4.3	20.9	43.7
211 OIL AND GAS	10.2	3.7	18.2	36.5
324 PETROLEUM AND COAL PRODUCTS	4.0	3.3	16.2	83.7
325 CHEMICALS	7.1	2.3	11.1	32.2
333 MACHINERY, EXCEPT ELECTRICAL	3.8	1.4	6.9	36.9
334 COMPUTER AND ELECTRONIC PRODUCTS	3.6	1.0	4.9	27.5
335 ELECTRICAL EQUIPMENT, APPLIANCES AND COMPONENTS	1.9	0.7	3.5	38.0
332 FABRICATED METAL PRODUCTS, NESOI	1.8	0.5	2.5	28.9
331 PRIMARY METAL MFG	10.8	0.5	2.4	4.5
339 MISCELLANEOUS MANUFACTURED COMMODITIES	1.5	0.4	2.1	29.0
910 WASTE AND SCRAP	0.6	0.3	1.6	59.5
212 MINERALS AND ORES	0.5	0.3	1.6	68.5
990 SPECIAL CLASSIFICATION PROVISIONS, NESOI	3.7	0.3	1.3	7.4
326 PLASTICS AND RUBBER PRODUCTS	0.8	0.3	1.3	32.7
312 BEVERAGES AND TOBACCO PRODUCTS	0.4	0.2	1.0	53.5
311 FOOD AND KINDRED PRODUCTS	0.7	0.2	0.9	27.7
322 PAPER	0.3	0.2	0.8	57.9
930 USED OR SECOND-HAND MERCHANDISE	1.3	0.1	0.5	7.6
321 WOOD PRODUCTS	1.6	0.1	0.5	5.7
111 AGRICULTURAL PRODUCTS	0.4	0.1	0.4	22.0
327 NONMETALLIC MINERAL PRODUCTS	0.2	0.1	0.4	38.8
323 PRINTED MATTER AND RELATED PRODUCTS, NESOI	0.3	0.1	0.4	25.9
337 FURNITURE AND FIXTURES	0.1	0.0	0.1	24.8
113 FORESTRY PRODUCTS, NESOI	0.0	0.0	0.1	74.4
315 APPAREL AND ACCESSORIES	0.1	0.0	0.1	23.0
112 LIVESTOCK AND LIVESTOCK PRODUCTS	0.0	0.0	0.1	42.6
313 TEXTILES AND FABRICS	0.1	0.0	0.1	15.8
115 PRODUCTS SUPPORTING AGRICULTURE AND FORESTRY	0.0	0.0	0.1	73.4
316 LEATHER AND ALLIED PRODUCTS	0.0	0.0	0.0	20.0
314 TEXTILE MILL PRODUCTS	0.0	0.0	0.0	17.0
114 FISH, FRESH/CHILLED/FROZEN AND OTHER MARINE PRODUCTS	0.0	0.0	0.0	0.5
Total	**65.9**	**20.6**	**100.0**	**31.2**

Source: US Census Bureau Related Party Goods Trade (2025), https://www.census.gov/foreign-trade/Press-Release/related_party/index.html.

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While the 'Related Parties' dataset provides a useful perspective for policy makers, it has several limitations:

- Definition of 'related parties' - The US approach defines 'related parties' based on ownership thresholds (over 10% for exports and over 5% for imports) which do not directly correspond to a standard control-based definition (ownership share of 50% or higher). As a result, US Related Party statistics likely overstate true intra-firm trade.

- Mirror statistics - Using mirror statistics means that UK intra-firm trade values are based on US statistical methods. However, significant asymmetries exist in bilateral trade data reported by the UK and the US due to methodological and conceptual differences in their estimation practices. For example, the US estimates UK goods imports from the US at USD 65.9bn (Table 3), whereas the UK reports USD 92.0bn for the same flow (Table 4). Similarly, the US estimates UK goods exports to the US at USD 68.2bn (Table 2) while the UK reports USD 71.8bn for the same flow (Table 4). Such discrepancies are well documented in the literature (see, ONS 2020 and 2022a for a discussion) and can lead to differing interpretations of the trade data.

- Limited coverage - Although the US is a major trading partner for the UK (Table 4), it represents only about 12% of total UK goods trade, according to UN Comtrade data. Furthermore, US Census Bureau statistics exclude intra-firm trade in services. To obtain a more comprehensive view of UK intra-firm trade, data for other key partners, covering both goods and services, must also be considered.

- Differences in industry classification - US data are reported by NAICS, whereas UK industry classifications follow the UK Standard Industrial Classification (SIC), which corresponds to the Statistical Classification of Economic Activities (NACE). Mapping between these systems is complex and involves numerous one-to-many and many-to-one relationships. Internally, the US Census Bureau maps customs data (defined according to Harmonised System (HS) codes) to NAICS using mapping files, but these mappings are also many-to-one, making it impossible for users to derive intra-firm trade at the HS level without making assumptions.

Table 4. Top 10 trade in goods partners for the UK, as reported by the UK, 2024

Trading partner	Goods imports (USD bn)	Goods exports (USD bn)	Total goods trade (USD bn)	Share of total goods trade (%)
US	92.0	71.8	163.8	12.4
China	98.5	46.5	144.9	11.0
Germany	76.2	38.2	114.4	8.7
France	38.8	28.1	66.9	5.1
Netherlands	26.2	33.3	59.5	4.5
Switzerland	19.2	29.0	48.2	3.7
Ireland	20.2	23.1	43.4	3.3
Italy	31.8	11.1	42.9	3.3
Belgium	18.2	20.8	39.0	3.0
Spain	26.7	11.7	38.4	2.9
World	**809.2**	**508.7**	**1317.9**	**100.0**

Source: UN Comtrade
Note: Selected trading partners have been determined and ordered by the partners with the largest trade (imports + exports of goods) with the UK

2.5 Summary and Next Steps

Despite its importance across several policy areas, such as trade and GVCs, tax and tariff policy, competition and industrial policy, data on intra-firm trade at a global level remains extremely limited. Producing reliable estimates of intra-firm trade requires knowledge of transactions between firms (including whether they are cross border) and the ownership structure of MNEs. For NSOs, obtaining this information is very challenging due to privacy constraints, cost barriers, survey confusion and survey fatigue.

Several attempts have been made to estimate intra-firm trade using micro level approaches that examine corporate hierarchies to determine firms' roles in the production process. However, these methods rely on broad assumptions and struggle to capture the uniqueness of each firm.

Using mirror statistics compiled by the US Census Bureau provides a useful benchmark for UK-US intra-firm trade. However, these statistics are subject to several limitations (use of mirror statistics, limited coverage, definition of intra-firm trade etc) and do not provide a comprehensive picture of UK intra-firm trade.

Since the UK does not currently collect intra-firm trade data through customs declarations or business surveys, alternative approaches are required to identify firms involved in this type of trade in the UK. This paper aims to add to the literature by using a novel methodology based on the use of LLMs and a range of firm-level datasets to estimate intra-firm trade for the UK. Firm level datasets include administrative records of traders, international shipping records (bills of lading), trademark ownership data and company level databases. By evaluating the quality and coverage of each of these data sources, we aim to provide guidance for NSOs on how measures of intra-firm trade could be developed in the future for the UK.

This approach offers a more refined and detailed way of identifying relationships between entities within the same corporate group compared to existing methodologies. However, the lack of comprehensive data covering all UK trading partners, limits its ability to produce an estimate of the total value of UK intra-firm trade. Instead, the analysis focuses on selected

countries and patterns of intra-firm trade permitted by the available data. Through this approach, we demonstrate the methodology's potential to generate comprehensive estimates of intra-firm trade for the UK when detailed, high quality, datasets become available.

3. Extending the analysis using alternative data sources

The previous chapter highlighted that, without relying on strong assumptions, deriving reliable estimates of intra-firm trade requires:

- detailed knowledge of individual transactions, including the parties involved

- a method for determining the ownership structure of those parties within the transaction-level dataset

This chapter begins by reviewing alternative UK-focused data sources. It then introduces a novel method for identifying company ownership structure and presents estimates derived from each source. It concludes with a discussion of the key findings.

3.1 Alternative data sources for deriving intra-firm trade measures in the UK

In the UK, HMRC holds raw trade in goods data within the Customs Data Analytical Platform (CDAP). This platform contains detailed information on individual firms involved in trade in goods, the products traded and the value of these transactions. CDAP data are considered uncleansed and are therefore not available for research purposes. HMRC processes and cleans these data to produce the Overseas Trade Statistics (OTS), which underpin official trade statistics. However, OTS data are published at an aggregated level to protect confidentiality of traders, meaning they cannot identify related-party trade.

As a result, researchers must consider alternative publicly available sources to examine intra-firm trade. Table 5 summarises the datasets considered in this paper, with Annex A providing more detail. While none of these sources match the robustness of official statistics, each offers unique insights despite limitations in coverage, timeliness and quality.

Our analysis begins with UK Bill of Lading (BoL) records which offer global coverage but only capture a subset of containerised maritime trade. To address this gap, we extend the analysis by incorporating US BoL data which covers all maritime trade and overcomes some of the limitations of the UK dataset. Canadian importer data offers another avenue for identifying intra-firm trade, and when combined with HMRC's OTS data, enables estimation of upper bounds of intra-firm trade for UK exports to Canada by product category. Finally, granular Colombian trade statistics illustrate what is possible when detailed information on both parties, values and products is available – though its relevance to the UK is limited due to low bilateral trade values.

Table 5. Data sources considered in this study

Data source	Trade flow	Partner countries	Transport mode	Time period	Key points	Limitations
UK Bill of Lading	Exports and imports of goods	All	Maritime	2022	Dataset most complete known source of trade focussing solely on the United Kingdom	• Reliant on information sharing agreements with shipping companies, so only a subset of UK maritime trade is covered • Value data is not complete • Product codes are not complete
US Vessel Manifest Data	Exports of goods	United States	Maritime	2022-23	Dataset often considered to be one of the most complete sources of trade data for the United States.	• Companies can request to suppress their information • Value data is not complete • Product codes are not complete
Matching of UK exporters and Canadian importers	Exports of goods	Canada	All	2022	Offers an alternative methodology for determining intra-firm trade using datasets of UK exporters and Canadian importers, and determining where there exists a potential for intra-firm trade.	• Both datasets are subject to suppressions • No value data available • Methodology only determines whether intra-firm trade might possibly exist and is not conclusive.
Colombian Trade Statistics	Exports and imports of goods	Colombia	All	2019-24	Dataset underpins Colombian official statistics and is the most complete data source considered in this paper.	• Issues with unknown trading companies

Source: Author's representation.
Notes: Data is sourced from (1) UK Bill of Lading: ThinkDataWorks (www.thinkdataworks.com), (2) US Vessel Manifest Data (www.importyeti.com), (3) Canadian Importers Database (https://ised-isde.canada.ca/app/ixb/cid-bdic/), (4) UK Trade Info Bulk Data on Exporters (https://www.uktradeinfo.com/trade-data/latest-bulk-data-sets/bulk-data-sets-archive/#exporter-details), (5) Colombian Trade Statistics (https://www.dian.gov.co/dian/cifras/Paginas/Bases-Estadisticas-de-Comercio-Exterior-Importaciones-y-Exportaciones.aspx)

3.2 A novel method for determining companies in the same corporate family

Producing intra-firm trade estimates from transaction-level microdata requires developing methods that can accurately map text representations of company names to a physical entity globally, as well as knowledge of the corporate structure of every global firm.

While NSOs are experienced in matching company names within their own jurisdictions - for survey design purposes for example – extending this exercise to a global scale is far more complex and rarely undertaken. This would require access to comprehensive company data at the global level, which is generally not publicly available. Commercial data providers such as Bureau Van Dijk (Orbis) and Dun & Bradstreet offer relevant databases, but coverage

gaps remain across jurisdictions. OpenCorporates (2025) aims to make this information public through freedom of information requests, covering over 140 jurisdictions and 220 million companies, yet global coverage remains elusive. This challenge underscores one of the longstanding aims of the United Nations Committee of Experts on Business and Trade Statistics to develop a unique global identifier for every company worldwide.

However, even if a complete global database were to exist, there are additional challenges to overcome, including:

- Abbreviations – Abbreviated company names (e.g. IBM for International Business Machines) can be used by multiple entities.

- Missing company suffixes – Transaction-level databases often omit company suffixes. For example, Company A might have multiple companies within the family (e.g. Company A Ltd in the UK and Company A GmbH in Germany). If a reference to 'Company A' is made without additional information, it would not be possible to determine which entity the data truly relates to.

- Doing business as names - Companies may operate under different names from their official incorporation name. In transaction-level databases, it is possible that the 'doing business as' name is used instead of the full legal entity name.

- Translations - Company names are often translated for convenience. For example, the legal name of a Chinese entity would be in Chinese, but in documentation and transaction-level databases, it is common for the company to use a translated version of its name.

These complexities make global company mapping a difficult task, beyond the abilities of most NSOs and researchers.

Understanding corporate relationships adds another layer of difficulty. Data providers such as Bureau Van Dijk (Orbis) and Dun & Bradstreet, provide relevant (ownership) data, however coverage is often incomplete across most countries and access costs are high. The Global Legal Entity Identifier Foundation (GLEIF) promotes the Legal Entity Identifier (LEI) system which aims to provide a global identifier for each company alongside relationship data. But with only 3 million LEIs issued and 0.5 million relationships declared at the time of writing this paper, coverage remains insufficient for the purposes of estimating intra-firm trade.

Beyond NSOs, several initiatives have sought to improve understating of MNE structures. Eurostat's EuroGroups Register (EGR) helps NSOs understand corporate group structures within EU member states, but its EU focus limits global applicability. To address this gap, the UN and OECD developed the Multinational Enterprise Information Platform (MEIP) which provides global profiles for the largest 500 MNEs using solely open-source data. However, this database only considers the largest companies and does not provide sufficient coverage to be suitable for the estimation of intra-firm trade.

The US Census Bureau has provided the most practical approach for identifying related-party trade through customs declarations. However, recent advancements in Generative Artificial Intelligence (AI) create an opportunity to integrate entity resolution and relationship structure determination within the same process.

Our approach uses AI to interpret text representations and determine the ultimate parent. The approach is multistep, or 'agentic' in its nature. First, it validates whether the text representation relates to a company (since individuals cannot engage in intra-firm trade) and excludes companies in the logistics sector (as these typically trade on behalf of others). For non-logistics companies, the second stage determines the ultimate parent by iteratively asking for the parent company of each company until a parent no longer exists. Intra-firm trade is then inferred when the text representations for both the importer and the exporter share the same parent company. Figure 5 illustrates this process, alongside a real-world example.

Annex B outlines the full and detailed methodology applied in this study - representing, to our knowledge, the first known use of AI for detecting intra-firm trade. This approach groups company names into corporate families and, by leveraging firm-level datasets, enables breakdowns by firm characteristics.

Figure 5. A graphical representation of the approach applied

Corporate Family Identification	Text Example 1
	'Bob Smith' is not a company and therefore intra-firm trade is not possible.
	Text Example 2
	'Maersk' is a company, but is a logistics company, and therefore intra-firm trade is not possible.
	Text Example 3
	'IBM' is a non-logistics company. It does not have a parent company and therefore we classify this as belonging to the 'IBM' corporate family.
	Text Example 4.
	'IBM UK Ltd' is a non-logistics company. It does have a parent company, which is 'IBM' and 'IBM' does not have a parent company, therefore we classify this as belonging to the 'IBM' corporate family.
	Intra-firm Trade Example:
	Trade between 'IBM' and 'IBM UK Ltd' would be classified as intra-firm trade as they are part of the same corporate family. Trade between all other parties would be considered as arm's-length.

Source: Author's representation.

Generative AI is increasingly adopted by NSOs, with applications discussed in forums such as the UNECE Generative AI and Official Statistics Workshop. The use cases are varied, and outputs are generally classified as experimental statistics intended for analytical and research purposes rather than official statistics. This distinction helps build confidence in applying these new technologies to statistical development. However, it remains essential that developers validate methods and results at every stage to ensure the generated statistics align with expectations.

Accordingly, the results presented here should be considered experimental and are not directly comparable to official statistics, such as those published by the US Census Bureau. It should also be noted that all estimates in section 3.3 cover trade in goods only.

3.3 Results

3.3.1 UK Bill of Lading data

The first dataset we examine is UK shipping instructions (or Bill of Lading) data, which contains details on international goods shipments, including origin, destination, company names, weight and product descriptions. For this study, we use UK trade data for 2022, provided by the Department for Business and Trade (DBT) from ThinkData Works (TDW). As mentioned earlier, further details on the characteristics of each dataset considered in this study can be found in Annex A.

Applying our methodology to the UK BoL data, we estimate that 3.6% of UK goods imports and 7.6% of UK goods exports covered by the UK BoL dataset were intra-firm in 2022. However, as discussed in more detail in Annex A, the UK BoL dataset – despite its high granularity and partner country coverage – has notable limitations. The most important limitation is that it captures only a subset of containerised trade. Moreover, as the data is sourced directly from shipping companies, the parties referenced often represent the logistics providers handling the trade rather than the actual traders themselves. This limitation hides the true parties involved and limits the ability to accurately determine intra-firm trade. This issue is evident in the fact that only around 24% of UK import records and 59% of UK export records in the UK BoL dataset can be classified as true company-to-company transactions – below the equivalent levels in all the other datasets considered in this study. If analysis is restricted to these classifiable company-to-company transaction records, (rescaled) intra-firm shares in 2022 rise to around 15% for imports and 13% for exports.

Breaking down imports by selected trading partners (Table 6) reveals a clear difference: China, India and Turkey show relatively low rescaled intra-firm shares (12.0%,11.1% and 7.7%, respectively), whereas US's share (45.9%) is notably higher.

Table 6. UK intra-firm import values and shares, by major UK trading partner, 2022

Trading partner	Total imports (USD bn)	Intra-firm imports (USD bn)	Intra-firm share (%)	Known level (%)	Rescaled intra-firm share (%)
China	32.6	0.4	1.2	10.3	12.0
India	12.3	0.4	2.9	25.8	11.1
Turkey	10.2	0.2	2.3	30.3	7.7
Bangladesh	6.2	0.0	0.0	15.1	0.0
United States	5.7	0.7	12.2	26.5	45.9
Brazil	5.1	0.2	3.8	45.9	8.3
Italy	3.8	0.0	0.3	0.8	34.0
Pakistan	2.5	0.0	0.0	22.9	0.1
South Africa	2.0	0.3	16.6	68.1	24.4
Canada	1.9	0.1	4.0	23.0	17.2
World	**98.4**	**3.5**	**3.6**	**23.6**	**15.2**

Source: Author's calculation based on UK Bill of Lading data

Similarly, for exports (Table 7), the US, Canada and Sweden show rescaled intra-firm shares of 17.2%, 1.4% and 0.2%, respectively. The data for Japan highlights a key limitation - only 7.5% of records within the UK BoL data can be classified as company-to-company transactions, making estimates for this trading partner unreliable.

Table 7. UK intra-firm export values and shares, by major UK trading partner, 2022

Trading partner	Total exports (USD bn)	Intra-firm exports (USD bn)	Intra-firm share (%)	Known level (%)	Rescaled intra-firm share (%)
United States	11.2	1.3	11.2	65.1	17.2
Canada	6.1	0.1	1.2	89.6	1.4
Sweden	3.9	0.0	0.2	100.0	0.2
Japan	3.4	0.0	1.0	7.5	13.8
India	3.3	0.3	8.0	36.9	21.7
United Arab Emirates	2.0	0.0	0.7	43.7	1.7
China	1.6	0.2	9.7	54.6	17.7
Brazil	1.4	0.1	6.7	21.0	32.1
Australia	1.4	0.2	12.3	36.4	33.9
Pakistan	1.3	0.0	1.0	53.0	1.8
World	**52.4**	**4.0**	**7.6**	**58.6**	**12.9**

Source: Author's calculation based on UK Bill of Lading data

Breaking down imports by product category (Table 8) and exports by product category (Table 9) reveals some interesting results. Imports show mixed intra-firm shares across product categories, with all categories below 40%. The highest intra-firm shares are observed in UK imports of Wood and Wood products (39%) and Vehicles and equipment (32%). Exports display a stronger presence of intra-firm transactions compared to imports, particularly in Prepared foods and beverages (51%) and Vehicles and equipment (44%).

Table 8. UK intra-firm import values and shares, by HS product category, 2022

HS product	Total imports (USD bn)	Intra-firm imports (USD bn)	Intra-firm share (%)	Known level (%)	Rescaled intra-firm share (%)
Animal Products	1.0	0.1	12.4	64.7	19.2
Vegetable Products	5.2	0.5	9.0	64.7	14.0
Prepared Foods and Beverages	6.5	0.1	1.3	15.6	8.3
Mineral Products	0.1	0.0	9.5	33.1	28.7
Chemicals and Allied Industries	4.6	0.3	7.0	30.2	23.1
Plastics, Rubber and Leather	6.3	0.5	8.3	39.8	21.0
Wood and Wood products	2.4	0.3	14.0	36.0	38.9
Textiles and Footwear	20.5	0.1	0.3	15.8	2.0
Stone and Glass	8.3	0.0	0.1	15.7	0.8
Metals	5.4	0.2	3.5	26.5	13.1
Machinery and Electrical Products	24.4	0.8	3.5	22.4	15.5
Vehicles and Equipment	5.3	0.2	4.4	13.9	31.7
Other	8.4	0.3	3.8	15.1	25.0

Source: Author's calculation based on UK Bill of Lading data

Table 9. UK intra-firm export values and shares, by HS product category, 2022

HS product	Total exports (USD bn)	Intra-firm exports (USD bn)	Intra-firm share (%)	Known level (%)	Rescaled intra-firm share (%)
Animal Products	1.0	0.0	1.8	65.6	2.8
Vegetable Products	0.2	0.0	2.7	57.9	4.7
Prepared Foods and Beverages	8.7	3.0	34.5	67.4	51.1
Mineral Products	0.1	0.0	7.8	68.4	11.4
Chemicals and Allied Industries	5.0	0.3	6.3	31.5	20.1
Plastics, Rubber and Leather	1.7	0.1	5.2	44.5	11.7
Wood and Wood products	1.3	0.0	0.5	55.1	0.9
Textiles and Footwear	1.1	0.0	3.0	56.5	5.3
Stone and Glass	16.7	0.0	0.0	77.6	0.0
Metals	4.3	0.1	1.5	49.3	3.1
Machinery and Electrical Products	9.7	0.1	1.4	45.4	3.2
Vehicles and Equipment	1.6	0.3	15.3	34.8	43.9
Other	0.9	0.0	1.8	28.6	6.3

Source: Author's calculation based on UK Bill of Lading data

Overall, these findings should be interpreted with caution due to the high uncertainty about the coverage and quality of the underlying BoL data. Whilst UK BoL can offer interesting insights into UK intra-firm trade patterns, it is insufficient for a comprehensive assessment, and additional data sources need to be considered for a fuller understanding.

3.3.2 US Vessel Manifest Data

US Vessel Manifest data, derived from the Automated Manifest System (AMS), are accessible via third parties. For this study, ImportYeti supplied around 200,000 UK-to-US export records for 2022-23 covering more than 70,000 distinct shippers and consignees. These records cover maritime exports only (44% of UK exports to the US by value, 97% by volume in 2022-23).

Unlike the UK BoL dataset, the US Vessel Manifest dataset provides complete coverage of maritime exports, rather than just a subset, and does not have the same limitations regarding the role of logistics companies. However, intra-firm estimates for UK imports from the US are not possible due to the lack of consignee details in the data.

Applying our methodology to the export records, we estimate that 49% of UK maritime exports to the US in 2022, and 55% in 2023, was intra firm (the share averaging 52% across 2022-23). These high shares reflect the strong corporate linkages between the two economies.

High intra-firm shares are observed across all HS product categories (Table 10), with Mineral (67%) and Vehicles and equipment (63%) products displaying the highest shares. According to the US Vessel Manifest data, Vehicles and equipment represented around a third (30%) of all UK goods exports to the US in 2022-23, suggesting that one of the UK's most important export categories is largely driven by intra-firm transactions.

Table 10. UK intra firm exports to the US, by HS product category, 2022-23

HS product	Share in UK goods exports to the US (%)	Intra-firm share (%)
Animal Products	0.5	51.6
Vegetable Products	0.7	31.2
Prepared Foods and Beverages	8.6	60.1
Mineral Products	9.7	67.0
Chemicals and Allied Industries	17.8	31.0
Plastics, Rubber and Leather	2.8	36.1
Wood and Wood products	2.0	44.4
Textiles and Footwear	1.0	39.1
Stone and Glass	1.2	24.0
Metals	3.4	27.2
Machinery and Electrical Products	18.8	53.5
Vehicles and Equipment	30.2	63.4
Other	3.3	39.0
All products	**100.0**	51.7

Source: Author's calculation based on US Vessel Manifest data

Products can be broken down further for a more granular analysis of the most important products exported from the UK to the US in 2022-23 (Table 11). Vehicles make up 23.4% of trade and have one of the highest intra-firm export shares (79.1%). Pharmaceutical products make up 9.7% of exports but have a far lower share of intra-firm exports (22.1%), perhaps reflecting one of the weaknesses of this dataset as high value pharmaceutical products with a high degree of product specialisation could be more likely to be transported by air as opposed to sea.

Table 11. Intra-firm shares for Top-15 UK exports to the US, by HS product category, 2022-23

HS	Product (HS) description	Share in total UK goods exports to the US (%)	Intra-firm share (%)
87	Vehicles; other than railway or tramway rolling stock, and parts and accessories thereof	23.4	79.1
84	Machinery and mechanical appliances, boilers, nuclear reactors; parts thereof	15.3	55.6
27	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	9.7	67.2
30	Pharmaceutical products	9.4	22.1
22	Beverages, spirits and vinegar	7.0	65.5
38	Chemical products n.e.c.	4.3	46.4
89	Ships, boats and floating structures	3.9	10.0
39	Plastics and articles thereof	2.3	36.7
85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles	1.9	49.6
33	Essential oils and resinoids; perfumery, cosmetic or toilet preparations	1.7	33.5
88	Aircraft, spacecraft, and parts thereof	1.7	11.7
94	Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, n.e.c.; illuminated signs, illuminated name-plates and the like; prefabricated buildings	1.6	42.1
90	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories	1.5	38.4
73	Iron or steel articles	1.4	35.5
86	Railway, tramway locomotives, rolling-stock and parts thereof; railway or tramway track fixtures and fittings and parts thereof; mechanical (including electro-mechanical) traffic signalling equipment of all kinds	1.2	3.8

Source: Author's calculation based on US Vessel Manifest data

3.3.3 Matching of Canadian importers and UK exporters

HMRC in the UK publishes lists of importers and exporters by HS 8-digit product, including names and addresses of UK firms trading with non-EU countries and GB firms exporting to the EU (excluding Northern Irish exporters).

Government of Canada publishes the Canadian Importers Database, listing major importers by HS 6-digit product and origin country. 'Major importers' are businesses which collectively account for up to 80% of all imports of a specific product.

As neither dataset identifies both parties in a transaction, we introduce the concept of 'potential intra-firm trade', where a UK exporter has a related company importing the same commodity into Canada. It should be noted that our methodology only indicates the potential existence of intra-firm trade and is not definitive. Intra-firm shares cannot be calculated because neither dataset includes trade value information.

By matching these datasets at the HS 6-digit level, we identified a total of 2,360 corporate families potentially engaging in UK intra-firm exports to Canada in 2022. Breaking this down by HS 2-digit product (Table 12), Machinery and mechanical appliances (HS 84) shows the highest number of matches with 874 corporate families identified within this category.

Table 12. Number of corporate families identified potentially engaging in UK intra-firm exports to Canada, by HS 2-digit product, 2022

HS	Product (HS) description	Number of corporate families potentially engaging in intra-firm trade
84	Machinery and mechanical appliances, boilers, nuclear reactors; parts thereof	874
85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles	741
90	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories	509
39	Plastics and articles thereof	457
73	Iron or steel articles	308
83	Metal; miscellaneous products of base metal	210
40	Rubber and articles thereof	193
94	Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, n.e.c.; illuminated signs, illuminated name-plates and the like; prefabricated buildings	180
82	Tools, implements, cutlery, spoons and forks, of base metal; parts thereof, of base metal	168
61	Apparel and clothing accessories; knitted or crocheted	156
62	Apparel and clothing accessories; not knitted or crocheted	154
87	Vehicles; other than railway or tramway rolling stock, and parts and accessories thereof	143
38	Chemical products n.e.c.	132
42	Articles of leather; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut (other than silk-worm gut)	121
48	Paper and paperboard; articles of paper pulp, of paper or paperboard	121

Source: Author's calculation based on the Canadian Importers Database (https://ised-isde.canada.ca/app/ixb/cid-bdic/) and the UK Trade Info Bulk Data on Exporters (https://www.uktradeinfo.com/trade-data/latest-bulk-data-sets/bulk-data-sets-archive/#exporter-details).

The dataset also enables more granular analysis by product. Box 2 outlines a method for estimating an upper-bound of intra-firm UK exports of Passenger Motor Vehicles over 3,000cc (HS 870324) to Canada.

Box 2. Developing an upper bound for intra-firm trade using customs data

Whilst alternative data sources can provide information on traders potentially engaging in intra-firm trade, this paper highlights challenges in developing reliable indicators.

Firstly, in some cases we can only apply a binary classification to determine whether intra-firm trade occurs (e.g. the Canadian importers with UK exporters matching method). This approach requires assumptions about firm size to derive estimates of intra-firm trade.

Secondly, in cases where a weighting is available, such as in the US Vessel Manifest Data, the information typically relates to the volume of goods transported rather than their value. Consequently, product values must be inferred, assuming goods are homogeneous – an assumption that ignores differences in quality.

In reality, the only source that overcomes these limitations is raw customs data. In the UK, HMRC maintains such data within the Customs Data Analytical Platform (CDAP), which includes details on both trading parties, the goods traded and the value of these trades. HMRC cleans this data to produce the Overseas Trade Statistics (OTS), which underpin official trade in goods statistics. However, OTS information on the non-UK trading party is not published in OTS, which limits its use for intra-firm analysis.

CDAP data are considered uncleansed, and as such are not available for research purposes. However, our findings suggest that when intra-firm trade occurs for a firm within a given commodity and country combination, it typically represents the majority of trade. Therefore, OTS data can provide an 'upper bound' for intra-firm trade, likely aligning closely with actual intra-firm trade patterns.

For example, in UK exports of Passenger Motor Vehicles over 3,000cc (HS 870324), our methodology identified 10 companies potentially engaged in intra-firm exports from the UK to Canada. Following a request to HMRC for microdata from the OTS dataset we were able to determine that these 10 companies account for 99.5% of volume and 98.22% of value in this product category. The difference between volume and value reflects the impact of assuming product homogeneity, suggesting that higher value products within this product category are less likely to be traded intra-firm.
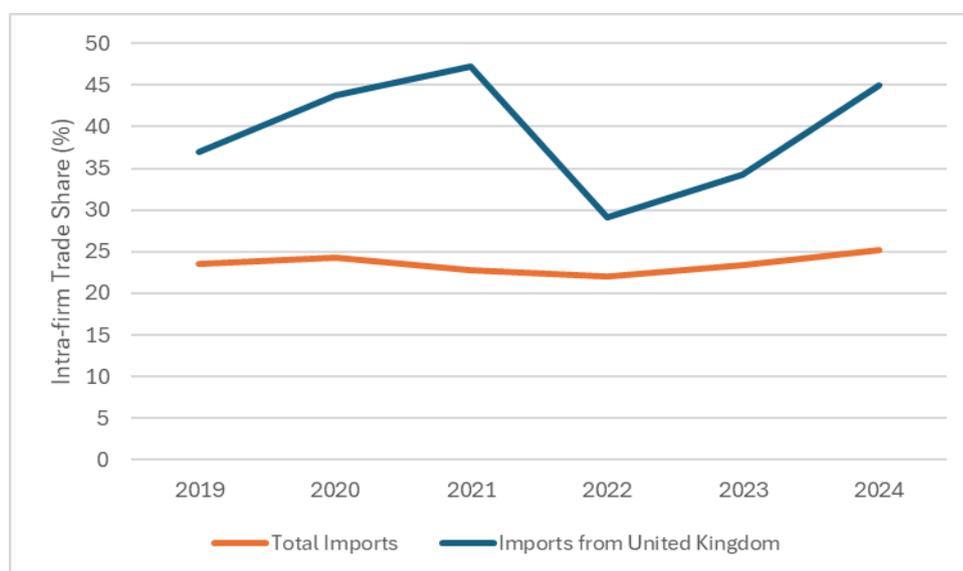
3.3.4 Colombian Trade Statistics: Imports

Colombia's National Tax and Customs Directorate (DIAN) publishes detailed international trade statistics based on administrative records. These data allow estimates of intra-firm trade by product, partner country, year and mode of transport. For this study, we use a subset covering 2019–2024 to estimate intra-firm trade between Colombia and its main trading partners, including the UK. Although, from a UK perspective, Colombia represents a relatively minor trading partner, this dataset provides an opportunity to demonstrate the potential of our methodology for estimating intra-firm trade when detailed trade statistics (such as those from Colombia) are available.

Using this dataset, we estimate that Colombian intra-firm imports from the UK accounted for 38% of all Colombian goods imports from the UK on average during 2019-24 - significantly higher than the intra-firm share estimate of 23% relating to total Colombian goods imports (partner=World).

Figure 6 shows the trend over time. Although the intra-firm share for total Colombian imports is relatively stable over time, the intra-firm share relating to imports from the UK is more volatile. A closer examination reveals that the lower share observed in 2022 and 2023 reflects a small number of high value non-intra firm transactions – underscoring the importance of a microdata approach. The decisions of a relatively small number of importing and exporting companies can have a large impact on the estimation of intra-firm trade shares.

Figure 6. Share of intra-firm trade in Colombian goods imports from the UK and the World, 2019-24
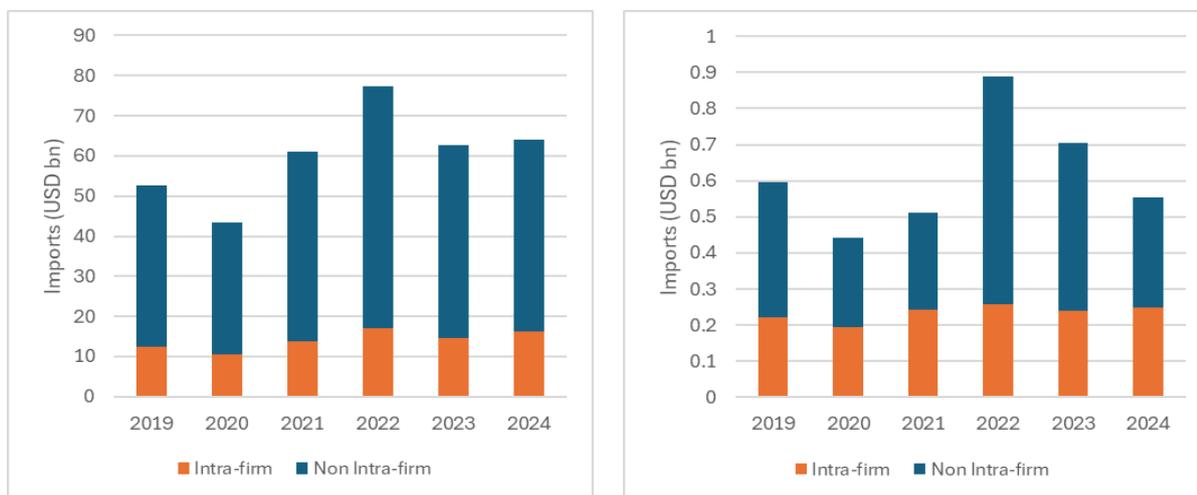

Source: Author's calculation based on Colombian Trade Statistics

The period considered also coincides with major disruptions to global trade, such as the COVID-19 pandemic (2020-21). Consistent with the literature, intra-firm trade appears more resilient and stable during this economic shock (Figure 7) for both Colombian total imports and imports from the UK.

Figure 7. Value of intra-firm and non-intra-firm Colombian goods imports from the UK and the World, 2019-24

Total imports (left) and imports from the UK (right)

Source: Author's calculation based on Colombian Trade Statistics

According to Colombian trade statistics, the UK ranked as the 19th most important import partner for Colombia on average between 2019 and 2024, with imports averaging USD 0.7billion – see Table 13. Whilst a relatively small import partner in comparison to the US (USD 17.8bn) and China (USD 15.4bn), the UK stands out as having one of the highest intra-firm shares for imports (38.0%). Only Mexico (51.2%), Argentina (40.0%), Vietnam (61.4%) and Switzerland (42.4%) are estimated to have higher shares amongst the top 25 trading partners.

Table 13. Top-20 import partners for Colombia – Values and intra-firm shares, average 2019-24

Import partner	Average yearly imports (USD bn 2019-24)	Intra-firm share (%)
United States	17.8	15.1
China	16.9	15.4
Brazil	4.4	37.0
Mexico	4.2	51.2
Germany	2.5	33.5
France	1.9	17.1
India	1.6	17.6
Japan	1.5	31.4
Argentina	1.4	40.0
Spain	1.4	18.4
Canada	1.2	14.7
Italy	1.2	21.2
Korea	1.0	14.7
Vietnam	1.0	61.4
Peru	1.0	12.4
Ecuador	1.0	5.6
Chile	0.9	10.2
United Kingdom	0.7	38.0
Bolivia	0.5	10.4

Source: Author's calculation based on Colombian Trade Statistics

At the product level, Table 14 shows that imports into Colombia from the UK are concentrated in Chemicals and Allied Industries (26.2%), Mineral Products (23.9%), Machinery and Electrical Products (18.9%), Prepared Foods and Beverages (14.6%) and Vehicles and Equipment (9.1%). For most of these products, the intra-firm share for UK imports is higher than that for total Colombian imports (partner=World). A notable example is Prepared Foods and Beverages, where the intra-firm share for imports from the UK is 85.9%, compared to 17.7% for total imports.

Table 14. Colombian imports from the UK and the World, values and intra-firm shares by HS product, average 2019-24

HS Product	Total imports			Imports from the UK		
	Share (%)	Value per kg (USD)	Intra-firm share (%)	Share (%)	Value per kg (USD)	Intra-firm share (%)
Animal Products	1.6	2.6	3.5	0.0	2.5	13.6
Vegetable Products	7.3	0.4	8.2	0.6	0.9	2.7
Prepared Foods and Beverages	5.5	1.0	17.7	14.6	5.4	85.9
Mineral Products	8.8	0.6	12.8	23.9	0.8	0.1
Chemicals and Allied Industries	17.1	1.9	36.7	26.2	13.7	61.9
Plastics, Rubber and Leather	6.7	2.3	11.3	2.3	6.0	15.1
Wood and Wood products	2.2	1.0	12.5	1.5	2.4	11.4
Textiles and Footwear	4.7	5.5	10.1	0.3	14.8	12.8
Stone and Glass	1.2	0.8	9.4	0.2	8.8	7.6
Metals	7.5	1.4	16.0	2.0	2.3	5.7
Machinery and Electrical Products	23.9	16.3	28.0	18.9	38.1	17.1
Vehicles and Equipment	10.8	12.5	38.0	9.1	14.9	57.8
Other	2.6	6.1	28.9	0.3	20.6	1.9

Source: Author's calculation based on Colombian Trade Statistics

Products can be further disaggregated to enable more granular analysis from a UK perspective. Table 15 shows the top-15 products at the HS2 level imported into Colombia from the UK. Mineral Fuels and Oils make up 23.4% of all Colombian imports from the UK, with a value of USD 0.8/kg - comparable to the value of USD 0.7/kg for total Colombian imports. Given the high homogeneity of these products, opportunities for specialisation are minimal, resulting in negligible intra-firm shares. In contrast, Pharmaceuticals and Beverages present greater scope for product specialisation. The average value of Colombian imports from the UK in these categories are more than three times higher than those from all jurisdictions. As a result, intra-firm shares are substantial, exceeding 75%.

Table 15. Top-15 Colombian imports from the UK, values and intra-firm shares, average 2019-24

HS	Product description	Total imports			Imports from the UK		
		Share (%)	Value per Kg (USD)	Intra-firm share (%)	Share (%)	Value per Kg (USD)	Intra-firm share (%)
27	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	8.4	0.7	12.9	23.4	0.8	0.0
30	Pharmaceutical products	5.6	29.0	59.0	14.3	108.3	75.3
22	Beverages, spirits and vinegar	0.9	1.3	32.0	12.9	5.5	90.3
84	Machinery and mechanical appliances, boilers, nuclear reactors; parts thereof	10.6	12.8	24.4	8.9	27.6	11.4
87	Vehicles; other than railway or tramway rolling stock, and parts and accessories thereof	8.2	9.8	50.1	8.4	15.0	63.1
90	Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories	2.9	49.2	24.7	6.3	93.8	20.5
38	Chemical products n.e.c.	2.2	3.6	34.8	5.5	11.1	48.8
85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, parts and accessories of such articles	10.3	17.8	33.0	3.7	34.7	25.3
29	Organic chemicals	4.1	1.7	19.3	2.4	3.3	26.5
33	Essential oils and resinoids; perfumery, cosmetic or toilet preparations	1.2	8.4	49.8	1.7	22.6	68.4
39	Plastics and articles thereof	4.8	1.9	11.5	1.6	4.8	17.4
32	Tanning or dyeing extracts; tannins and their derivatives; dyes, pigments and other colouring matter; paints, varnishes; putty, other mastics; inks	0.8	4.0	13.8	1.4	6.2	34.1
48	Paper and paperboard; articles of paper pulp, of paper or paperboard	1.3	1.3	11.5	1.1	2.2	2.1
73	Iron or steel articles	1.8	2.1	23.9	0.9	8.8	7.8
40	Rubber and articles thereof	1.6	3.9	11.6	0.7	12.7	10.2

Source: Author's calculation based on Colombian Trade Statistics

3.3.5 Colombian Trade Statistics: Exports

Top level estimates of intra-firm trade for Colombian exports are not reliable due to the suppression of details about the importing party – see Annex for more detail. These suppressions are most likely in cases involving businesses of significant importance to Colombia, where the likelihood of intra-firm trade is high.

However, when considering only Colombian exports to the UK the impact of these suppressions decreases. At the aggregate level, over 90% of trade can be classified as involving identifiable companies on both the importing and exporting sides. However, the

degree of suppression varies over time - 95% of trade was classifiable in 2019, falling to 82% in 2024 – making time series analysis unsuitable.

With these caveats in mind, our methodology estimates that 4.7% of Colombian exports to the UK were intra-firm during 2019-24. Over this period, Colombian exports to the UK averaged USD 574 million, with intra-firm trade accounting for only USD 26 million.

At the HS product level (Table 16), Vegetable Products accounted for the largest share of exports (64.5%), followed by Mineral Products (25.0%). As with imports, Prepared Foods and Beverages have the highest intra-firm shares (21.1%), followed by Mineral Products (9.2%) and Wood and Wood Products (7.8%) – though estimates for Wood and Wood Products should be interpreted with caution due to limited data coverage (20.8%).

Table 16. Colombian exports to the UK, values and intra-firm shares by HS product, average 2019-24

HS Product	Exports to the UK			
	Share (%)	Value per Kg (USD)	Intra-firm share (%)	Known level (%)
Animal Products	0.4	6.1	0.3	82.8
Vegetable Products	64.5	0.9	2.1	91.9
Prepared Foods and Beverages	3.8	2.2	21.1	94.6
Mineral Products	25.0	0.2	9.2	90.6
Chemicals and Allied Industries	1.1	2.4	4.9	96.0
Plastics, Rubber and Leather	0.7	3.4	0.1	89.9
Wood and Wood products	0.5	3.9	7.8	20.8
Textiles and Footwear	0.9	94.6	0.3	86.5
Stone and Glass	0.2	4.7	0.0	78.1
Metals	1.7	5.5	4.2	95.4
Machinery and Electrical Products	0.5	23.9	6.0	93.3
Vehicles and Equipment	0.1	0.3	2.9	28.0
Other	0.6	9.5	1.7	89.6

Source: Author's calculation based on Colombian Trade Statistics

Analysis at a more granular HS2 product level indicates that intra-firm shares are particularly high for exports of Cocoa and Cocoa Preparations to the UK (Table 17). The intra firm share for this category exceeds 90% and is largely driven by the trading relationships of a single company. Paper and Paperboard is another interesting case, with an estimated intra-firm share of 9.0%, however only 9.3% of records in this category could be classified, suggesting that heavy data suppressions may mean the true intra-firm share may be considerably higher.

Table 17. Top-15 Colombian exports to the UK, values and intra-firm shares by HS product, average 2019-24

| HS | Product description | Colombian exports to the UK | | | |
		Share (%)	Value per Kg (USD)	Intra-firm share (%)	Known level (%)
8	Fruit and nuts, edible; peel of citrus fruit or melons	38.7	0.6	0.5	91.4
27	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	25.0	0.2	9.2	90.6
9	Coffee, tea, mate and spices	13.9	4.8	2.8	88.7
6	Trees and other plants, live; bulbs, roots and the like; cut flowers and ornamental foliage	11.4	4.4	6.9	97.1
72	Iron and steel	1.6	5.4	0.0	95.8
20	Preparations of vegetables, fruit, nuts or other parts of plants	1.2	5.6	1.8	95.3
21	Miscellaneous edible preparations	0.9	8.4	0.0	98.6
18	Cocoa and cocoa preparations	0.8	4.8	91.4	94.9
62	Apparel and clothing accessories; not knitted or crocheted	0.7	129.1	0.3	85.9
39	Plastics and articles thereof	0.6	2.9	0.1	91.4
17	Sugars and sugar confectionery	0.6	0.9	10.0	93.6
48	Paper and paperboard; articles of paper pulp, of paper or paperboard	0.5	3.7	9.0	9.3
95	Toys, games and sports requisites; parts and accessories thereof	0.4	21.3	2.2	99.3
15	Animal, vegetable or microbial fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes	0.4	1.6	0.0	96.3
28	Inorganic chemicals; organic and inorganic compounds of precious metals; of rare earth metals, of radio-active elements and of isotopes	0.4	1.1	8.4	100.0

Source: Author's calculation based on Colombian Trade Statistics

3.4 Headline findings across the datasets considered

3.4.1 Intra-firm trade represents a significant share of overall UK trade in goods

Across all datasets considered, intra-firm trade emerges as a significant component of overall trade in goods. Given its unique characteristics, understanding the scale of intra-firm trade is important for shaping effective policy decisions. Table 18 summarises the headline findings for each dataset. In general, intra-firm shares appear to be higher in exports than imports, likely reflecting the UK's position in the value chain, importing lower value inputs to export higher value, more specialised goods.

Table 18. Summary of intra-firm trade estimates for the UK

Source	Trade flow	Partner economy	Year	Intra-firm share (%)	Coverage
US Census Bureau	Exports	US	2024	57.5	Includes all modes of transport
	Imports	US	2024	31.2	
UK Bill of Lading	Exports	World	2022	7.6	Covers only a subset of containerised trade, with only 23.6% of import records and 58.6% of export records relating to company-to-company transactions
	Imports	World	2022	3.6	
US Vessel Manifest	Exports	US	2022	49.2	Covers only vessel-based trade
Matching of Canadian Importers and UK Exporters	Exports	Canada	2022	98.2	Covers only HS 870324, and assumes companies which engage in intra-firm trade use this as their only trading method
Colombian Trade Statistics	Exports	Colombia	2019-24	38.0	Includes all modes of transport
	Imports	Colombia	2019-24	4.7	

Source: Author's calculation based on the datasets discussed in Annex A

3.4.2 Intra-firm trade is concentrated within a small number of large companies

Across all datasets, the influence of the largest companies is apparent in intra-firm trade. For example, for UK exports to Colombia, a single firm is responsible for almost a quarter of intra-firm exports while 10 companies account for 73.1% of intra-firm exports. On the import side, the largest company is responsible for almost half of intra-firm trade and 94.9% is attributable to only 10 companies.

Although Colombia is a relatively small trading partner, similar patterns appear also with larger partners. US Vessel Manifest data indicate that, a single firm is responsible for 17.6% of UK intra-firm exports to the US and 63.1% is concentrated among only 10 companies.

This high level of concentration means that the decisions of individual firms can significantly impact intra-firm trade levels in the UK, suggesting that approaches that do not leverage microdata are unlikely to produce robust results. At an aggregated level, this also implies that intra-firm trade tends to cluster in industries relating to these firms, and this is apparent in the concentrations we see present in products relating to beverages, vehicles, machinery, oil, chemicals and pharmaceuticals. Therefore, analyses aiming to identify the drivers of intra-firm trade should consider data at the firm-level.

1.4.3 The prevalence of intra-firm trade increases with firm size

Each corporate cluster identified as trading in our datasets can be broken down by employee size. Across all datasets, a clear trend emerges: the larger the employee count, the more likely for the firm to engage in some form of intra-firm trade (Figure 8). A notable example is UK maritime exports to the US derived from Vessel Manifest data, where on average 55.6% of companies with 10,001+ employees engage in intra-firm trade, compared to just 6.3% of companies with fewer than 10 employees. These findings are consistent with previous research which suggests that the fixed costs associated with intra-firm trade pose less of a barrier for larger corporations.

Figure 8. Share of firms engaging in intra-firm trade broken down by employee size
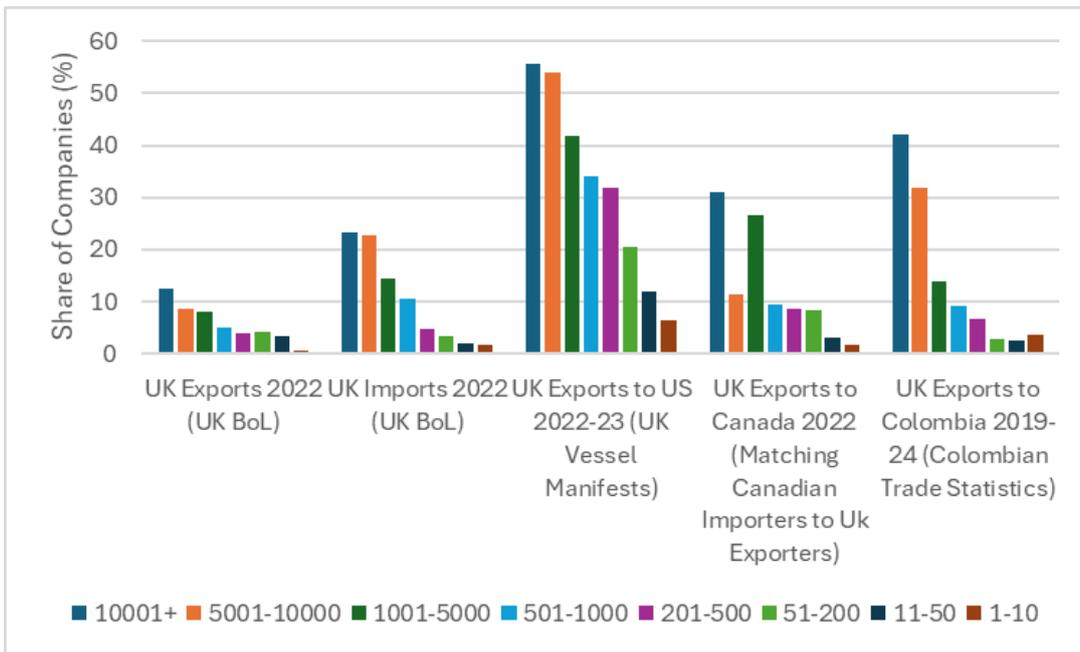
Source: Author's calculation based on the datasets discussed in Annex A

3.4.4 When intra-firm trade exists it tends to be the primary trading channel

Firms that engage in intra-firm trade typically rely on it as their main route to market (Figure 9). For example, during 2019-24, 73% of corporate families engaging in intra-firm exports from the UK to Colombia had an intra-firm share of over 90%. More broadly, across all datasets, when a company engages in intra-firm trade, it is the primary channel in over 80% of cases.

These results suggest that once a presence is established in another jurisdiction, trade is most likely to occur with the affiliated party rather than external firms. This provides supporting evidence that the assumptions used in calculating intra-firm trade in Box 2 are valid.

Figure 9. Cumulative density function demonstrating that most corporate families engaging in intra-firm trade rely on it as their main trading method

Source: Author's calculation based on the datasets discussed in Annex A

3.4.5 Intra-firm trade is most common among corporate families headquartered in London and the South-East

When granular data are available, it becomes possible to identify the number of companies engaging in intra-firm trade and assess its prevalence by UK regions. For example, in UK maritime exports to the United States, a total of 4,661 corporate families headquartered in the UK were identified, of which 683 engaged in intra-firm trade (Table 19). These companies can be further broken down by UK region, along with indicators of intra-firm trade participation. London and the South East of England show the highest incident, with 22.9% and 14.7% of companies, respectively, trading intra-firm with the United States.

These results likely reflect the tendency of large global corporations to establish headquarters in these regions, as well as the greater availability of services that facilitate intra-firm trade.

Table 19. UK headquartered companies engaging in intra-firm trade by UK region

Region	UK Exports to Colombia 2019-24 (Colombian Trade Statistics)			UK exports to the US 2022-23 (UK Vessel Manifests)		
	Number of corporate families	Number of corporate families with intra-firm trade	Share of corporate families with intra-firm trade (%)	Number of corporate families	Number of corporate families with intra-firm trade	Share of corporate families with intra-firm trade (%)
London	140	11	7.9	715	164	22.9
South East	185	14	7.6	694	102	14.7
East of England	112	5	4.5	483	65	13.5
South West	83	4	4.8	407	64	15.7
West Midlands	105	6	5.7	498	61	12.2
North West	102	2	2	479	63	13.2
Yorkshire and The Humber	88	3	3.4	389	45	11.6
Scotland	59	3	5.1	257	39	15.2
East Midlands	76	4	5.3	364	33	9.1
Wales	26	0	0	166	20	12
North East	17	1	5.9	101	15	14.9
Northern Ireland	23	0	0	108	12	11.1

Source: Author's calculation based on Colombian Trade Statistics and US Vessel Manifest data

3.4.6 Air transport accounts for a significant share of intra-firm trade, so methods that discount it have potential shortcomings

The depth of data available in the Colombian trade dataset allows for analysis of intra-firm trade by mode of transport (Table 20). Maritime transport is the dominant mode for UK-Colombia trade, accounting for 53.1% of UK goods exports to Colombia and 89.9% of UK goods imports from Colombia. Air transport also represents a significant share, with notably different values and shares of intra-firm trade.

Literature suggests that intra-firm trade is more common when products are specialised which, with few exceptions, tend to be higher in value. This is reflected in UK exports to Colombia where goods transported by sea have a lower intra-firm share (24.1%), compared to air shipments (39.5%), with goods shipped by sea averaging USD 1.5/kg compared to USD 160.1/kg for air shipments. Interestingly, the 'Other' category – road transport – shows an even higher share of intra-firm exports (69.1%). Since the UK has no land border with Colombia, this likely represents goods transiting through major ports (e.g. Brazil) by road before reaching their final destination. This seems to suggest that firms engaging in intra-firm trade may place a premium on being able to control their supply chains, as managing lorries is likely far less complex than coordinating trade via vessels or aircrafts.

In comparison to UK exports to Colombia, the price of goods is far lower (USD 0.4/kg compared to USD 1.5/kg for sea-based trade, and USD 7.0/kg compared to USD 160.1/kg for air-based trade) for UK imports from Colombia. This suggests that UK imports from

Colombia are primarily lower-value products, and this is reflected in lower intra-firm shares. The lower intra firm share for UK imports from Colombia via air (2.2%) compared to sea (5.0%) may reflect the prominence of time-sensitive, low-value products such as fruit and flowers.

Table 20. Breakdown of UK trade with Colombia by mode of transport, average 2019-24

Mode of transport	UK exports to Colombia			UK imports from Colombia		
	Share (%)	Value per Kg (USD)	Intra-firm share (%)	Share (%)	Value per Kg (USD)	Intra-firm share (%)
Maritime	53.1	1.5	24.1	89.9	0.4	5.0
Air	24.1	160.1	39.5	8.0	7.0	2.2
Other	22.8	7.7	69.1	2.1	0.9	0.0

Source: Author's calculation based on Colombian Trade Statistics

3.4.7 Assumptions of uniform prices based on volume may not be valid as there is evidence of product premiums or profit shifting

Adjusting for product characteristics enables an assessment of whether intra-firm goods command a price premium compared to arm's-length trade. Using the Colombian trade dataset, we estimate import price differentials for intra firm goods.

For total Colombian imports, intra-firm goods are valued at a 40% premium relative to arm's-length goods. Given Colombia's corporate tax rate (35%) is higher than a number of jurisdictions, these premiums could be indication of profit shifting.

3.5 Summary of strengths and caveats of the analysis

This paper introduces a novel methodology for determining intra-firm trade using a range of firm-level datasets. Despite the wide range of sources considered, the lack of firm-level microdata across all UK trading partners means our estimates capture only a small portion of total UK trade. A further limitation is that our analysis focuses on goods trade, where detailed microdata are most accessible. Annex C provides an exploratory extension to services trade using trademark data, illustrating the potential for broader application of our method when richer services datasets become available.

The UK BoL dataset covers the largest portion of UK trade in goods but it has two major weaknesses. First, providers of logistics services are often included in the dataset, instead of the actual companies involved in the transaction, reducing the usable sample for analysis. Second, the dataset only covers a subset of maritime trade, not all modes of transport - a significant shortcoming given our findings that intra-firm dynamics vary by transport mode. Similarly, US Vessel Manifest data reflect a large share of UK trade but cover maritime exports only, with the US being the largest UK export destination.

The Canadian Importer-UK Exporter matching method identifies firms in the same corporate family which potentially engage in intra-firm trade, however it cannot quantify the importance of each company's role. While combining this approach with confidential microdata could potentially yield meaningful results, it relies on strong assumptions such as intra-firm trade

being the sole trading method for MNEs. Our results demonstrate that this assumption may be suitable, or possible with an adjustment factor, but would require a strong assumption.

On the other hand, the Colombian dataset is the most comprehensive, covering all modes of transport and providing actual trade values, therefore avoiding the need for product value assumptions required in the UK BoL and US Vessel Manifest data. However, Colombia represents only a small trading partner for the UK, therefore this dataset, on its own, cannot deliver a meaningful picture of UK intra-firm trade. That said, its level of detail demonstrates the strong potential of our method to produce more comprehensive measures of intra-firm trade when similarly rich datasets become available across all partner countries. Achieving broader coverage will require access to granular firm-level data, typically available only through customs declarations or detailed surveys of MNEs.

4. Conclusion

The trading decisions of large multinational companies can significantly influence both intra-firm and overall trade levels. Because these decisions often drive complex trading patterns within corporate groups, macro-level estimation approaches – which rely on aggregated data - are unsuitable for accurately identifying and measuring intra-firm trade. Instead, microdata-based methods are essential as they provide the firm-level detail needed to capture ownership links and transaction structures that underpin intra-firm trade.

Previous attempts to develop a micro-based approach have faced challenges in determining corporate families and mapping raw company names to these families. The only official source of intra-firm trade data, published by the US Census Bureau, circumvents these issues by requiring traders to report in customs declarations whether the parties involved in cross-border transactions are related. While HMRC could adopt a similar approach, this would impose additional reporting burdens on businesses and is likely to face resistance.

In the absence of such data, data producers and researchers have explored alternative solutions. For example, Statistics Netherlands have used data from the Euro Groups Register (EGR) and VAT declarations alongside web-scraping methods to estimate intra-firm trade (Mounir and Visser, 2025). The UK's departure from the European Statistical System (ESS) limits access to the EGR, though similar methods could be considered if data sharing agreements were re-established. For the time being, and without additional data, the generative AI approach outlined in this paper offers a possible way to develop experimental estimates. The implementation of this approach is comparatively low in cost relative to the procurement of large scale global corporate databases, and its use with granular Colombian trade data demonstrate its potential.

Regardless of the method chosen, meaningful estimates are dependent on access to detailed microdata. While some open-source firm-level datasets exist, they are insufficient for a comprehensive understanding of UK intra-firm trade. Numerous gaps remain, including missing information on traders when logistics providers are involved, incomplete country coverage and poor coverage of non-maritime trade.

The most complete microdata in the UK is the raw data held by HMRC in its Customs Data Analytical Platform (CDAP), which includes information on all trading parties involved, the types of products traded and corresponding trade values. However, when producing Overseas Trade Statistics (OTS), HMRC removes information on the non-UK trading party to protect confidentiality of traders. In practice, raw CDAP data is considered uncleansed, and as such is not available for research purposes. This leaves two potential options for deriving intra-firm trade estimates from HMRC data:

- HMRC could retain information on the foreign trading partner when converting CDAP to OTS, making the resulting dataset available for research and enabling methodologies like those described in this paper.

- HMRC could apply a similar methodology to raw CDAP internally to identify intra-firm transactions and produce outputs that indicate companies engaged in intra-firm trade, along with associated shares of raw CDAP records or trade values. The resulting dataset could then be used together with OTS data by researchers to determine estimates of intra-firm trade.

While these methods show promise for goods trade, estimating intra-firm services trade poses an even greater challenge. Annex C presents a method for estimating trade in licencing of trademarks, but this represents only a small share of total services trade and does not provide value estimates.

To address these gaps, expanding existing official business or trade surveys to include specific and tailored questions on intra-firm trade in both goods and services could be effective – particularly if targeted towards firms most likely to engage in such trade. Large Case Units (LCUs) within NSOs could play a critical role here because they already maintain close relationships with major multinationals - the firms most likely to engage in intra-firm trade. They could test questions and run experimental modules on intra-firm trade before scaling up nationally. This would help refine methodology and questionnaire design. Our findings also show that alternative data sources can help identify firms engaged in intra-firm trade. Incorporating these sources into the sampling process could improve coverage of this concept while reducing respondent burden.

Furthermore, NSOs could also explore the feasibility of deriving intra-firm trade estimates from firm-level data collected through Foreign Direct Investment (FDI) surveys. These surveys typically identify ownership links between parent companies and their affiliates, which is essential for distinguishing related-party transactions. By integrating firm-level trade data with the ownership structures captured in FDI surveys, NSOs could potentially approximate the share and value of cross-border transactions occurring within MNE groups.

Finally, NSOs should explore applying experimental methods - such as those used in this study - to other firm-level datasets. Potential sources include administrative tax records and commercial business-to-business payment data, which could offer valuable insights into the scale and characteristics of intra-firm trade. Leveraging these datasets would help broaden coverage and deepen understanding beyond traditional survey approaches.

Annex A – Detailing the range of alternative data sources

A.1 UK Bill of Lading

Shipping instructions (or Bill of Lading) data include details on international shipments of goods, such as origin, destination, company names, weight and product descriptions. For this study, we use UK trade data for 2022, provided by the Department for Business and Trade (DBT) from ThinkData Works (TDW).

When considering TDW data, several caveats should be noted:

- Incomplete coverage - TDW represents a sample of data obtained from shipping companies and is not comprehensive. It covers approximately 50% of containers passing through Felixstowe, London Gateway and Southampton – ports that together handle about 70% of UK container traffic. This coverage is significantly lower than the equivalent US Vessel Manifest data (discussed in section A.2).

- Containerised traffic only - Substantial gaps exist for commodities typically shipped through bulk carriers (e.g. agricultural products, oil and gas, coal).

- True exporter may not be captured - Bill of Lading documents vary, with a key distinction between Master Bills of Lading (MBL) and House Bills of Lading (HBL). MBLs, issued by carriers, govern the relationship between the carrier and the shipper. They are often issued to freight forwarders who then sell capacity to exporters and issue HBLs which govern the relationship between the freight forwarder and the exporter. Since TDW sources data from shipping companies, it is more likely to reflect MBLs, meaning that some intra-firm relationships may be missed if the true exporter is not identified within the documents.

- HS codes are estimated - TDW applies a series of proprietary algorithms to assign HS codes to the shipment, which are used to produce estimates at a HS 2-digit level.

- Value of goods not included – Values instead need to be estimated by using the average annual value per kilogram for UK goods imports and exports by sea and multiplying by weight.

In total, the dataset comprises over 2.3 million shipping records (1.5 million on UK imports and 0.7 million on UK exports), covering more than 120,000 unique shippers and consignees. This equates to approximately 30 shipments per company, compared to approximately just 3 shipments per company in the US Vessel Manifest Data (200,000 records for 70,000 distinct companies). This big difference suggests many records in the UK Bill of Lading data involve freight forwarders. Although large companies are less likely to use freight forwarders and instead handle their own logistics, it is still likely that a significant share of intra-firm trade is missed within the dataset.

In volume terms, the UK BoL dataset covers 20,355 million tonnes (MT) of imports by sea into the UK, which is significantly (85%) lower than that reported by UN Comtrade. As previously mentioned, the lack of coverage of bulk carriers means that commodities carried by these vessels are likely to be under-reported. For example, UK BoL data for HS 27 ('Mineral fuels and oils') show 9MT of imports, compared to 45,301MT reported by UN Comtrade.

A similar picture exists for exports. The UK BoL dataset covers 11,417MT of UK exports by sea which is significantly lower (88%) than the 97,112MT reported by UN Comtrade. Again, bulk commodities are under-represented in UK BoL. For example, UK BoL data for HS 27 ('Mineral fuels and oils') show 26MT of exports, compared to 57,215MT reported by UN Comtrade.

As goods transported by container tend to be of higher value than those transported by bulk carrier (and are missing from the TDW dataset), coverage in value terms improves, with UK imports by sea 70% and UK exports by sea 73% lower in the UK BoL dataset than that reported by UN Comtrade.

A.2 US Vessel Manifest Data

In the United States, the Code of Federal Regulations allows access to vessel manifest data[3], derived from the Automated Manifest System (AMS) which is required before goods are handled in US Ports.

Regulations also allow trading companies to request confidential treatment (i.e. suppression of their data), and the Secretary of the Treasury may also choose to suppress data if disclosure of the information contained on the cargo declaration poses risks.

Data availability varies by whether the manifest relates to US exports (outward bound) or US imports (inward bound). Table A.1 summarises the available variables for exports and imports.

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[3] Information on vessel manifests and summary statistical reports: https://www.ecfr.gov/current/title-19/chapter-I/part-103/subpart-C/section-103.31

Table A.1. Data availability of US Vessel Manifest Data by trade type

Variable	US imports	US exports
Carrier code	Yes	Yes
Vessel country code	Yes	Yes
Vessel name	Yes	Yes
Voyage number	Yes	Yes
District/port of unlading	Yes	Yes
Estimated arrival date	Yes	Yes
Bill of lading number	Yes	Yes
Foreign port of lading	Yes	Yes
Manifest quantity	Yes	Yes
Manifest units	Yes	Yes
Weight	Yes	Yes
Weight unit	Yes	Yes
Shipper name	Yes	Yes
Shipper address	Yes	Yes
Consignee name	Yes	No
Consignee address	Yes	No
Notify party name	Yes	No
Notify party address	Yes	No
Piece count	Yes	Yes
Description of goods	Yes	Yes
Container number	Yes	Yes
Seal number	Yes	Yes

Source: Author's representation.

The vessel manifest data offer highly granular information on US goods trade. However, because export records do not include consignee details, the publicly available data are

insufficient for estimating intra-firm trade for US exports. For US imports, however, estimates can be compiled under the following caveats:

- Estimates cover only trade by sea. According to UN Comtrade, 43.7% of UK exports to the US in 2022-23 were transported by sea, with most remaining goods transported by air. In volume terms, 96.5% of UK exports to the US were transported by sea, suggesting that low-value-to-weight goods are more likely to be transported by sea, and therefore estimates for these products are likely to be more reliable.

- Estimates exclude cases where shippers or consignees have requested confidentiality. The impact of this suppression on intra-firm estimates cannot be quantified.

Access to this data requires a subscription and purchase from the US government at production cost. Several data providers enrich and resell the information to subscribers for supply chain analysis. ImportYeti[4] is one such provider and supplied UK-to-US export records for 2022-23 for the purposes of this study. The dataset includes around 200,000 records covering over 70,000 distinct shippers and consignees.

To improve the data, three adjustments were applied:

- Correcting infeasible weights - Weight values are often miscoded when units are mistaken, with some values 1,000 time larger than expected. These mis-coded weights were adjusted by comparing shipment weights to the theoretical maximum weight capacity of the vessel (deadweight) and dividing by 1,000 when this threshold was exceeded.

- Classifying HS codes from descriptions – Goods descriptions and shipper names were processed using a Large Language Model (LLM) to assign HS codes at the 2-digit level. It should be noted that, while effective, this method may introduce some bias and inaccuracies into our calculations of intra-firm trade by product. Furthermore, around 0.5% of goods could not be assigned an HS code.

- Estimating value of goods from weight and HS classification - Values were estimated using the average annual value per kilogram for US goods imports by sea at the HS2 level. However, this assumes that HS2 Chapters are homogenous at both the product and the country level. For example, HS Chapter 22 'Beverages, spirits and vinegar' includes both beer and whisky, and this assumption means these products are assumed to be the same value. Furthermore, Scotch whisky is likely to be more highly valued than whisky from other destinations, and as a global assumption has been applied country level quality differentials are missed.

After these adjustments, US Vessel Manifest data show 4,507MT of UK maritime exports to the United States on average in 2022-23 – around 20% lower than the 5,638MT reported by UN Comtrade, but within a reasonable margin of error given differences in the two data sources and data suppressions. Figure A.1 compares HS 2-digit codes across both sources, showing reasonable alignment with some discrepancies likely due to HS misclassification from the text description of the goods, and data suppressions.

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[4] Website: https://www.importyeti.com/

Figure A.1. Estimated volume of UK maritime exports to the United States by HS product, US vessel manifest data vs UN Comtrade data, average 2022-23

Standard Axis (Left) and Logarithmic axis (Right)
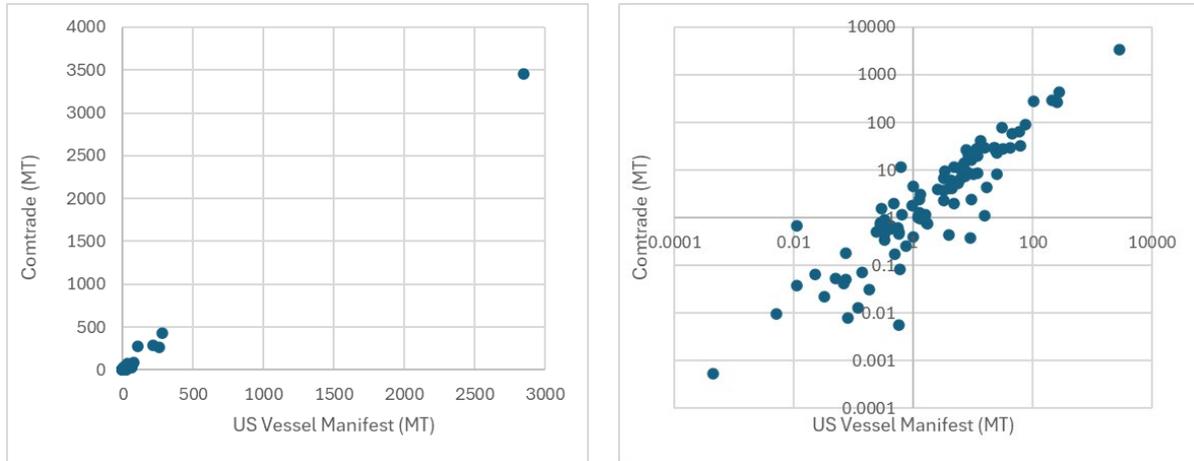
Source: UN COMTRADE, ImportYeti and Author's calculations.

In value terms, US Vessel Manifest data shows that UK exports to the United States averaged $25.9bn in 2022-23 - 13% lower than the $29.8bn reported by UN Comtrade. Figure A.2 compares the two sources by HS 2-digit code and shows broad alignment, though differences are wider than those observed for volumes. This is expected given the uncertainty in valuing commodities.

Figure A.2. Comparing estimated value by data source for UK exports to the US by sea, by HS product, 2022-23.

Standard Axis (Left) and Logarithmic axis (Right)
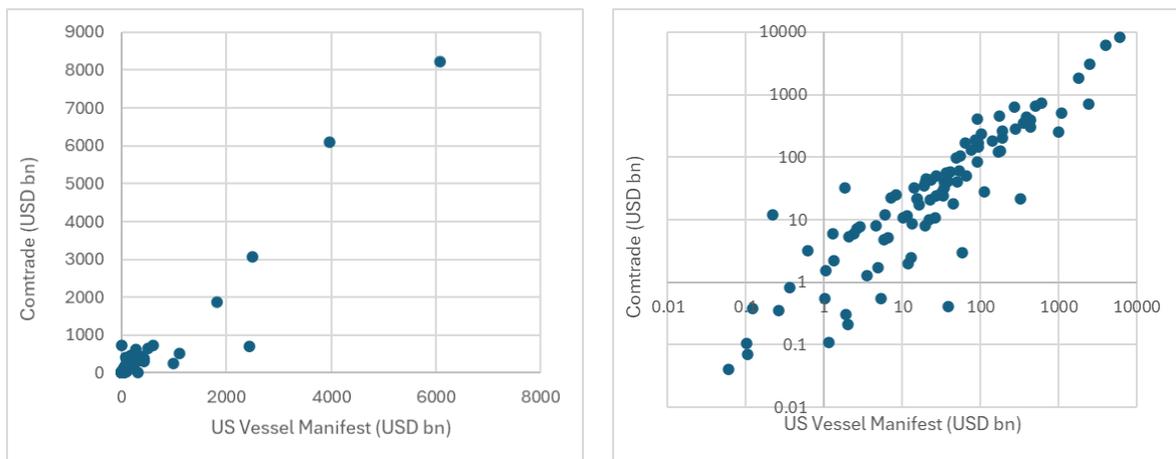
Source: UN COMTRADE, ImportYeti and Author's calculations.

A.3 Matching UK exporter to Canadian importer data

The UK and Canada are relatively unique among jurisdictions in making information on companies engaging in trade publicly available.

In the UK, HMRC publishes lists of importers[5] and exporters[6] on a monthly basis by product traded at the HS 8-digit level. These data contain names and addresses of UK firms trading with non-EU countries and GB firms exporting to the EU (Northern Irish exporters to the EU are not included). Suppressions apply where fewer than three active traders exist for a given 8-digit commodity code in a month, and additional suppressions may apply for commercial or national interest reasons. Traders can also request suppression of their details.

Canada makes available the Canadian Importers Database[7] which provides lists of major importers by HS product and country of origin. 'Major importers' are defined as businesses collectively accounting for up to 80% of imports for a given product. For example, if five companies import 22%, 21%, 20%, 19% and 18% of a given HS product, only the first four (totalling 82%) would appear in the dataset.

As neither of these datasets identifies both parties in a trade transaction, we introduce the concept of 'potential intra-firm trade' – where a UK exporter has a related company which engages in imports of a specific commodity into Canada.

To align the two datasets, we use:

- UK exporter data (2022) mapped from HS 8-digit codes to HS 6-digit codes, yielding a dataset of around 123,000 unique UK exporters

- Canadian importer data (2022) at HS 6-digit level, covering around 68,000 unique Canadian importers

In determining firms that engage in 'potential intra-firm trade', the following caveats should be kept in mind:

- A necessary condition for intra-firm trade is that the same product is exported from the UK and imported into Canada. However, this does not guarantee intra-firm trade. For example, if within the same MNE a UK factory was exporting to France, and a US factory was exporting to Canada then this methodology would falsely classify that there is an intra-firm trade relationship between the UK and Canada.

- Some relationships may be missed due to data suppressions, especially when many exporters share the same HS 6-digit code.

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[5] UK Importers: https://www.uktradeinfo.com/trade-data/latest-bulk-data-sets/bulk-data-sets-archive/#importer-details
[6] UK Exporters: https://www.uktradeinfo.com/trade-data/latest-bulk-data-sets/bulk-data-sets-archive/#exporter-details
[7] Canadian Importers Database: https://ised-isde.canada.ca/site/canadian-importers-database/en

A.4 Colombian trade statistics

Colombia's National Tax and Customs Directorate (DIAN) publishes statistics on foreign trade[8] derived from administrative records. The data undergo a robust process of validation in accordance with international methodologies and quality criteria defined by the National Administrative Department of Statistics (DANE).

As part of Colombia's accession to the Organisation of Economic Co-operation and Development (OECD), efforts focused on modernising and improving trade statistics, including Trade by Enterprise Characteristics (TEC) statistics, which link customs trade records with business registers and enterprise data. Colombia goes further than most countries by including information on both parties in trade transactions and making it publicly available.

This enables estimates of intra-firm trade by product, partner country, year and mode of transport. DIAN provides data from 2001 onward. For this study, we consider a subset of data for 2019-24 to balance time-series needs and computational complexity.

Although our focus is the UK, we include estimates for all partner countries to:

- compare intra-firm trade across Colombia's partner countries

- compare our estimates against US Census Related Party estimates

- demonstrate our method's applicability for estimating intra-firm trade at a country level

Between 2019-24, over 630,000 Colombian firms engaged in merchandise trade, of which 20,267 (3%) traded with the UK. 11,431 UK firms exported to 5,416 Colombian firms, and 2,660 UK firms imported from 1,136 Colombian firms. It should be noted that some firms both import and export so there may be some double counting in the estimates.

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[8] Import and Export data are available here: https://www.dian.gov.co/dian/cifras/Paginas/Bases-Estadisticas-de-Comercio-Exterior-Importaciones-y-Exportaciones.aspx

Annex B – Detailing the methodology for determining intra-firm trade

The following sections outline our approach to develop estimates of intra-firm trade in five key steps:

- introducing Generative AI and model choices

- enriching the trader database using Generative AI and supplementary data sources

- building corporate family structures using a graph database

- enriching corporate families with additional data

- developing intra-firm trade estimates

B.1 Introducing Generative AI and model choices

Generative AI models possess the ability to capture patterns and structures within vast datasets and generate outputs that resemble these learned patterns and structures, often generating novel or unique content.

A major branch of Generative AI is Large Language Models (LLMs) which focus solely on text data. LLMs are trained on extremely large text databases - often beyond petabytes in size – obtained from webpages (such as company webpages, news articles, blog posts and social media posts), scientific papers and books.

This diversity of text sources makes them highly effective for understanding the meaning of text, helping to overcome shortcomings of other methods in entity resolution such as understanding abbreviations, missing company suffixes, 'doing business as' names and translations. Furthermore, due to the learnt patterns and structures they are also well suited to being able to determine connections the text may have to other concepts when questioned, such as the primary industry of a company or what website is most commonly associated with a company.

However, the size, complexity and proprietary nature of these models mean that, for the most advanced models, users are reliant on service providers to provide outputs, at a cost. Leading providers include OpenAI (GPT), Google (Gemini), xAI (Grok) and Anthropic (Claude), with performance rankings changing frequently as new models emerge and continuously update.

For this study, Gemini 2.5 Flash was selected for its favourable cost-performance ratio and free tier (USD 300 credits) for new cloud accounts, which were sufficient for our analysis. Given the similarity of training datasets used in the development of these models, similar results would likely be achieved using other LLMs.

To generate outputs from an LLM, it is necessary to define system instructions, the prompt, and model parameters, as illustrated in the example in Figure B.1. The system instructions provide high level guidance to the LLM on the model's overall behaviour. The prompt is the

main input that determines the output, while the model parameters control the behaviour of the LLM during the generation process.

A key model parameter is temperature, which controls the randomness of the output. A lower temperature (e.g. 0) makes the model stick to the most probable options, whereas a high temperature (e.g. 1) gives greater weight to less probable options. In practice, low temperatures are most suited to tasks such as answering factual questions, whereas higher temperatures are more suited to creative tasks. Since our requirements are more closely linked to factual responses, the temperature value has been set to 0 in the development of our results.

Figure B.1. Example: LLM inputs and resulting output

System Prompt:	You are a system designed to determine the parent of an inputted company name
Prompt:	Apples Sales International
Model Parameters:	Temperature = 0
Output:	Apple

Source: Google Gemini 2.5 Flash

The output of Gemini 2.5 Flash is limited by two key parameters – the number of daily requests and the output token limit. The number of daily requests is limited to 10,000 for most users, meaning that for the volume of data required for our analysis, it would take over a hundred days to generate the desired data. As a result, it was necessary to group companies into batches and send to the LLM. However, the batch size cannot be too large as the output token limit restricts how much data can be outputted. Therefore, depending on the complexity of the output, we batched companies together in group sizes between 20 and 100.

B.2 Enriching the trader database using Generative AI and supplementary data sources

The data sources discussed in Annex A include 1,030,558 unique traders, comprising both companies and individuals. Since intra-firm trade involves companies, the first step was to determine which traders related to companies and which related to individuals. Figure B.2 shows the system instructions for the LLM for this task. The input was a batch of 100 companies, and the output provided the inputted name and the binary classification as to whether it represented a company or not.

Figure B.2. System instruction to determine whether a trader is a company, and sample output

System Instruction:
You are system designed to take a list of text inputs and generate a structured output which details:
1. Company Name: The text input
2. IsCompany: A Boolean variable which details whether the input text relates to a company

Sample Output:

Company Name	*IsCompany*
BREATRIZ TORREALBA	*FALSE*
REFRIFO INDUSTRIA E COMERCIO DE EQUIPAMENTOS DE REFRIGERECAO	*TRUE*
TECUMSEH EUROPE SALES & LOGISTICS S A S	*TRUE*
ASOCIACION TECNICA COMERCIAL E INDUSTRIAL S.A ASTECO	*TRUE*
ZHEJIANG ENJINE IMPORT AND EXPORT CO. LTD	*TRUE*
WENZHOU TYCHEN FLUID EQUIPMENT CO LTDA	*TRUE*
LOGISTICS TRANSPORT SOLUTION	*TRUE*
DUBAI REFRESHMENTS PJSC	*TRUE*
BARNETS AND DAUGHTERS LTD	*TRUE*
ROY HOWELLS & SON	*TRUE*

Source: Author's representation based on outputs from Google Gemini 2.5 Flash

A total of 936,210 traders (90.8%) were identified as companies by the LLM. However, visual inspection reveals occasional LLM confusion over company names such as identifying Alexander Dennis - a bus manufacturer - as an individual. To address these cases, we matched all company names against LSEG's PermID[9] database using its entity resolution service. PermID is an open-source database of over 7 million companies, primarily focusing on large global companies, making it well-suited to correct errors like the misclassification of Alexander Dennis. After adjusting for PermID, the total number of traders identified as companies rose to 940,075 (91.2%).

The PermID database also enables evaluation of the LLM's classification accuracy. Of the 293,814 traders matched to the PermID database, 289,949 were correctly classified as companies, a 98.7% accuracy rate.

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[9] PermID: https://permid.refinitiv.com/

Table B.1 summarises the unique trader counts for each of the data sources considered in this study, and their allocations at each stage.

Table B.1. Data sources and the number of unique traders

Data Source	Number of traders	Companies identified by LLM	Companies identified by LLM or PermID
UK Bill of Lading	151,821	138,519	139,211
US Vessel Manifest Data	70,595	53,439	54,142
UK Exporters	123,003	114,771	115,304
Canadian Importers	68,368	67,016	67,169
Colombian trade statistics	630,801	576,299	578,131
Total	**1,033,558**	**936,210**	**940,075**

Source: Author's calculations based on outputs from Google Gemini 2.5 Flash and PermID
Note: The same trader may be listed multiple times within each dataset, therefore the summation of individual datasets will not equal the total.

For the 940,075 identified companies, the next step involves extracting additional details. The objective of this stage is to gather sufficient information to build corporate groupings, identify logistics companies and collect additional data points for cross-referencing with other sources.

Figure B.3 details the LLM's system instructions for generating these outputs. Given the response is quite detailed, companies are grouped together in batches of 20.

Figure B.3. System instruction to determine company details and sample output

> **System Instruction:**
>
> *You are system designed to take a list of company names and generate a structured output which details:*
>
> *1_CompanyName: The initial input data*
>
> *2_HarmonisedCompanyName: The name which is most commonly used to refer to the company*
>
> *3_NACECode: Output the NACE Rev. 2 code in the format [##.##]. Please do *not* use any other industry classification systems (e.g., SIC, NAICS, ISIC). If you are unsure about the correct NACE Rev. 2 code, state that explicitly instead of guessing or using a different system. IMPORTANT: Only provide the NACE Rev. 2 code. Do not include any other information.*
>
> *4_Website: The website domain most commonly associated with the company. If you are unsure about the correct website state that explicitly.*
>
> *5_PartofGroup: A Boolean variable which details If the company is part of a group of companies*
>
> *6_GroupName: If "PartofGroup" is TRUE then output the most common name for this group of companies*

Sample Output:

1_CompanyName	2_Harmonised Company Name	3_NACE Code	4_Website	5_Part of Group	6_Group Name
Curtius S.A.	Curtius S.A.	64.2	curtius.lu	FALSE	N/A
JINING HAOCHANG GROUP CO.,LTD	Jining Haochang Group Co Ltd	Unsure	Unsure	TRUE	Jining Haochang Group
FREIGHT SYSTEMS DWC (LLC) DUBAI LOGISTICS CITY	Freight Systems DWC (LLC)	52.29	freightsystems.com	TRUE	Freight Systems Group
HUNAN HAMYEE HOME DECOR CO., LTD	Hunan Hamyee Home Decor Co., Ltd.	46.49	hamyee.com	FALSE	N/A
Homejoy Enterprise Limited	Homejoy Enterprise Limited	Unsure	Unsure	FALSE	N/A
BRUCE FINE PROPERTIES LIMITED	Bruce Fine Properties Limited	68.2	Unsure	FALSE	N/A
Luna Innovations, Inc.	Luna Innovations, Inc.	26.51	lunainc.com	FALSE	N/A
MECONTROL ESTUDIOS DE DISTRIBUCION DE SL	Mecontrol Estudios de Distribucion de SL	71.12	mecontrol.es	FALSE	N/A
PIPE TOOL SPECIALISTS LIMITED	Pipe Tool Specialists Limited	46.74	pipetoolspecialists.co.uk	FALSE	N/A
NINGBO BOND INDUSTRIAL ELECTRIC CO LTD	Ningbo Bond Industrial Electric Co., Ltd.	27.9	bond-electric.com	FALSE	N/A

Source: Author's representation based on outputs from Google Gemini 2.5 Flash

As the LLMs understanding of a group of companies is nuanced - and determining the ultimate parent group of the company may require multiple steps - we apply this query iteratively to each Group Name until no unmatched company names remain. In total, 1,092,887 unique company names are analysed by the LLM.

Population coverage is generally very good: 95.5% of company names are assigned a NACE sector and 84% of companies are linked to a valid website. Regarding group names, 25% of companies are identified as part of a corporate group.

B.3 Building corporate families using a graph database

The next step is to group company names that belong to the same corporate family, as these may involve intra-firm trade. First, we remove companies operating in the logistics sector (NACE Sectors 49-53), as these typically provide freight forwarding services and are unlikely to physically own goods. This reduces the set of companies considered to 1,022,292.

To determine whether the non-logistics companies are linked, we build connections between companies using the LLM-generated database. Several types of connections are created:

- Company Name -> Harmonised Company Name: The purpose of this stage is to map raw company names to a cleaned representation of the company. For example, raw company names 'Company A UK Ltd.' and 'Company A UK Ltd' should map to the same harmonised name, allowing them to be grouped into the same corporate family. In total, 1,022,292 connections of this type are added into the model.

- Company Name -> Group Name: The purpose of this stage is to map raw company names to a group name. For example, 'Company A UK Ltd' and 'Company A Germany GmbH' should share the group name 'Company A', enabling groupings into the same corporate family. In total, 246,194 connections of this type are added into the model.

- Company Name -> Domain: This stage serves as a secondary method for identifying corporate connections. For example, 'Company A France SA' with website *companya.fr* and 'Company A Germany GmbH' with website *companya.de*, share the root *companya* after removing the Top Level Domain (TLD), indicating a common corporate family. In total, 850,788 connections of this type are added into the model.

In total, 2,119,274 connections are then built into a graph database consisting of a series of nodes and edges. Nodes represent company names, harmonised company names, group names and websites, while edges represent the identified connections. We then search the graph for unique clusters of nodes which are connected by any path of connections, with each cluster representing a corporate family.

Figure B.4 illustrates this process for 'Company A' in the example above, and Table B.2 lists companies linked together in the case of NFI Group.

Figure B.4. Diagram representing the connections generated in the case of 'Company A'
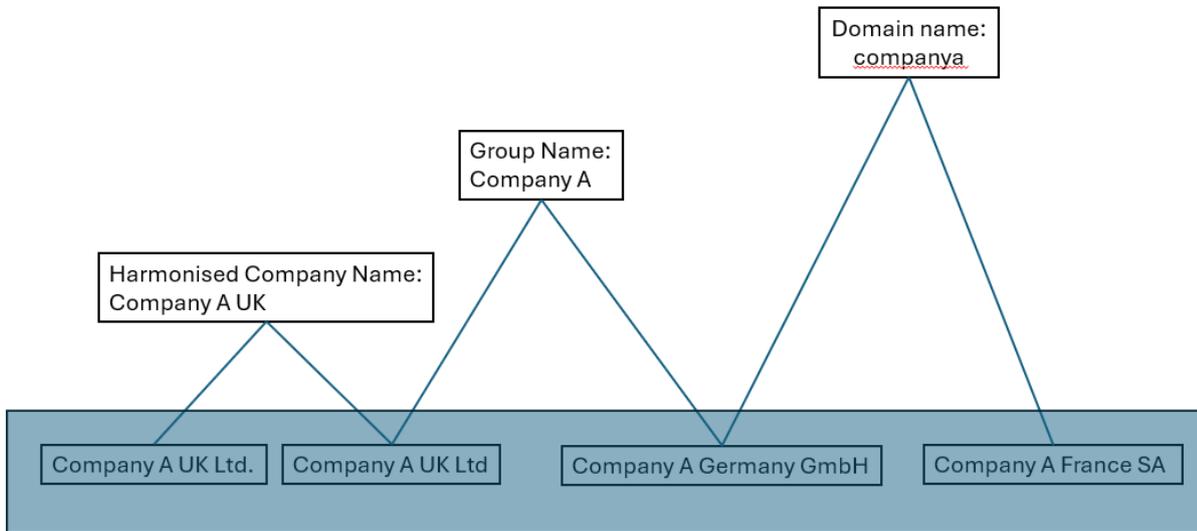
Source: Author's representation
Note: Boxes correspond to nodes and lines correspond to vertices within the graph database. The blue box corresponds to raw company names which have been determined to be within the cluster for the Company A family through the clustering procedure.

Table B.2. Connected companies generated in the case of NFI Group

| Company Name	Notes
NEW FLYER OF AMERICA	*New Flyer is one of the primary brands of NFI Group and specialises in the manufacture of buses.*
NEW FLYER OF AMERICA INC.	
New Flyer Of America	
NEW FLYER PARTS	
NFI Group	*Parent Company based in Canada*
NFI Group Inc.	
ALEXANDER DENNIS	*Alexander Dennis is bus manufacturer headquartered in Scotland, owned by NFI Group. With presence in a number of jurisdictions it is a likely company engaging in intra-firm trade from the United Kingdom.*
Alexander Dennis	
ALEXANDER DENNIS CANADA INC	
ALEXANDER DENNIS CANADA INC.	
ALEXANDER DENNIS INC	
ALEXANDER DENNIS INC.	
ALEXANDER-DENNIS INC	
ALEXANDER DENNIS LIMITED	
ALEXANDER DENNIS LTD	
Alexander Dennis Limited	
Alexander Dennis Ltd	
ALEXANDER DENNIS NZ LTD	
Alexander Dennis New Zealand Ltd	
ALEXANDER DENNIS USA INC	
CARFAIR COMPOSITES INC.	*Fibre Glass Reinforced Polymer (FRP) manufacturer a key component in the manufacture of buses.*
MOTOR COACH INDUSTRIES LTD	*A US Headquartered bus manufacturer*

Source: Authors representation

In total, 486,706 clusters are generated, with the majority of these (69%) relating to company groups with only one matching trader name within the input dataset. This aligns with the expectations that most traders do not engage in intra-firm trade.

Figure B.5 illustrates the distribution of clusters by the number of distinct trader names in the input dataset, showing that as the number of traders increases, the number of clusters

rapidly declines. In total, there are only 9,098 distinct company clusters where 10 or more company names are used.

Figure B.5. Distribution of number of clusters grouped by number of distinct trade names
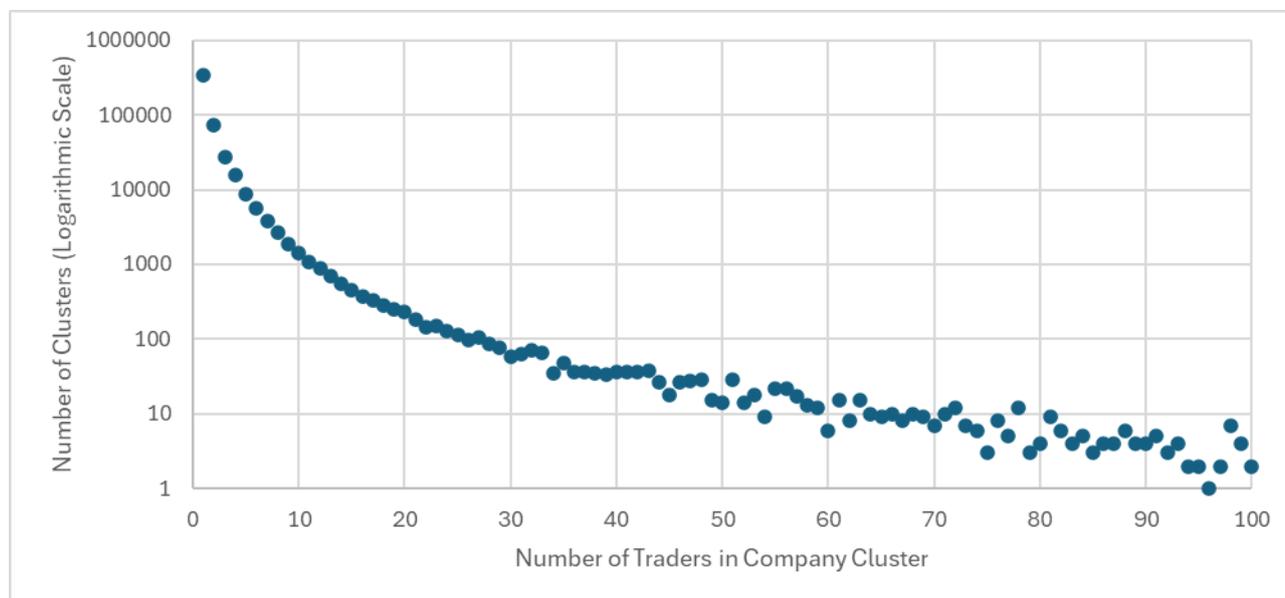
Source: Author's calculations.

To validate the robustness of our estimates, we compare them against the Global Register company clusters provided by the OECD UNSD Multinational Enterprise Information Platform (MEIP).

Using PermID entity resolution, we identify 4,724 matches between our dataset and the 72,580 subsidiary companies listed in MEIP. MEIP assigns these subsidiaries to 411 group companies and our methodology assigns to these 1,204 clusters. At first glance, these results do not look promising, however the broader picture reveals that while some small connections are missed, the bulk of the connections are captured.

Table B.3 illustrates this with an example for Zoetis Inc., where the largest cluster reflects the vast majority of companies. When considering only the largest cluster for each company, 3,646 companies are covered – representing 77% of the firms identified by MEIP). Given that this approach is entirely automated and global in its application, these results are promising. Furthermore, since MEIP covers some of the most complex global firms, it is reasonable to expect better results for smaller companies with less complex corporate structures.

Table B.3. Connected companies using our method, classified as belonging to Zoetis Inc. by MEIP

Cluster 1 (12 Companies)	Cluster 2 (1 Company)	Cluster 3 (1 Company)
Zoetis US LLC	Platinum Performance, Inc.	PETMEDIX LTD
Abaxis, Inc.		
Zoetis Services LLC		
ZOETIS INC.		
PHARMAQ AS		
ZOETIS MEXICO S DE RL DE CV		
PT Zoetis Animalhealth Indonesia		
Zoetis Uk Limited		
PHARMAQ ANALYTIQ LIMITED		
ZOETISECUADOR Cia. Ltda.		
Zoetis Colombia S.A.S.		
ZOETIS CANADA INC.		

Source: Author's representation based on company clusters from OECD-UNSD MEIP

B.4 Enriching corporate families with supplementary data

To further enrich each company cluster, we incorporate additional information from the PeopleDataLabs company dataset[10]. This dataset contains details on over 20 million companies, including company name, website domain, industry, location, LinkedIn profile, employee count and year founded.

Using the website domain, we join this information to the 486,706 identified company clusters, resulting in 187,677 successful matches. This enables breakdowns by employee size and headquarter locations.

Figure B.6 provides a breakdown of the clusters by country and company size.

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[10] PeopleDataLabs Company Dataset: https://www.peopledatalabs.com/resource-lab/dataset/company-dataset

Figure B.6. Distribution of number of clusters broken down by employee size class and headquarter location
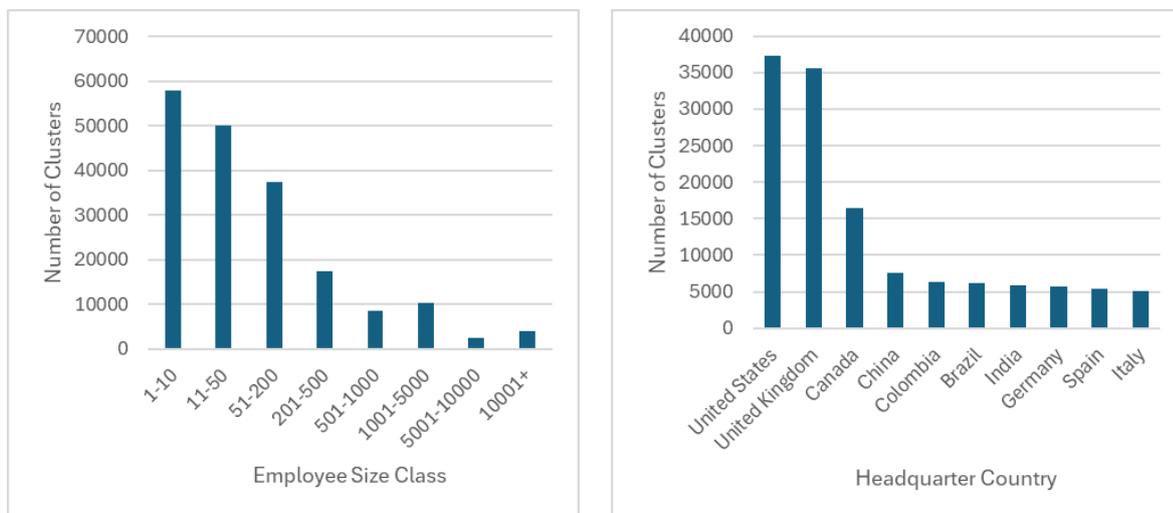
Source: Author's calculation based on data from People Data Labs

B.5 Developing intra-firm trade estimates

To estimate intra-firm trade for both exporters and importers, we classify each raw trader name and associated data into the following categories:

- unknown: cases where classification is not possible (e.g. missing trader name)

- individual: entities not identified as a company by either the LLM or PermID

- logistics company: entities identified by the LLM as belonging to NACE sectors 49-53

- company (non-logistics): entities identified by the LLM as companies but not in NACE sectors 49-53

Table B.4 provides a breakdown of these classifications by dataset considered in this study, helping assess the level of analysis possible for each dataset.

For Colombian imports, over 95% of data points are classified as company names for both the importing and the exporting party, suggesting strong data coverage and the potential of the dataset to produce reliable estimates. In contrast, for Colombian exports, while exporter names are populated in over 95% of cases, importer names are far less complete, reflecting a large share of exporters that are unknown (31.2%) - likely due to data suppressions or cases where the importing party was not known at the point of export (e.g. those classified as 'To order'). The high share of unknowns makes it impossible to produce reliable top-level estimates for Colombian exports. However, estimates are feasible for specific subsets of the data, such as Colombian exports to the UK, where the proportion of unknowns is lower.

For US imports based on US Vessel Manifest data, importers and exporters are classified as companies in about 90% of cases, again suggesting that top-level estimates are reliable, though limited to sea transport only.

Conversely, UK Bill of Lading data show high rates of unknown and logistics companies, making top-level estimates unreliable.

Finally, when matching UK exporter to Canadian importer data, records classified as companies exceed 90%, but since estimates are based on raw company counts rather than trade values, a direct comparison of coverage rates should be interpreted with caution.

Table B.4. Connected companies using our method, classified as belonging to Zoetis Inc. by MEIP

Dataset	Importer / Exporter	Company	Individuals	Logistics	Unknown
Colombian Imports	Importer Names	95.6	0.6	3.9	0.0
	Exporter Names	97.2	0.6	2.2	0.0
Colombian Exports	Exporter Names	97.2	1.5	0.8	0.4
	Importer Names	64.3	0.8	3.7	31.2
US Imports Vessel Manifest Data	Importer Names	89.4	2.1	8.5	0.0
	Exporter Names	90.8	1.7	7.4	0.0
UK Imports (BoL)	Importer Names	33.1	0.8	39.9	26.1
	Exporter Names	45.4	1.2	48.6	4.8
UK Exports (BoL)	Exporter Names	54.8	4.1	15.1	25.9
	Importer Names	72.5	0.7	20.5	6.1
UK Exports with Canadian Imports matching	UK Exporters	90.3	6.2	3.0	0.4
	Canada Importers	95.7	1.8	2.5	0.0

Source: Author's calculation

Intra-firm trade is identified when the importing and exporting party share the same cluster. Since reliability of estimates at the macro level is only assured for Colombian imports and US imports, we validate our estimates by comparing to Related Party Trade estimates published by the US Census Bureau.

We estimate that, during 2019-24, 15.1% of Colombian imports from the US are intra-firm, compared to 17.9% reported by the US Census Bureau. These estimates are within reasonable range, with differences likely due to differences between export declarations (reported by the United States) and import declarations (reported by Colombia), as well as definitional differences. Related Party Trade is defined by the US as cases when one party owns 10% or more of the other party, whereas our definition assumes ownership control of over 50%. Because our definition is stricter, lower intra-firm trade shares are expected.

For US imports from the UK via sea transport, we estimate 51.7% intra-firm trade in 2022-23, compared to 54.6% reported by the US Census Bureau across all modes of transport.

This is again within reasonable range, though our estimate is limited to sea transport and relies on weight-based value approximations rather than actual transaction values.

To further validate our methodology, we examine more granular breakdowns. Since our data uses HS codes while US data is based on NAICS, we apply the concordance developed by Liao and others (2020)[11] to map HS to the NAICS 3-digit level. Figure B.7 compares intra-firm trade shares derived from our approach with those reported by the US Census Bureau.

Figure B.7. Intra-firm trade shares – Our approach compared to estimates published by the US Census Bureau at NAICS 3-digit levels

Colombian imports from the US (2019-24)   US imports from the UK (2022-23)
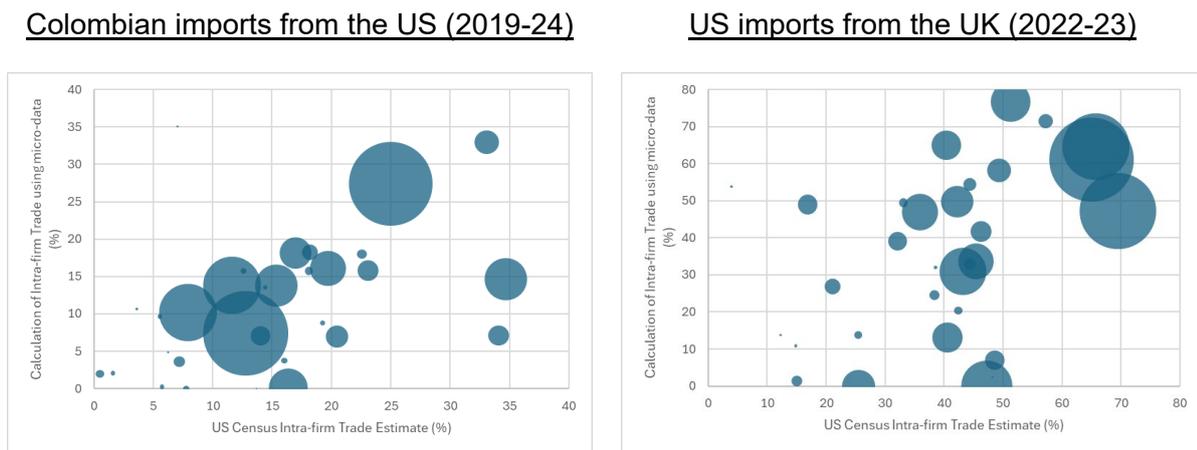
Source: Author's calculation.
Note: Bubble Size reflects the value (importance) of each NAICS sector.

As expected, the alignment of the Colombian data is stronger than that of the US, reflecting fewer estimations and greater coverage. For the largest sectors (represented by the largest bubble sizes in Figure B.7), alignment is generally good. For example, the estimated intra-firm share of Colombian imports from the US is 7.4% for Petroleum and Coal Products and 27.4% for Chemicals, compared to equivalent US Census Bureau estimates of 12.8% and 25.0% respectively. There is also broadly good alignment of estimates for products predominantly transported by sea. For example, US imports from the UK show intra-firm shares of 61.1% for Transport Equipment and 64.5% for Machinery (excluding electrical) equipment, versus US estimates of 65.0% and 65.8%, respectively.

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[11] Concordance package: Steven Liao, In Song Kim, Sayumi Miyano, Hao Zhang (2020). concordance: Product Concordance. R package version 2.0.0.
https://CRAN.R-project.org/package=concordance

Annex C – An application to services trade

Whilst detailed transaction-level microdata for merchandise trade are limited, such data for services is even rarer. When NSOs compile trade in services statistics, they primarily rely on business surveys. These surveys contain highly confidential information, which is not publicly available, and they typically do not include questions on intra-firm trade to balance the need for data with the reporting burden on businesses.

In the context of intra-firm trade, an alternative dataset of interest is trademark designations. Trademarks are primarily designed to protect brands and allow legal action against unauthorised use. However, they also serve as a mechanism for transferring and licensing brands, including within the same corporate family.

Trademark data can serve as a proxy for measuring intra-firm trade in intellectual property-related (IP) services, where official data are unavailable. If, for example, a trademark is owned by a foreign affiliate of a UK-headquartered company, this suggests that the UK entity may be paying royalties or licensing fees to its affiliate abroad - a UK intra-firm IP services import. Conversely, if a UK-headquartered company owned a trademark and charged a foreign affiliate for its use, that would count as a UK export of IP services.

In the UK, trademark notices are managed by the Intellectual Property Office (IPO), which covers both UK trademarks and international registrations designating the UK. As part of this function, the IPO publishes a weekly journal of trademark applications, enabling objections before their approval. These journals include details such as the trademark's logo, the trademark's owner and the associated Nice Classifications (NCL). The NCL, established under the Nice Agreement (1957) and administered by the World Intellectual Property Organization (WIPO), provides an international classification for goods and services in trademark registrations. The latest version breaks down trademarks into 45 classes, of which 34 relate to goods and 11 relate to services. Figure C.1 illustrates this with an example for 'Eat Natural', a UK-based manufacturer of fruit and nut bars.

Figure C.1. An example of the data held within a trademark application

Trademark number:	WO0000001628905
Owner:	SOREMARTEC S.A.
Image:	
Classes:	29: Meats and Processed Foods 30: Staple Foods

Source: UK IPO.

The IPO makes trademark journals from the previous year publicly available[12]. However, since trademarks remain valid for longer periods, additional trademark journals were extracted from the National Archives[13] for the purposes of this study. This resulted in a comprehensive set of trademark journals spanning from 16th September 2016 to 12th September 2025 - approximately 9 years. Given that trademarks are only valid for a period of 10 years and often updated, this dataset represents the most complete publicly available record of UK trademarks. Filtering for applications that include an image, results in a dataset of 636,047 trademark applications linked to 354,354 unique companies or individuals.

Despite this breadth, the dataset has notable limitations. These mainly reflect the fact that the journals are designed primarily as a reference point for people to challenge applications rather than as a definitive record of all valid trademarks in the UK. This means that our dataset has the following weaknesses:

- Renewals - Trademarks remain valid for 10 years and must be renewed once this period expires. However, renewals are not included in the trademark journals, as they simply confirm continuation of use. As such, the dataset may omit a number of long-dated trademarks.

- Refusals – The journals do not indicate whether the trademark is granted or refused. For our analysis, we assume that all trademark applications are granted.

- Changes in ownership - Trademarks can change ownership over their lifespan, but changes of ownership are not recorded in the journals.

With these limitations in mind, we apply a modified version of the method to determine corporate families outlined in Annex B, omitting the step to capture logistics companies, as these companies do not affect this dataset.

Using the OpenCorporates Open Refine Reconciliation API[14] each trademark owner was matched against the OpenCorporates database to determine whether the owner is likely based in the UK or in another jurisdiction. Of the 354,354 unique companies and individuals listed in the trademark journals, 165,877 (47%) were successfully matched to a company in the OpenCorporates database, with a reasonable degree of accuracy. This matching rate is considered acceptable given that many applications may come from individuals and the OpenCorporates database does not cover all jurisdictions. Of the 165,877 matched companies, 101,979 (61%) were located in the UK.

For comparison, we focus on corporate families identified as being headquartered in the UK (24,070 in total). Intra-firm imports of IP services are defined as cases where a trademark is owned by a company within the corporate family in a jurisdiction outside the UK (1,361 in total). Based on this definition, we estimate that 5.7% of UK-headquartered corporate families engage in intra-firm trade in IP services.

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[12] UK IPO Trademark Journals: https://www.ipo.gov.uk/t-tmj/t-tmj-previous.htm
[13] National Archives for UK IPO Trademark Journals:
https://webarchive.nationalarchives.gov.uk/ukgwa/timeline/https://www.ipo.gov.uk/t-tmj.htm
[14] Open Refine Reconciliation API: https://api.opencorporates.com/documentation/Open-Refine-Reconciliation-API

Further analysis by corporate family size shows that larger groups are more likely to engage in intra-firm trade. For example, among corporate families with more than 10,001 employees, 46.9% have trademarks owned outside the UK, indicating potential intra-firm imports. Several factors may explain this pattern: large firms are more likely to acquire other firms and their associated brands, and the fixed costs of moving their brand assets to another jurisdiction may be justified by potential tax advantages for larger firms, compared to smaller firms.

Table C.1. Intra-firm IP services imports by firm size, 2016-25

Number of employees	Number of UK headquartered corporate families	Number of UK headquartered corporate families engaging in intra-firm trade	Share of UK headquartered coroprate families engaging in intra-firm trade (%)
10001+	226	106	46.9
5001-10000	140	47	33.6
1001-5000	695	143	20.6
501-1000	625	72	11.5
201-500	1264	129	10.2
51-200	3744	235	6.3
11-50	7034	318	4.5
1-10	10342	311	3.0
All	**24,070**	**1,361**	**5.7**

Source: Author's calculation based on IPO data

For UK regions, London is host to the largest number of corporate families (562) with intra-firm trade, or 42.7% of all corporate families headquartered in the UK with intra-firm trade – even adjusting for the number of corporate families located within London (7,861) is shows one of the highest rates of intra-firm imports with 7.1% of corporate families showing evidence of intra-firm imports. Only Northern Ireland has a higher rate, and this may be linked to the unique position which Northern Ireland holds or alternatively could be explained by the small number of corporate families headquartered there.

Table C.2. Intra-firm IP services imports, by HQ location, 2016-25

HQ location	Number of corporate families	Number of corporate families engaging in intra-firm trade	Share of corporate families engaging in intra-firm trade (%)
London	7861	562	7.1
South East	3255	176	5.4
North West	2160	100	4.6
East of England	1897	99	5.2
South West	1824	74	4.1
Yorkshire and The Humber	1410	71	5.0
East Midlands	1247	60	4.8
West Midlands	1465	55	3.8
Scotland	1127	39	3.5
North East	490	28	5.7
Northern Ireland	256	26	10.2
Wales	615	25	4.1

Source: Author's calculation based on IPO Data

When looking at NCL Classes, 6.3% of corporate families appear to import goods-related trademarks through intra-firm channels, while the share for services-related trademarks is 5.2%. Most (475) corporate families engaging in intra-firm imports of service-related trademarks, concern imports of Advertising & Business Management trademarks, followed by Scientific & Technological Services trademarks. For goods-related trademarks, most corporate families engage in intra-firm imports of Electrical Apparatus & Instruments and Clothing and Footwear (184) trademarks.

Table C.3. Intra-firm IP services imports, by NCL Class, 2016-25

	Class Number	Class Description (Shortened)	Number of UK headquartered corporate families	Number of UK headquartered corporate families engaging in intra-firm trade	Share of UK headquartered corporate families engaging in intra-firm trade (%)
G	1	Chemicals	702	60	8.5
o	2	Paints	275	16	5.8
o	3	Cosmetics & Cleaning Preparations	1324	105	7.9
d	4	Lubricants & Fuels	510	33	6.5
s	5	Pharmaceuticals	1197	102	8.5
	6	Metals & Metal Ores	959	64	6.7
	7	Machines & Machine Tools	982	91	9.3
	8	Hand Tools	536	46	8.6
	9	Electrical Apparatus & Instruments	6975	491	7.0
	10	Medical & Surgical Apparatus	770	68	8.8
	11	Lighting & Heating Apparatus	1203	85	7.1
	12	Vehicles	869	57	6.6
	13	Firearms & Ammunition	49	6	12.2
	14	Precious Metals & Jewellery	785	46	5.9
	15	Musical Instruments	69	4	5.8
	16	Paper Goods & Printed Matter	3341	181	5.4
	17	Rubber & Plastic Goods	423	40	9.5
	18	Leather Goods	1310	97	7.4
	19	Building Materials (non-metallic)	767	37	4.8
	20	Furniture	1306	83	6.4
	21	Household Utensils & Containers	1598	99	6.2
	22	Ropes & Textiles	246	12	4.9
	23	Yarns & Threads	57	4	7.0
	24	Fabrics	857	52	6.1
	25	Clothing & Footwear	3094	184	5.9
	26	Lace & Embroidery	427	22	5.2
	27	Carpets & Floor Coverings	397	28	7.1
	28	Games & Toys	1483	109	7.3
	29	Meats & Processed Foods	916	52	5.7
	30	Staple Foods	1389	72	5.2
	31	Agricultural & Horticultural Products	626	39	6.2
	32	Beers & Non-Alcoholic Beverages	850	57	6.7
	33	Alcoholic Beverages	688	45	6.5
	34	Tobacco & Smokers' Articles	169	15	8.9
S	35	Advertising & Business Management	8812	475	5.4
e	36	Insurance & Financial Services	3664	256	7.0
r	37	Construction & Repair Services	2708	147	5.4
v	38	Telecommunications	1860	139	7.5
i	39	Transport & Storage	1959	105	5.4
c	40	Material Treatment	1289	71	5.5
e	41	Education & Entertainment	6945	349	5.0
s	42	Scientific & Technological Services	6455	431	6.7
	43	Food & Accommodation Services	2088	97	4.6
	44	Medical & Beauty Services	2277	104	4.6
	45	Legal & Security Services	2219	110	5.0

Source: Author's calculation based on IPO data
Note: Trademarks can be assigned to multiple classes and therefore it should not be expected that these columns align with global aggregates.

References

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