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Abstract

Through what channels do fluctuations in the financial costs of exporting affect exports, and how important are financial conditions for export dynamics over the business cycle? We first establish, using balance sheet data for UK manufacturing firms, that exporting firms have more short-term liabilities than non-exporting firms. We find evidence consistent with exporting firms taking on these short-term loans to (partly) cover labour costs. We then build a model with heterogeneous firms in which exporters need to access external finance to export, in line with the evidence, and parameterise it to UK data. We use rich firm level data to inform the calibration of the financial costs facing exporting firms, and estimate the shock processes in our model with Bayesian methods. Our estimations show that global shocks to the financial costs of exporting are the main driver of UK export dynamics over the business cycle, alongside shocks to productivity. These two shocks each contribute to around a third of UK export dynamics. Moreover, we find that global shocks to the financial costs of exporting played a crucial role in explaining the fall in UK exports in the early stages of the Global Trade Collapse, and slowed the recovery.

Key words: Open economy macroeconomics, small open economy, exports, trade finance, heterogeneous firms.

JEL classification: F41, F44, F47.

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1 Introduction

It is by now well documented that exporters require external finance and that credit conditions are an important determinant of international trade.[1] But what are the channels through which changes to the financial costs of exporting affect international trade and what role do they play for export dynamics over the business cycle? Our aim is to get insights into these questions, focusing on a small open economy, the UK.

We first provide evidence on exporting and non-exporting firms' balance sheets, using firm level data from Bureau Van Dijk (BvD). This dataset has the advantage of including not only large firms quoted on the stock market, but also small and medium sized firms that are not quoted on the stock market. We show that exporting firms tend to have more short term liabilities than non-exporting firms, and we provide evidence that these short term loans are related to labour costs, controlling for firm size. These facts are consistent with exporting firms requiring more short term loans to cover production costs than non-exporting firms because of the time between production and sales being longer for exporters.

We then build an international business cycle model which is consistent with the uncovered facts. In our model, firms are heterogeneous in terms of their productivity and face fixed and variable export costs as in Ghironi and Melitz (2005), but we extend Ghironi and Melitz (2005) on several dimensions. First, we introduce financial costs to exporting by assuming that a share of exporters' costs has to be paid in advance, and that firms require external short term finance to cover that payment. There is thus a positive relation between short term loans and labour costs for exporting firms in our model, in line with our firm level evidence. Firms decide on their intensive as well as extensive margins of exports, and only the most productive firms, who can pay the variable and fixed trade costs as well as the financial costs of exporting and still make positive profits, export. Second, we generalize the model by allowing for unequal country sizes.[2] We can thus use the model to understand the behaviour of exporters in a small open economy such as the UK.

We estimate the model to UK data and investigate the importance of shocks to the financial costs of exporting in explaining exports dynamics. The introduction of financial costs to exporting constitutes an important departure of our model from the literature it builds on. We estimate the fraction of production costs that exporters are required to pay in advance and therefore seek external finance to cover, by taking the implications of our model for the average exporting and non-exporting firm to the data. In particular, we compare the average exporting and non-exporting firms' short term liabilities, using UK firm-level data from two data sources. First, we investigate the characteristics of the average exporting and non-exporting firms using the UK's Office for National Statistics' (ONS) Annual Business Survey (ABS); second, we use the FAME dataset provided by Bureau van Dijk (BvD) to consider the value of short term loans on the balance sheets of exporting and non-exporting firms that resemble the average exporting and non-exporting firms identified in the first step.[3] Our model implies that the difference between the average exporter and

[1] The literature on this topic includes among others Manova (2008), Amiti and Weinstein (2011), Paravisini et al. (2014), Niepmann and Schmidt-Eisenlohr (2017), Antràs and Foley (2015) Caballero et al. (2018) and Claessens and van Horen (2021). Kohn et al. (2022) provide an extensive survey of the literature.

[2] This is an important innovation in our approach, and this approach is different from the assumption of similar sizes usually assumed for instance by Contessi (2010) and Zlate (2016), or that of a small open economy where the rest of the world is not modelled explicitly as assumed by Barattieri et al. (2021).

[3] These two steps are necessary because the FAME BvD dataset is skewed towards medium and larger firms. The ABS data is representative of the entire universe of UK firms, but does not include balance sheet data.

non-exporter's short term loans is due to exporters having to cover a fraction of their costs. We use this to compute an estimate for the fraction of costs exporters need to cover using external finance, and calibrate our model to match this.

In order to investigate the source of UK export fluctuations within this framework, we estimate shock processes for six shocks, using UK and Rest of the World (RoW) data and Bayesian methods. The six shocks we consider are the supply and demand shocks most likely to affect exports over the business cycle: country-specific shocks to productivity and preference, a global shock to trade demand, a shock to the preference for UK exports (home bias), and a global shock to the financial costs of exporting. By building and estimating a dynamic model in which financial conditions for exporting play a role, we are able to identify shocks to exporters' financial conditions and quantify their role in driving exports over the business cycle. The estimated shocks to exporters' financial conditions are closely related to different measures of global financial conditions and UK firm credit spreads. We find that their role as drivers of exports is considerable: it is the main driver of the variance in UK exports, alongside UK productivity shocks. Each of those shocks explain around a third of UK export dynamics.

We also investigate what shocks hit during the Global Trade Collapse (GTC) after the Global Financial Crisis (GFC) and how these explain the fall in exports and the subsequent slow recovery. We find that a surge in the cost of finance for exporting was the main contributor to the fall in UK exports in the early stages of the GTC, with global trade demand shocks and weak UK productivity contributing in the later stages. After the GTC, global financial conditions for exporting continued to pull down on exports for a prolonged period, explaining the slow recovery.

Our paper relates to three strands of the international economics literature. First, we contribute to the literature on the effects of financial conditions for exports, which includes among others Manova (2008), Amiti and Weinstein (2011) and Caballero et al. (2018). We show that exporting firms are more likely to take on short term loans, and we uncover a link between these loans and labour costs. These findings are in line with Antràs and Foley (2015) and Paravisini et al. (2014) who find evidence, using different methods, that exporters use external finance mainly to cover their variable costs of production. Informed by these facts, our modelling of firms' financial requirements for exporting, differ from the existing literature: In our framework, exporting firms face financial costs associated with exporting that are related to their labour costs. These financial costs have effects on both the extensive and intensive margins of trade, and work mostly through the intensive margin, in line with Paravisini et al. (2014) and Manova (2013).

Second, as a result of our interest in export dynamics over the business cycle, our paper contributes to a growing literature building on the framework developed by Ghironi and Melitz (2005).[4] Our focus on business cycle dynamics means that we deviate from previous literature with static and/or partial equilibrium models incorporating financial constraints for exporting such as those developed by Manova (2013), Chaney (2016) and Leibovici (2021). The framework by Ghironi and Melitz (2005) on which we build is an international business cycle model in which firms are heterogeneous with respect to their individual levels of

[4]Alessandria and Choi (2007) also builds a similar model with firm heterogeneity. Their focus is on the extensive margin of trade and net exports, and in their model, firms pay a sunk cost to enter a foreign market, and following a fixed cost to continue to export.

productivity. Firms face variable and fixed export costs, and therefore only the most productive firms will find it profitable to export. The productivity threshold at which firms can export depends on productivity and demand conditions, such that the number of firms exporting varies with economic conditions. Within this framework, the authors analyse the implications of their model for international prices, focusing in particular on the Harrod-Balassa-Samuelson effect. The bulk of the literature building on that framework analyses the effects of trade policies such as changes in tariffs and other fixed costs, but has not focused on the drivers of exports over the business cycle: Cacciatore (2014) considers how labour market frictions impact the outcome of trade integration, Cacciatore and Ghironi (2021) study how the effect of monetary policy on labour markets depend on trade integration and Barattieri et al. (2021) consider the effects of protectionism. We contribute to this literature by developing the framework in two ways: by incorporating a role for financial costs for exporting, and by allowing for market size asymmetry.

Third, given our focus on the GTC period, this paper is also related to the literature on the GTC which broadly concentrates on two main explanations. The first explanation emphasises the role of the credit crunch as do we (e.g. Ahn et al. (2011), Amiti and Weinstein (2011), Chor and Manova (2012) and Paravisini et al. (2014)). The second explanation focuses on the fall in demand and on its composition which was skewed towards investment. As investment goods are highly tradable and have a high import content the fall in investment had an outsized impact on trade (e.g. Bussiere et al. (2013) and Eaton et al. (2016)). In this paper, we focus on the role of financial determinants but we do allow for shocks to demand to play a role too. We can thus, to some extent, compare the role of these two main explanations.[5] We also add to this literature by quantifying the role of finance for exports, not only during the GTC, but also during the recovery after the GTC.

The next section presents some motivational evidence on the short term financing needs of exporters. We use this evidence to inform firms' behaviour in our two-country model which we present in section 3. We discuss the calibration in section 4 and present the transmission of shocks within our framework in section 5. We then discuss the estimation strategy in section 6 and present our main results in section 7. Section 8 concludes.

2 Motivational evidence

2.1 Data

This section presents evidence on the characteristics of UK exporting and non-exporting firms, focusing on their financial situation. We use the FAME dataset provided by the Bureau van Dijk (BvD), which provides accounting data on UK firms. This accounting data has been obtained from Companies House, which acts as a registrar of companies in accordance with legislation set out in Companies Act 2006. The FAME database includes almost all firms operating in England, Wales and Scotland.[6] It provides information on individual firms' accounts, and in particular their balance sheet and their profit and loss accounts. It also includes information on what sector the firms operate in.

[5]We do not model investment explicitly in our model, so we cannot explicitly account for investment-specific demand shocks, but we can identify several types of demand shocks, each of which have different effects on trade.

[6]Firms not covered by the dataset include sole proprietorships and partnerships.

An important advantage of this dataset is that it includes small and medium sized firms that are not quoted on the stock market as well as large firms that may be quoted on the stock market. There are many small and medium sized firms in the UK and many of these are exporting firms. So, as compared to using datasets with financial information on quoted firms only, this dataset gives us a better overall picture of exporting firms in a small open economy.

That said, not all firms report detailed balance sheet and profit and loss accounts. In particular, the reporting requirements differ depending on the size of firms: small firms may choose to disclose less information than medium sized and large companies.[7] The implication of this is that compared to the universe of UK firms, the sample of firms reporting balance sheet information is skewed towards small and medium sized firms and away from micro firms (with 10 or less employees). In our model calibration, we take this into account as the distribution of firms matter for our calibration.

Following Bahaj et al. (2020), we include in our sample live public and private companies, which are required to file with Companies House, and exclude companies that have a parent or are part of a group. We also exclude firms where the accounting period is irregular. Bahaj et al. (2020) provide a detailed description of the dataset, which they analyse to provide evidence for the link between firm directors' home values and their firm's investment and labour decisions. Our focus is on firms operating in the manufacturing sector, and we drop firms that did not provide information on our main variables of interest.

Our baseline dataset has 83,745 firm-year observations over the period 1995-2019, with the number of firms observed each year varying between 2,051 and 5,240. On average 46.5% of firms export each year.[8] Table 1 reports selected characteristics of firms, comparing exporting and non-exporting firms. The numbers reported correspond to the sample mean, while the numbers in parenthesis correspond to the sample median. It is clear from comparing the mean and median that the sample has many small and medium sized firms, and some very large firms too. The median firm in our sample has a turnover of £9,145,000 and 86 employees. The table shows that exporting firms tend to be larger than non-exporting firms in terms of their turnover and the number of employees. Moreover, exporting firms tend to have more short term liabilities, more long-term liabilities and a higher amount of total assets.

These characteristics are in line with findings in previous literature: Exporting and non-exporting firms differ in terms of their size as e.g. pointed out in Bernard and Jensen (1995) for US firms or Greenaway and Kneller (2004) for a sample of UK firms. Greenaway et al. (2007) also point out that exporting firms tend to have more assets than non-exporting firms.[9]

[7] Companies House divide firms into micro-entities, small, medium and large firms. In 2014, micro-entities were to satisfy at least two of the following three requirements: have a turnover of less than £632.000, a balance sheet of less than £316.000, and less than 10 employees, while small (medium) companies needed to satisfy two of the following requirements: have a turnover of less than £6.5 million (£36 million), a balance sheet of less than £3.26 million (£18 million) and less than 50 employees (250 employees). Micro-entities and small firms may report an abbreviated account while medium-sized and large companies must include all of the constituent parts of their accounts to Companies House, though medium-sized companies may submit a slightly reduced version of the profit and loss account. See Companies Act 2006 (Part 15) for details.

[8] To divide firms into exporting and non-exporting firms, we consider their reported overseas turnover. Specifically, we assume that firms that report overseas turnover export, while those that do not report any overseas turnover do not export.

[9] Greenaway et al. (2007) proxy the financial health of firms by their liquidity and leverage ratios (defined as $\frac{\text{current assets-current liabilities}}{\text{total assets}}$ and $\frac{\text{short term debt}}{\text{current assets}}$) and find that while exporting firms are generally in a better financial health

Table 1: Summary statistics - Baseline sample

	Total	**Exporters**	**Non-exporters**
Turnover (1000£)	108,564 (9,145)	130,013 (12,682)	82,005 (6,366)
Number of employees	626 (86)	758 (118)	512 (65)
Short term liabilities (1000£)	39,363 (2,330)	52,976 (3,366)	27,489 (1,598)
Long term liabilities (1000£)	42,915 (424)	60,246 (692)	27,798 (263)
Total assets (1000£)	123,899 (6,000)	168,461 (8,744)	85,028 (3,985)
Observations	83,745	39,016	44,729

2.2 The link between exporting and short term liabilities

To gain insights into whether and why exporting firms have different short term financing requirements than non-exporting firms, we investigate how the relation between short term liabilities and firm characteristics depends on firms' exporting status. Our focus is on short term liabilities following evidence that short term debt plays an important role in the transmission of business cycles, pointed out inter alia in Kalemli-Ozcan et al. (2022) and Ivashina et al. (2022). For exporters, this role may be more important given evidence that export-intensive firms used trade credit less as an alternative source of finance during the GFC (Coulibaly et al. (2011)). In our data, short term liabilities include all trade credit, short term loans, overdrafts and other current liabilities with a maturity of less than 12 months.[10]

Our main focus is to understand whether exporters' short term loans are related to their labour costs, once we control for their size. This would likely be the case if, as emphasised by Alfaro et al. (2021), timings matter and that different timings of production and sales are likely to exacerbate financial risks and requirements for exporters. This would also be in line with Antràs and Foley (2015) who point out that longer delivery and transportation times in international trade mean that firms that trade internationally have a larger need for working capital. If exporters are more likely to require short term finance to cover labour costs during the longer time between production and receipt of proceeds, then we should see a positive correlation between labour costs and short term loans at the firm level that is more pronounced for exporters. In order to investigate this, we estimate the following model:

$$STL_{i,t} = \beta_1 TO_{i,t} + \gamma_1 TO_{i,t} Exp_{i,t} + \beta_2 LC_{i,t} + \gamma_2 LC_{i,t} Exp_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t} \tag{1}$$

where the subscript i indexes firms and the subscript t indexes years. $STL_{i,t}$ denotes the short term liabilities of firm i in year t, and $Exp_{i,t}$ is a dummy variable that takes the value 1 if firm i is an exporter in year t.[11]

than non-exporting firms, this is not the case for firms which have just entered the export market. This could be a sign that these firms face sunk export costs.

[10]These are denoted "Current Liabilities" in the FAME dataset.

[11]We have also experimented with keeping the exporter status for each firm fixed, so that firms that export in at least one

$TO_{i,t}$ denotes firm i's turnover in year t, and $LC_{i,t}$ denotes firm i's labour costs in year t. We include cross terms between exporter status and respectively turnover and labour costs, to allow for the effect of these to differ across exporting and non-exporting firms. We proxy the labour costs by using either a measure of firms' remuneration costs or by using its number of employees. We include firm fixed effects denoted α_i to control for unobserved firm characteristics, and time fixed effects denoted δ_t to control for business cycle fluctuations. We cluster our standard errors two-way at the time and firm level. The results from our estimations figure in Table 2. In columns 1-2, we use "Remuneration" (which includes wages and salaries, social security costs, pension costs and other staff costs) as a proxy for labour costs, while in columns 3-4 we use "Number of employees". Columns 1 and 2 (as well as 3 and 4) differ in their inclusion of time fixed effects.

We first note that firms' short term loans are statistically highly significantly correlated with turnover across all specifications. The coefficient of around 0.2 means that an extra £1000 of firm turnover is associated with an increase in short term loans of around £200. For exporting firms, this relationship is a little lower, as the negative sign on the coefficient on the cross term between exporter status and turnover shows. This could be the result of overseas turnover being perceived as riskier by the financial institutions giving out short term loans.

We now turn to the relation between exporting firms' short term loans and their labour costs, proxied either by their remuneration costs or the number of employees, to get some insights into whether these short term loans are (partly) used to cover labour costs. If firms tend to take out short term loans to cover labour costs, we should see a positive coefficient on the remuneration costs (number of employees), as each extra pound spent on remuneration (each extra employee) will lead to an increase in short term loans. If these working capital requirements are particularly pronounced for exporters due to the increased time between production and sales, we would also expect a positive coefficient on the cross term between exporter status and remuneration costs (number of employees).

Our results reported in Table 2 show that firms' short term loans are significantly correlated with its remuneration costs (but not number of employees), controlling for other firm characteristics, and that the coefficient on the cross term between remuneration costs (number of employees) and exporter status is significant. These results indicate that while short term loans are related to remuneration for all firms, the correlation is significantly higher for exporters than non-exporters. This is consistent with exporting firms requiring more short term loans than non-exporting firms in order to finance labour costs. For every extra pound paid in remuneration costs, non-exporting firms increase their short term loans by around £0.74 - but exporters increase their short term loans by more than £1.30. Likewise, for every extra employee, non-exporting firms increase their short term loans by £5,500 while exporting firms increase theirs by more than £30,000. These results indicate that exporters use (parts of) their short term loans to finance labour costs.

The results are robust to using total assets as a proxy for size rather than turnover as shown in Appendix A, Table 10. Our results are also unaffected by including industry-time fixed effects to account for the possibility that certain industries within manufacturing may be more financially dependent than others, as pointed out inter alia in Rajan and Zingales (1998). Table 11 in Appendix A shows the results including

year of the sample are considered exporters throughout the sample. The results are robust.

Table 2: Regression results

1995-2019 Dep. var: $STL_{i,t}$	**(1)**	**(2)**	**(3)**	**(4)**
Turnover	0.1961***	0.1961***	0.2292***	0.2289***
	(0.0194)	(0.0194)	(0.0196)	(0.0196)
Turnover x Export status	-0.0357***	-0.0357***	-0.0162	-0.0163
	(0.0086)	(0.0086)	(0.0182)	(0.0181)
Remuneration	0.7443*	0.7436*		
	(0.4071)	(0.4071)		
Remuneration x Export status	0.6245***	0.6254***		
	(0.2094)	(0.2094)		
No of employees			5.5746	5.5846
			(10.7788)	(10.7947)
No of employees x Export status			25.9500**	25.8991**
			(10.1228)	(10.1107)
Time fixed effects	NO	YES	NO	YES
Firm fixed effects	YES	YES	YES	YES
No of obs.	78,121	78,121	78,121	78,121
R^2	0.9513	0.9513	0.9374	0.9375

Note: Results are from Equation (1). Turnover and Remuneration are reported in units of £1000. The numbers reported are the central estimates, with the standard errors in parenthesis. *** indicates significance of the results at the 1% level, ** indicates significance at the 5% level and * indicates significance at the 10% level. Standard errors are clustered two-way at the time and firm level.

industry-time fixed effects where the industries are defined at the two digit level (e.g. "Manufacture of food products and beverages", "Manufacture of textiles" or "Manufacture of office machinery and computers", with 22 manufacturing industries in total.) Our results thus show a robust difference between exporting and non-exporting firms' short term finance requirements, with these being related to labour costs. They indicate that exporting firms require short term external finance (partly) to cover labour costs, consistently with the evidence uncovered by Paravisini et al. (2014) for Peru, using a different methodology.[12] We use this evidence to inform our modelling assumptions presented in the next section: In particular, we introduce in our framework financial costs associated with exporting, consistent with the stylized facts pointed out in this section.

3 Model

The benchmark model we present here builds on the model developed in Ghironi and Melitz (2005), expanding it in several dimensions. Ghironi and Melitz (2005) set up a two country general equilibrium model in which firms are heterogeneous with respect to their productivity levels. Firms face fixed and variable costs of exporting so only more productive firms are able to export. This structure allows variations both at the extensive and intensive margins of trade. Building on this framework, we introduce a role for export finance by assuming that exporters need to finance a proportion of their export costs before they receive payment for their exported goods. To study the behaviour of export dynamics within this framework, we allow the economies to be affected by country-specific shocks to demand and productivity as well as global and country-specific shocks to trade demand and shocks to the financial costs of exporting.[13] We also explicitly allow for differences in the two countries' size and explain how this affects the transmission of shocks and export dynamics.

In the following we present the model focusing on the equilibrium in the Home economy, with the understanding that the Foreign economy's structure is similar except for differences in the two countries' size: the proportion of households in the Home economy is n and the proportion of households in the Foreign economy is $1-n$. We denote the Foreign country variables with an asterisk (*).

3.1 Households

The representative Home household's lifetime utility can be expressed as a function of consumption (C_t):

$$U_t = \mathrm{E}_t \sum_{t=0}^{\infty} \beta_t \, \chi_t \, \frac{C_t^{1-\gamma} - 1}{1-\gamma} \tag{2}$$

where E_t denotes the expectations at time t, β is the discount factor and $1/\gamma$ is the intertemporal elasticity of substitution. χ_t is a preference shock affecting households' intertemporal decisions, which follows an AR(1)

[12] Paravisini et al. (2014) show that credit shocks to banks during the Global Financial Crisis affected the intensive margin of exports, in line with firms' financial requirements being related to working capital.

[13] The literature building on the Ghironi and Melitz (2005) model has mainly focused on the implications of productivity and tariff shocks, see for example Cacciatore (2014); Fattal Jaef and Lopez (2014) or Liao and Santacreu (2015).

process:

$$\chi_t = \bar{\chi} + \rho_\chi \left(\chi_{t-1} - \bar{\chi}\right) + \varepsilon_{\chi,t}$$

where $\bar{\chi}$ is the steady state productivity level, and $0 \leq \rho_\chi < 1$ and $\varepsilon_{\chi,t} \sim N(0, \sigma_\chi^2)$.

Consumption is a composite of domestically produced goods C_D and imported goods C_X^*, aggregated using a constant elasticity of substitution (CES):

$$C_t = \left[\alpha_H^{\frac{1}{\phi}} C_{D,t}^{\frac{\phi-1}{\phi}} + \alpha_F^{\frac{1}{\phi}} C_{X,t}^{*\frac{\phi-1}{\phi}}\right]^{\frac{\phi}{\phi-1}} \tag{3}$$

where α_H and α_F determine the share of imported goods in the aggregate consumption basket and ϕ is the elasticity of substitution between domestically produced and imported goods.

The basket of domestically produced goods consists of differentiated goods indexed by ω defined over a continuum set of domestic goods, Ω, and the basket of imported goods consists of differentiated goods defined over the continuum set of imported goods Ω^*:

$$C_{D,t} = \left[\int_{\omega\epsilon\Omega} c_{D,t}(\omega)^{\frac{\theta-1}{\theta}} d\omega\right]^{\frac{\theta}{\theta-1}} \quad , \quad C_{X,t}^* = \left[\int_{\omega\epsilon\Omega^*} c_{X,t}^*(\omega)^{\frac{\theta-1}{\theta}} d\omega\right]^{\frac{\theta}{\theta-1}}$$

where θ denotes the elasticity of substitution between varieties. Each period only a subset of varieties are actually available for consumption.

The consumer price index of the home country P_t can then be written as:

$$P_t = \left[\alpha_H P_{D,t}^{1-\phi} + \alpha_F P_{X,t}^{*1-\phi}\right]^{\frac{1}{1-\phi}} \tag{4}$$

where the consumer price indices for domestic and imported varieties, $P_{D,t}$ and $P_{X,t}^*$, are:

$$P_{D,t} = \left[\int_{\omega\in\Omega} p_{D,t}(\omega)^{1-\theta} d\omega\right]^{\frac{1}{1-\theta}} \quad , \quad P_{X,t}^* = \left[\int_{\omega\in\Omega^*} p_{X,t}^*(\omega)^{1-\theta} d\omega\right]^{\frac{1}{1-\theta}}$$

Households supply labour (L) inelastically in each period at the real wage rate w_t.[14]

3.2 Firms

In each country, a continuum of monopolistically competitive firms produce differentiated goods. These firms are heterogeneous in their productivity. Home firms producing the differentiated goods $\omega \in \Omega$ use a production function $Y_t(\omega) = Z_t z(\omega) L(\omega)$, where $Y_t(\omega)$ is output of variety ω, Z_t is aggregate productivity in the Home country and $z(\omega)$ is firm-specific productivity. We assume that aggregate productivity is subject

[14]We have experimented with endogenous labour supply in our model, and found that it does not have consequences for our main results. For simplicity, and because the data is consistent with a high correlation between labour productivity and output, we therefore decided for a benchmark with exogenous labour supply.

to productivity shocks and follow an AR(1) process:

$$Z_t = \bar{Z} + \rho_Z \left(Z_{t-1} - \bar{Z} \right) + \varepsilon_{Z,t}$$

where $\bar{Z}$ is the steady state productivity level, and $0 \leq \rho_Z < 1$ and $\varepsilon_{Z,t} \sim N(0, \sigma_Z^2)$.

To start producing i.e. to enter the market, firms need to pay a sunk cost (f_E) in the form of a labour requirement which is equal to $w_t f_E / Z_t$ where w_t is the real wage. Once a firm has entered the market, it draws its productivity from a common distribution $G(z)$ where $z \in [z_{min}, \infty)$. This productivity does not vary over the life of the firm. A firm produces in every period until it is hit by an exogenous "death" shock. In every period, firms face this death shock with probability $\delta \in (0, 1)$, which is independent from their relative productivity. Foreign firms face the same productivity distribution and behave similarly to Home firms.

Once firms enter, they produce and sell in the domestic market. Firms can also export, and every period firms decide whether to do so. To export in a given period, firms need to pay a fixed export cost (f_X) in effective labour units as well as a variable cost, τ, which is proportional to their wage bill. The importance of both fixed and variable export costs is emphasised in Manova (2013). Fixed export costs can include product customization e.g. to comply with regulations, country-specific marketing as well as paper work such as filling out customs forms (i.e. red tape) to comply with complex requirements.[15] Variable trade costs include transportation costs, duties and insurance.

Besides facing fixed and variable export costs, exporters face additional financial costs that reflect the fact that international trade requires more financing than supplying the domestic market does, as shown in the previous section. Firms must, in our model, pay a share $\zeta \in [0, 1]$ of their costs (which include labour costs as well as variable and fixed export costs) in advance in order to export, and they must access external finance to do so. Firms that engage in international trade therefore borrow from domestic households at the beginning of the period to finance the share of the costs that needs to be paid in advance. The gross real interest rate paid on that loan is equal to $1 + r_t^{TF}$. The need for external finance for exporting and a link to labour costs is in line with our findings for UK manufacturing firms detailed in the previous section: exporting firms have more short term loans and these are correlated with their labour costs. It is also supported by Antràs and Foley (2015) and Alfaro et al. (2021) who point out that longer delivery and transportation times in international trade mean that firms that trade internationally have a larger need for external finance. And Antràs and Foley (2015) and Paravisini et al. (2014) point out the importance of working capital constraints for exporters, implying that finance requirements faced by exporting firms are proportional to their costs.

Firms decide to export if they extract positive profits from exporting, and this depends on their productivity and demand conditions as well as on the financial conditions. Only the most productive firms - who can afford the fixed cost as well as the variable and trade finance costs - will export.

Each firm produces one variety ω with associated productivity level z and maximises profits subject to a downward sloping demand curve. Profits obtained by selling to the domestic (Π_t^D) and the export market

[15] Fixed costs could also include repayments of loans to finance sunk entry costs.

(Π_t^X) respectively are:

$$\Pi_t^D(\omega) = \frac{p_{D,t}(\omega)}{P_t} C_{D,t}(\omega) - w_t l_D(\omega)$$

$$\Pi_t^X(\omega) = \frac{1-n}{n} Q_t \frac{p_{X,t}(\omega)}{P_t^*} C_{X,t}(\omega) - (1-\zeta)\left[w_t l_X(\omega)\tau - \frac{w_t f_X}{Z_t}\right] - \zeta(1+r_t^{TF})\left[w_t l_X(\omega)\tau - \frac{w_t f_X}{Z_t}\right]$$

where $l_D(\omega)$ and $l_X(\omega)$ denote the amount of labour required to produce variety ω for the domestic and the exports market respectively, $Q_t = \frac{S_t P_t^*}{P_t}$ is the real exchange rate (RER) and S_t is the nominal exchange rate defined as the home currency price of buying one unit of Foreign currency. $p_{D,t}(\omega)$ denotes the price charged in the domestic market for variety ω, and $p_{X,t}(\omega)$ denotes the corresponding price charged in the export market (in Foreign currency).

The interest exporters pay on the share of their costs to be paid in advance r_t^{TF} may vary so as to capture changes in trade finance conditions. In line with the literature showing that trade finance is mostly obtained through global banks (see e.g. Claessens and van Horen (2021)), we assume that trade finance conditions may change as a consequence of a global shock $\varepsilon_{TF,t}$ to trade finance costs. We assume that r_t^{TF} follows an AR(1) process:

$$r_t^{TF} = \bar{r}^{TF} + \rho_{r^{TF}}\,(r_{t-1}^{TF} - \bar{r}^{TF}) + \varepsilon_{r^{TF},t}$$

where $\bar{r}^{TF}$ is the steady state interest rate on trade costs that is paid in advance, equal to the steady state interest rate faced by households, and $0 \leq \rho_{r^{TF}} < 1$ and $\varepsilon_{r^{TF},t} \sim N(0, \sigma_\zeta^2)$.

Because each firm produces a single variety associated with a level of productivity z, such that z is a good summary statistics for a firm, we index variables by z in the rest of the paper rather than by ω. Prices are flexible, and therefore profit maximisation implies that prices are set as a mark-up over marginal costs. The firm producing variety ω with associated productivity level z sets the following prices:

$$\rho_{D,t}(z) \equiv \frac{p_{D,t}(z)}{P_t} = \frac{\theta}{(\theta-1)}\frac{w_t}{Z_t\, z}, \qquad \rho_{X,t}(z) \equiv \frac{p_{X,t}(z)}{P_t^*} = \frac{\theta}{(\theta-1)}\frac{\tau\, w_t}{Q_t\, Z_t\, z}\left[(1-\zeta) + \zeta(1+r_t^{TF})\right] \tag{5}$$

All firms have the choice to export, but only those with a relative productivity z above a cutoff level $z_{X,t} = inf\{z : \Pi_t^X(z) > 0\}$ ensuring non-negative profits from exporting, will do so. The exporting firms sell their goods both in local and foreign markets. So, while all firms can export, a firm with productivity between z_{min} and the export cutoff level, $z_{X,t}$, will decide to serve only the local market.[16] The export productivity cutoff level $z_{X,t}$ varies with economic conditions, and therefore so does the number of exporting firms. The size of the non-traded sector is thus determined endogenously. As a result, given a mass $N_{D,t}$ of firms in the home country, $N_{X,t} = [1 - G(z_{X,t})]N_{D,t}$ of them also export. This structure is symmetric in the Foreign country; $z_{X,t}^*$ fluctuates endogenously in an isomorphic way.

[16] The lower bound for idiosyncratic productivity, z_{min}, is below $z_{X,t}$.

3.3 Firm Averages

Average productivity for all domestic firms and for only exporting firms respectively are:

$$\tilde{z}_D \equiv \left[\int_{z_{min}}^{\infty} z^{\theta-1} dG(z)\right]^{\frac{1}{\theta-1}}, \qquad \tilde{z}_{X,t} \equiv \left[\frac{1}{1-G(z_{X,t})}\int_{z_{X,t}}^{\infty} z^{\theta-1} dG(z)\right]^{\frac{1}{\theta-1}} \tag{6}$$

Following Ghironi and Melitz (2005), we assume that relative productivity is drawn from a Pareto distribution with lower bound z_{min} and shape parameter k which is higher than $\theta - 1$[17]: $G(z) = 1 - (z_{min}/z)^k$. By defining $\nu \equiv \{k/(k-(\theta-1))\}^{1/(\theta-1)}$ and integrating (6), one can obtain: $\tilde{z}_D = \nu z_{min}$ and $\tilde{z}_{X,t} = \nu z_{X,t}$. So the share of home exporting firms, the extensive margin of trade, can be written as:

$$\frac{N_{X,t}}{N_{D,t}} = 1 - G(z_{X,t}) = \left(\frac{z_{min}}{z_{X,t}}\right)^k$$

Using productivity averages we can rewrite the share of exporters as:

$$\frac{N_{X,t}}{N_{D,t}} = \left(\frac{z_{min}\nu}{\tilde{z}_{X,t}}\right)^k \tag{7}$$

Defining the average price of domestic varieties as $\tilde{\rho}_{D,t} = \rho_{D,t}(\tilde{z}_D) \equiv N_{D,t}^{1/(\theta-1)}\rho_{D,t}$ and the average price of exported varieties as $\tilde{\rho}^*_{X,t} = \rho^*_{x,t}(\tilde{z}^*_x) \equiv N_{X,t}^{*1/(\theta-1)}\rho^*_{X,t}$,[18] we note that the consumer price index (Equation (4)) can be written as $1 = [\alpha_H \rho_{D,t}^{1-\phi} + \alpha_F \rho_{X,t}^{*1-\phi}]^{1/1-\phi}$, or equivalently

$$1 = \alpha_H \left(N_{D,t}^{1/(1-\theta)} \tilde{\rho}_{D,t}\right)^{1-\phi} + \alpha_F \left((N^*_{X,t})^{1/(1-\theta)} \tilde{\rho}^*_{X,t}\right)^{1-\phi} \tag{8}$$

The average (per capita) profits in the Home country are:

$$\widetilde{\Pi}_t = \widetilde{\Pi}_{D,t} + [1 - G(z_{X,t})]\widetilde{\Pi}_{X,t} = \widetilde{\Pi}_{D,t} + \left[\frac{N_{X,t}}{N_{D,t}}\right]\widetilde{\Pi}_{X,t} \tag{9}$$

where

$$\widetilde{\Pi}_{D,t} = \tilde{\rho}_{D,t}\,\widetilde{C}_{D,t} - \frac{w_t}{\nu z_{min} Z_t}\,\widetilde{C}_{D,t} \tag{10}$$

$$\widetilde{\Pi}_{X,t} = \frac{1-n}{n}\tilde{\rho}_{X,t}\,\widetilde{C}_{X,t}\,Q_t - \left[(1-\zeta) + \zeta(1 + r_t^{TF})\right]\left[\frac{1-n}{n}\,\frac{w_t \tau}{\tilde{z}_{X,t} Z_t}\,\widetilde{C}_{X,t} - \frac{w_t f_X}{Z_t}\right] \tag{11}$$

[17]Ghironi and Melitz (2005) assume Pareto distribution for firm productivity as this distribution fits firm level data quite well. A Pareto distribution is a skewed and heavy-tailed distribution. As it is heavy-tailed for a finite mean and variance the shape parameter needs to be sufficiently high: $k > 1$ ensures a finite mean and $k > 2$ ensures a finite variance. In our case the mean firm size/sale will be finite when $k/\theta - 1 > 1$.

[18]The aggregation details can be found in Melitz (2003).

and the average demand for domestic and exported goods is given by

$$\widetilde{C}_{D,t} \;=\; \alpha_H \, N_{D,t}^{\frac{\theta-\phi}{1-\theta}} \; \tilde{\rho}_{D,t}^{-\phi} \, C_t \tag{12}$$

$$\widetilde{C}_{X,t} \;=\; \Psi_t \alpha_F^* \, N_{X,t}^{\frac{\theta-\phi}{1-\theta}} \; \tilde{\rho}_{X,t}^{-\phi} \, C_t^* \tag{13}$$

Export demand may be affected by changes to the global demand for traded goods Ψ_t. Ψ_t which affects the Home and Foreign demand for traded goods in similar ways, follows an AR(1) process:

$$\Psi_t \;=\bar{\Psi} + \rho_\Psi \left(\Psi_{t-1} - \bar{\Psi}\right) \,+\, \varepsilon_{\Psi,t}$$

where $\bar{\Psi}$ is the steady state trade demand level, and $0 \leq \rho_\Psi < 1$ and $\varepsilon_{\Psi,t} \sim N(0, \sigma_\Psi^2)$.

The marginal exporting firm will make zero profit, so for the cut-off firm with productivity denoted z_X, $\Pi_t^X(z_{X,t}) \;=\; 0$. By plugging in the prices set by the firm with cut-off productivity, $\rho_{X,t}(z_{X,t}) = \frac{\theta}{(\theta-1)} \frac{\tau\, w_t}{Q_t\, Z_t\, z_{X,t}} \left[(1-\zeta) + \zeta(1+r_t^{TF})\right]$ and the demand for the variety with cut-off productivity, $C_{X,t}(z_{X,t}) = \left[\frac{\rho_{X,t}(z_{X,t})}{\rho_{X,t}}\right]^{(-\theta)} C_{X,t}$ to Equation (11), we solve for $z_{X,t}$ and we obtain the zero export profit condition:

$$\frac{1-n}{n} \, N_{X,t}^{\frac{\theta}{1-\theta}} \; C_{X,t} \, \tau \, \left[(1-\zeta) + \zeta(1+r_t^{TF})\right] \;=\; f_X \, \tilde{z}_{X,t} \, \frac{k(\theta-1)}{k-(\theta-1)} \left[(1-\zeta) + \zeta(1+r_t^{TF})\right] \tag{14}$$

where

$$C_{X,t} = (N_{X,t})^{\theta/(\theta-1)} \widetilde{C}_{X,t} = \alpha_F^* \rho_{X,t}^{-\phi} \, C_t^* \tag{15}$$

3.4 Free Entry

Firms enter the market at time t and start their production at $t+1$, so some of these new entrants will die (with probability δ) before starting the production at the end of period t. The total number of firms at period t in home country will be equal to the new entrants and established firms who survived from the previous period:

$$N_{D,t} \;=\; (1-\delta)(N_{D,t-1} + N_{E,t-1}) \tag{16}$$

Households will decide to start a business by calculating the expected present discounted value of future profits which gives simply the post entry value:

$$\tilde{v}_t = \mathrm{E}_t \sum_{s=t+1}^{\infty} [\beta(1-\delta)]^{s-t} \left(\frac{C_{t+s}}{C_t}\right)^{-\gamma} \left(\frac{\chi_{t+s}}{\chi_t}\right) \widetilde{\Pi}_s \tag{17}$$

The free entry condition implies that, firms will enter until the average firm value is equal to the entry cost; $\tilde{v}_t = w_t f_E / Z_t$.

3.5 Budget Constraint

Households finance their expenditure through labour income and holdings of Home and Foreign bonds. In addition households buy the shares from a mutual fund and receive dividends in return, x_t. Households can trade these shares domestically. Each period that mutual fund pays the entry costs, collects the profits and distributes them to the owners of the shares. International asset markets are incomplete in the sense that households are able to trade only nominal bonds. We follow Benigno (2001) in modelling the incomplete asset market structure. Households in the Home country can hold two kinds of nominal bonds; one is issued by the Home country and denominated in units of the Home currency, and the other is a Foreign bond denominated in the Foreign currency. The bonds issued by the Home country are not traded internationally for simplicity. When Home households wish to borrow from abroad, they pay a premium on the Foreign interest rate which is increasing in the amount of Foreign debt they have. This premium, accumulated by Foreign intermediaries, is distributed among Foreign households. As discussed in Schmitt-Grohe and Uribe (2003), we thus avoid non-stationarity in the model, as the premium $\Theta(.)$ ensures a stationary distribution of wealth across countries.[19] In particular, we assume that $\Theta(.) = 1 - \nu(Q_t B_{F,t} - Q_t \bar{B}_F)$ where $\nu > 0$. The budget constraint in real terms is:

$$\begin{aligned} C_t + B_{H,t+1} + \tilde{v}_t(N_{D,t} + N_{E,t})x_{t+1} + \frac{Q_t B_{F,t+1}}{\Theta(Q_t B_{F,t+1})(1 + r^*_{t+1})} &= (1 + r_t)B_{H,t} + w_t L \\ + Q_t B_{Ft} + (\widetilde{\Pi}_t + \tilde{v}_t)N_{D,t}x_t & \end{aligned} \tag{18}$$

where $B_{H,t}$ and $B_{F,t}$ are Home and Foreign currency nominated bonds, $(1 + r_t)$ and $(1 + r^*_t)$ are the gross real interest rates on the Home and Foreign bonds, respectively.

Households make the intertemporal decision by maximising (2) subject to (18). This yields the following Euler equations for bonds and share holdings respectively and, combined with the analogous Foreign conditions, the uncovered interest parity (UIP) condition:

$$1 = \mathrm{E}_t \left[\beta \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} \left(\frac{\chi_{t+1}}{\chi_t} \right) (1 + r_{t+1}) \right] \tag{19}$$

$$\tilde{v}_t = \mathrm{E}_t \left[\beta(1 - \delta) \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} \left(\frac{\chi_{t+1}}{\chi_t} \right) (\tilde{v}_{t+1} + \widetilde{\Pi}_{t+1}) \right] \tag{20}$$

$$1 = \beta(1 + r^*_{t+1})\Theta(Q_t B_{F,t+1})\mathrm{E}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} \left(\frac{\chi_{t+1}}{\chi_t} \right) \frac{Q_{t+1}}{Q_t} \right] \tag{21}$$

Note that the presence of country-specific preference shocks imply that deviations from UIP may arise, in line with the empirical evidence.[20]

[19] In order to have a well-behaved steady state in the model, we impose the following restrictions on the cost function: $\Theta(.)$ is a differentiable decreasing function in the neighbourhood of steady state level of net foreign assets and when the net foreign assets are in the steady state level ($B_{F,t} = 0$), the cost function is equal to 1 ($\Theta(0) = 1$). See Benigno (2001) for a more detailed explanation.

[20] See, for instance, Lewis (1995).

3.6 Market Clearing

Aggregating across household budget constraints shows that revenue from production (labour income and profits) and bond holdings is invested in new firms as well as used for consumption of domestic and imported goods and bond purchases:

$$w_t L + N_{D,t}\widetilde{\Pi}_t = C_t + N_{E,t}\tilde{v}_t + CA_t$$

We define the current account as the change in claims on Foreign households, evaluated at the current exchange rate:

$$CA_t = \frac{Q_t B_{F,t}}{(1+r_t^*)\Theta(Q_t B_{F,t})} - Q_t B_{F,t-1} \tag{22}$$

The trade balance is defined as

$$TB_t \equiv \frac{1-n}{n} Q_t \rho_{X,t} C_{X,t} - \rho^*_{X,t} C^*_{X,t}$$

equivalently:

$$TB_t = \frac{1-n}{n} N_{X,t} Q_t \tilde{\rho}_{X,t} \widetilde{C}_{X,t} - N^*_{X,t} \tilde{\rho}^*_{X,t} \widetilde{C}^*_{X,t}$$

The current account and the trade balance are equal in every period.

3.7 Price indices

As explained in Ghironi and Melitz (2005), in our model, the aggregate consumer price index, P_t is affected by changes in the number of varieties consumed. To clarify this, we can rewrite Equation (4) to show that P_t is a function of the average price of domestically produced goods and imported goods and the number of varieties of each of those: $P_t = \left[\alpha_H \left(N_{D,t}^{\frac{1}{1-\theta}} \tilde{P}_{D,t}\right)^{1-\phi} + \alpha_F \left(\left(N^*_{X,t}\right)^{\frac{1}{1-\theta}} \tilde{P}^*_{X,t}\right)^{1-\phi}\right]^{\frac{1}{1-\phi}}$. Therefore in this setting, even if the prices of each product remains the same, aggregate price index will move with the changes in the number of varieties consumed.

This aggregate price index differs from that statistics offices would compute: the consumer price index (CPI) computed by statistical offices does not take into account fluctuations in the number of varieties available in an economy each period. We compute a price index, CPI_t which adjusts for the fluctuations in varieties and hence is closer to its data counterpart, by defining $P_t = \Upsilon CPI_t$ where $\Upsilon_t = \left[\alpha_H \left(N_{D,t}^{\frac{1}{1-\theta}}\right)^{1-\phi} + \alpha_F \left(\left(N^*_{X,t}\right)^{\frac{1}{1-\theta}}\right)^{1-\phi}\right]^{\frac{1}{1-\phi}}$.

In our analysis of the dynamic transmission of shocks, we always report price indices from the model that are consistent with those computed by statistical offices. This allows us to compare our model to the data on these price aggregates. We also use those when estimating the model to match data.

4 Model calibration and data

We calibrate the model to fit data for the UK and the Rest of the World (RoW) for the period 1995Q1-2018Q4.[21] For most parameter values, we use aggregate UK/RoW data to inform us or rely on previous literature. We first note these parameter values. We then turn to focus on the financial costs for exporters which constitutes an important departure of our model from the literature it builds on, and is crucial for understanding the effect of financial conditions for exporting activities. We estimate the average fraction of export costs required to be paid in advance, to calibrate ζ. We use UK firm-level data from two data sources in order to estimate this average fraction.

4.1 Model parameterization

We calibrate our model using data for a small open economy, the UK, and the RoW. We assume that the Home country is the UK, and the Foreign country represents the RoW. For data access reasons, we use data for the OECD to compute RoW statistics. The calibrated parameter values figure in Table 3.

We set $n = 0.05$ so that the UK represents 5% of the world economy and the RoW the remaining 95%, consistently with GDP data over the period considered.[22] We calibrate $\alpha_H, \alpha_F, \alpha_H^*, \alpha_F^*$ to ensure the steady state values of imports relative to consumption corresponds to the UK and OECD averages over the period considered. The share of imported goods relative to consumption in the UK was equal to 36%, while the share of imports from UK over total consumption was equal to 2% in the RoW.[23]

While the parameter values described above imply differences across countries, all other parameter values are assumed similar across countries. We fix the discount factor to 0.99 so that the steady state interest rate is 4% per annum. Consistently with the DSGE literature, we assume that the degree of risk aversion is equal to 2. We assume that the trade elasticity, ϕ, equals 1.5.

We follow Ghironi and Melitz (2005) in our choice of parameter values that are related to firm dynamics. We set the elasticity of substitution between differentiated goods to 3.8 which suggests that k is equal to 3.4. The probability of firm death is 2.5% per quarter. We normalise the lower bound of firm productivity as well as the fixed entry cost to 1. The fixed export cost parameter is 0.0085 while the per unit export cost parameter is 1.3.

Finally, we assume that the cost of intermediation in the international financial markets is 0.0025. This ensures a stationary distribution of wealth in the model.

[21] Both exports and imports exhibit significant fluctuations in 2019, possibly influenced by important Brexit deadlines during that year. Given that our focus is not Brexit, we stop the sample at the end of 2018.

[22] The UK has consistently represented around 5% of total OECD GDP over the period considered.

[23] Because the steady state value of imports in each economy depends on steady state prices and the steady state number of exporters in each economy, which are endogenous, we compute $\alpha_H, \alpha_F, \alpha_H^*, \alpha_F^*$ in a separate steady state file.

Table 3: Parameter Values

n	0.05	Relative country size
α_H, α_F	-	Set to ensure UK share of imported consumption = 0.36
α_H^*, α_F^*	-	Set to ensure RoW share of imported consumption = 0.02
β	0.99	Discount factor
γ	2	Degree of risk aversion
θ	3.8	Elasticity of substitution between goods
ϕ	1.5	Elasticity of substitution between Home and Foreign goods
δ	0.025	Probability of firm death
k	3.4	Dispersion of the productivity distribution
z_{min}	1	Lower productivity bound
f_E	1	Entry cost
f_X	0.0085	Fixed export cost
τ	1.3	Per unit export cost
ω	0.0025	Cost of international financial intermediation

4.2 Calibration of exporters' financial constraint

In our model, exporters face a financial constraint: only those firms who can pay the interests from financing a fraction ζ of their production costs (i.e. their labour costs, which includes labour costs related to variable and fixed export costs) up front and still make positive profits export. Compared to non-exporters, exporters take on (more) short term loans and their short term loans exceed non-exporters' short term loans by an amount that is related to their labour costs and equal to $\zeta\left[w_t l_{X,t}(\omega)\tau + \frac{f_X w_t}{Z_t}\right]$.

To calibrate the fraction ζ of costs that exporters must finance in advance, we consider the short term loans of the average exporting and non-exporting firms and their production costs. We note that our model implies a relationship between production costs on the one hand, and turnover on the other hand. As we have data on turnover for all firms in our sample but only details related to costs for a minority of firms, this observation helps us calibrate ζ.[24] In particular, our model implies that for the average exporting firm, $\tilde{w}_t = \tilde{\rho}_{X,t}\frac{(\theta-1)}{\theta}\frac{Q_t\, Z_t\, \tilde{z}_{x,t}}{\tau}\frac{1}{\left[(1-\zeta)+\zeta(1+r_t^{TF})\right]}$ and $\tilde{l}_{X,t} = \frac{\frac{1-n}{n}\tilde{C}_{X,t}}{Z_t\, \tilde{z}_{x,t}}$, such that $\tilde{w}_t\tilde{l}_{X,t}\tau = \frac{1}{\left[(1-\zeta)+\zeta(1+r_t^{TF})\right]}\frac{(\theta-1)}{\theta}\tilde{\rho}_{X,t}Q_t\frac{1-n}{n}\tilde{C}_{X,t}$. The average exporter thus takes on short term loans to cover $\frac{\zeta}{\left[(1-\zeta)+\zeta(1+r_t^{TF})\right]}\frac{(\theta-1)}{\theta}\tilde{\rho}_{X,t}Q_t\frac{1-n}{n}\tilde{C}_{X,t} + \zeta\frac{f_X w_t}{Z_t}$ where $\tilde{\rho}_{X,t}Q_t\frac{1-n}{n}\tilde{C}_{X,t}$ denotes the average exporter's overseas sales in the domestic currency. We can thus use information on the average exporting and non-exporting firm's short term loans and the average exporting firm's overseas turnover to compute a value for ζ, conditional on a certain parameter calibration.

Our strategy consists in using two datasets in order to investigate how the average exporting firm's financial conditions differ from the average non-exporting firm and thus compute ζ. We proceed in two

[24]Importantly, we only have detailed data on "Wages and salaries" for around 1/3 of our sample, and the firms that report these tend to be larger firms. Therefore, considering this data implies a sample which is heavily skewed towards larger firms and would not be representative of the population of UK firms.

steps: first, we investigate the characteristics of the average exporting and non-exporting firms using the UK's Office for National Statistics' (ONS) Annual Business Survey (ABS); second, we use the FAME dataset provided by the Bureau van Dijk (BvD) to consider the value of short term loans on the balance sheets of exporting and non-exporting firms with the characteristics identified in the first step. This two-step approach is necessary to ensure our calibration is consistent with that from a representative sample of UK firms.[25] Our model implies that the difference between the average exporter and non-exporter's short term loans is due to exporters having to cover a fraction of their costs. We can extract our model-implied costs, excluding the fixed export costs for which we unfortunately have no data, using export sales data in conjunction with our calibration of mark-ups and interest rates. This allows us to compute an estimate for the fraction of variable export costs that need to be covered by loans in order for firms to export, ζ.

4.2.1 Exporting and non-exporting firms in the ONS Annual Business Survey

The Office for National Statistics (ONS) conducts an annual survey of UK non-financial businesses which covers around two thirds of all UK businesses.[26] Every year, the ONS samples around 62,000 of those non-financial businesses and sends them a detailed Annual Business Survey (ABS) industry-specific questionnaire with questions about the economic activity of their enterprises (reporting unit) in the previous calendar year (January to December). All firms with more than 250 employees are sampled, while only some firms with less than 250 employees are sampled. The sampling is carried out using a stratified random sample design, where groups are defined by their employment size band, SIC 2007 code and their geographical region.[27]

The ONS provides firm-specific weights to estimate statistics for the entire population of non-financial businesses using the ABS sample. These weights correct for the fact that, as a result of the sample design, firms in some SIC 2007 divisions, employment bands and regions are less likely to be sampled than firms in other SIC 2007 divisions, employment bands or regions. They also correct for potential bias in the selected sample, by comparing to auxiliary data sources. More details can be found in Appendix C.

We focus our analysis on the data concerning firms operating principally in the manufacturing sector, which is Section C (including divisions 10-33) in the SIC 2007 classification system. We also concentrate on the final datasets for 2013-2015. Questions regarding exporting were not asked prior to 2011 so unfortunately we are not able to characterise exporters prior to then. Our focus on the period 2013-15 is due to this period being a relatively normal period for exporters: the financial crisis and euro area crisis were largely over, and the Brexit vote had not yet taken place. To give the reader an understanding of the sample of firms, consider the 2014 ABS sample of firms which consists of 6,447 manufacturing firms of which 5,990 firms responded to the question regarding exports of goods. These 5,990 firms constitute our dataset for 2014.

[25] Kalemli-Ozcan et al. (2015) point out that representativeness is important when using the Orbis database for European firms which has similar information to the FAME database we use for UK firms.

[26] These businesses are the non-financial businesses registered on the Inter-Departmental Business Register (IDBR) which lists all businesses registered for Value Added Tax with HM Revenue and Customs (HMRC), registered for a Pay as You Earn scheme with HMRC or registered with Companies House. Some very small businesses are excluded from the sampling frame. In particular, the self-employed, businesses without employees or with very low turnover not registered for VAT are excluded.

[27] Further details about the ABS can be found in the ABS Technical Report, available online at http://webarchive.nationalarchives.gov.uk/20160105160709/http:/www.ons.gov.uk/ons/guide-method/method-quality/specific/business-and-energy/annual-business-survey/quality-and-methods/abs-technical-report—june-2014.pdf.

The ABS data is well suited to investigate how employment and turnover characteristics of UK manufacturing firms which export differ from those that do not. The ABS questionnaire asks whether firms have exported any goods during the last year. We can thus group firms into exporting and non-exporting firms. Using the weights described in Appendix C, we find that 24.3% of UK manufacturing firms exported goods in 2014.[28]

Exporting and non-exporting firms differ in terms of their size as e.g. pointed out in Bernard and Jensen (1995) for US firms or Greenaway and Kneller (2004) for a sample of UK firms. In line with this evidence, we find that on average UK exporting firms have both a higher number of employees and a higher turnover than non-exporting firms, see Table 4 which shows the average numbers for 2013-15.[29]

Table 4: Employment and turnover of exporting and non-exporting firms, 2013-2015

	All firms	Exporters	Non-exporters
Average number of employees (weighted)	19	50	8
Average turnover (weighted, £1,000)	3,892	12,202	1,086
Number of observations	17,095	9,944	7,151

Source: ONS and own calculations.

4.2.2 Short term liabilities of exporting and non-exporting firms in the BvD FAME database

To investigate how the financial situation of the average exporting and non-exporting firms differ and how this relate to their turnover, we use the FAME dataset provided by the Bureau van Dijk (BvD) in conjunction with the information from the ABS. The FAME dataset provides accounting data on firms, and is described in more details in Section 2. Smaller firms are generally not required to report detailed balance sheet and profit and loss accounts, and therefore the FAME dataset's balance sheet information is skewed towards medium and larger firms. To avoid our analysis of the average exporting and non-exporting firm's financial situation being biased as a result of these differing filing requirements, we compare exporting and non-exporting firms that have similar characteristics to those found in the ABS dataset (which, when weighed, is representative of all UK manufacturing firms) for the average exporting and non-exporting firms figuring in Table 4.[30]

We consider BvD FAME data for 2013-2015, in line with our analysis of ABS data. Using data for 2013-2015 is also a sensible choice to get an estimate of average financial conditions for exporters given its

[28] The ABS questionnaire also asks the amount firms have gained from exporting services. Most of the manufacturing firms which export services also export goods and so the proportion of firms exporting goods and/or services is only slightly higher than that of firms exporting only goods, at 25.7%.

[29] These numbers do not change significantly over the time period 2013-2015.

[30] Our analysis of exporting and non-exporting firms thus differ from that by Greenaway et al. (2007) who study the financial health of a panel of UK exporting and non-exporting firms using the BvD FAME database without taking into account that their sample is skewed towards larger firms. Given our focus on the average exporting and non-exporting firms, this distinction is important.

distance from the financial and euro area crises which may have had implications for the extent of finance available to exporters. The Brexit vote which is also likely to have played a role for UK exporters took place mid-2016 leading us to exclude 2016 and afterwards. For 2014, the BvD FAME database includes 157,958 active UK manufacturing companies, i.e. primarily operating in SIC 2007 codes 10-32.[31] However, for the majority of those companies, the database doesn't provide information on economic activities or detailed balance sheet information. As in Section 2, we exclude from our sample all firms for which the database doesn't include any detail on employment levels, turnover and/or balance sheets. This leaves us with a sample of 1,612 exporting firms and 1,449 non-exporting firms in 2014.

As already pointed out, given these set of firms include less micro firms than a representative sample would, we limit our sample to ensure that the average employment and turnover of exporting and non-exporting firms are close to those of the average exporting and non-exporting firm in the ABS data. We do so by following these steps: First, we drop the firms which have a turnover furthest from the average turnover observed in the ABS data. In particular, we drop between 75% of the sample of firms in a manner to ensure that the average turnover of the remaining firms is as close as possible to that observed in the ABS data. Second, we then drop from our sample another 75% of exporting (non-exporting) firms, keeping the 25% with employment levels closest to the average exporting (non-exporting) firm according to the ABS data. We also report the results from only dropping 70% of firms and from dropping 80% of firms in each of those steps. In our benchmark case, where we drop 75% of firms in each of these steps, we are left with 303 exporting firms (101 for each of the years 2013-2015) and 277 non-exporting firms (between 84 and 92 firms for each year). These samples of exporting and non-exporting firms are relatively close to the average firm according to the ABS data, as shown in Table 5. The table also shows that restricting (enlarging) the sample we consider here by dropping 80% (70%) in each step, makes it more (less) in line with the ABS averages. In particular, it has implications for the average of non-exporting firms: the more (less) firms we drop the smaller (larger) non-exporting firms become on average.

We can now investigate short term liabilities in the selected representative sample of exporting and non-exporting firms. We use balance sheet data for firms on current liabilities which include all debts which are to be repaid within the next 12 months, such as trade credit and bank loans and overdrafts, as in Section 2. In line with what our model would predict, the average exporting firm has higher short term liabilities than non-exporting firms. In particular, in our benchmark sample where we exclude 75% of firms in each of the steps resulting in a sample of firms that are reasonably similar to the average exporting firm as identified in the ABS data, exporting firms have £2,436,000 more in short term liabilities than the average non-exporting firm.

4.2.3 Calibration of financial export constraint

The observed differences between average exporting and non-exporting firms' short term liabilities helps us calibrate a value for ζ. We go back to our model implication that the average exporter takes on short term loans to cover a fraction of production costs which need to be paid up front: $\frac{\zeta_t}{\left[(1-\zeta_t)+\zeta_t(1+r_t^{TF})\right]}\frac{(\theta-1)}{\theta}\tilde{\rho}_{X,t}Q_t\frac{1-n}{n}\tilde{C}_{X,t}$

[31] In line with suggestions by Kalemli-Ozcan et al. (2015), we restrict our sample to firms with unconsolidated accounts (i.e. accounts for individual entities not parent companies), and check that all entries in our dataset refer to a unique firm implying that no firm has duplicate accounts.

Table 5: Summary statistics of selected exporting and non-exporting firms in BvD FAME - 2013-2015

	Exporters (75%)	Non-exporters (75%)	Exporters (80%)	Non-exporters (80%)	Exporters (70%)	Non-exporters (70%)	Exporters (ABS)	Non-exporters exporters (ABS)
Average employment	49.6	11.2	49.8	8.0	49.7	18.6	50	8
Average turnover (1,000£)	11,764	1,785	11,899	1,267	11,688	3,080	12,202	1,086
Average short term liabilities (1,000£)	3,070	634	3,159	529	2,991	1,007	-	-
Number of observations	303	277	194	171	437	384	9,944	7,151
ζ estimate	0.49		0.49		0.43		-	

Source: Bureau Van Dijk, ONS and own calculations. The first two columns show the summary statistics when we exclude the 75% of exporting and non-exporting firms furthest from exporting and non-exporting firms' average turnover and employment in the ABS data in each of the steps; columns 3-4 (5-6) show the summary statistics when 80% (75%) of firms are excluded in each step.

where $\tilde{\rho}_{X,t} Q_t \frac{1-n}{n} \tilde{C}_{X,t}$ denote the average exporter's overseas sales in the domestic currency.[32] Using $\theta = 3.8$ and $r^{TF} = (1/\beta)^4 - 1 = 0.04$, we can compute ζ for each of the years 2013-2015.

The results in our benchmark case for the years 2013-2015 range from 0.47 to 0.50, with an average of 0.49, as reported in Table 5. The table shows that the results are robust to restricting the sample further such as to ensure that the sample of non-exporting firms is more representative, but that increasing the sample reducing the representativeness of non-exporting firms reduces the gap between exporters and non-exporters' short term liabilities and thus reduces the estimated ζ. The results point to a value for ζ close to 50%, meaning that exporters need to finance around 50% of their production costs in advance. This is the calibration of zeta that we use in the remaining sections.

5 Impulse responses

In our model, UK export dynamics are determined by their response to UK productivity shocks, UK and RoW preference shocks, global shocks to the demand for traded goods, global shocks to the financial costs of exporting, and a shock to the preference (home bias) of RoW for UK exports. A combination of these shocks is likely to drive UK export dynamics over the period we consider and so we focus on these shocks.

To understand each of those shocks' effects on UK exports, and to understand how they differ from one another, we here present the impulse responses following the two supply shocks (the UK specific productivity shock and the global financial shock to exporting) and the two export demand shocks (to global trade de-

[32] Note that due to data on fixed costs of exporting not being available, we are limited to ignore these in our calibration of ζ.

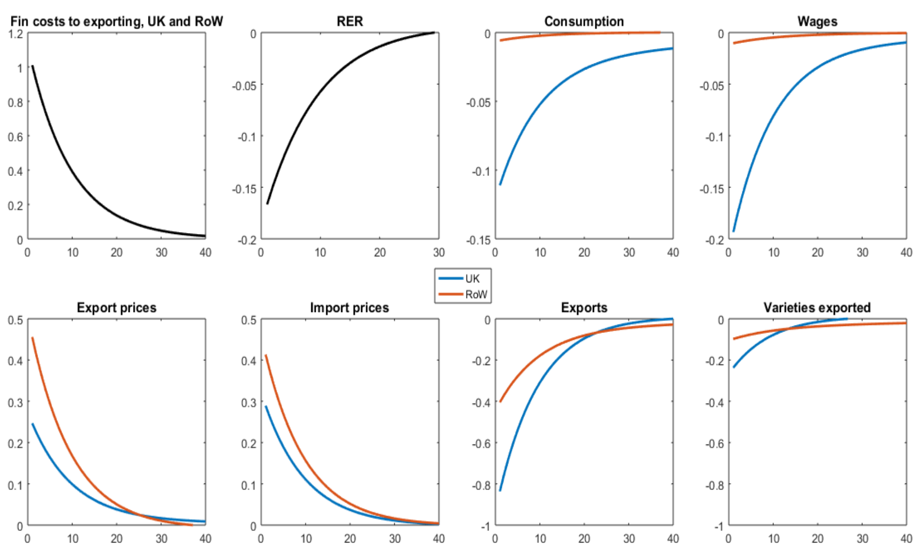
mand and to RoW preference for UK goods (home bias)).[33] The shock to the home bias of RoW is modelled so as to ensure that the shift in α_H^* is mirrored in α_F^*, implying that the shock is a shift in preferences between imported and domestic goods (and not an increase in overall demand). This shock also follows an AR(1) process, similarly to the other shocks in our model.

The impulse responses following each of those shocks help understand how they transmit through the UK and the RoW in our model, and how they affect UK exports. The impulse responses also help shed light on the differences in transmission and thus how the shocks can be identified separately by our estimation technique which we present in the next section.

5.1 Shock to financial costs to exporting

Our focus is on understanding UK export dynamics and the role of financial costs for exporting. Therefore, we first consider the effect of a global increase in financial costs to exporting, r_t^{TF}. A global increase in the financial costs to exporting increases the marginal costs of exporting thus raising export prices in both the UK and the RoW. Because of the difference in size between the export markets faced by the UK and the RoW, the impact on each of those economies will be quantitatively different, see Figure 1.

Figure 1: Effects of increase in global financial costs to exporting



Note: This figure depicts the percentage deviation from steady state of selected variables, over the first 40 quarters following a shock to the global financial costs to exporting corresponding to a one percentage point increase.

The increase in the marginal cost of traded goods affects the UK disproportionately as a larger share of its consumption is composed of traded goods. These goods now all have a higher price, pushing up the

[33] We do not report the impulse responses following preference shocks here, as these are standard and only have limited impact on UK exports.

relative price of consumption in the UK relative to the RoW. This is reflected in the appreciation of the real exchange rate. Accordingly, consumption in the UK falls more than consumption in the RoW, and wages likewise fall more in the UK. As a result of the differential impact on wages, export prices increase less in the UK than in the RoW.

However, the prices that matter for export demand are export prices in foreign currency relative to the foreign consumer price index, i.e foreign import prices relative to foreign consumer prices. And, as a result of the RER appreciation, these relative import prices increase more for the RoW than for the UK. Substitution away from imports will thus be higher in the RoW, and therefore demand for imports to the RoW (UK exports) falls further than the demand for imports to the UK from the RoW (RoW exports). In other words, exports fall most in the small open economy, UK. The number of exported varieties also falls.

To sum up, focusing on the variables that will help identify each of the shocks we consider (and which are detailed in the next section), a global financial shock leads to a fall in both exports and imports, with the UK being more affected than the RoW. Both export and import prices rise and consumption falls in both the UK and the RoW.

5.2 Shock to UK productivity

Next we consider the effect of a UK-specific productivity shock to Z_t. Productivity shocks are the main source of business cycle fluctuations considered within similar models, and Ghironi and Melitz (2005) and Ghironi and Melitz (2007) consider the effects in detail.[34]

A fall in UK productivity leads to a drop in UK consumption and wages, as shown in Figure 2. However, as productivity falls prices increase, including export prices. As a result the terms of trade improves and exports fall. The extensive margin of exports, captured by the number of varieties exported, falls in line with the fall in aggregate exports. The UK-specific productivity shock spills over to the RoW mainly through its effects on the terms of trade: RoW exports increase, but this has little impact on RoW consumption and wages given the small size of the UK.

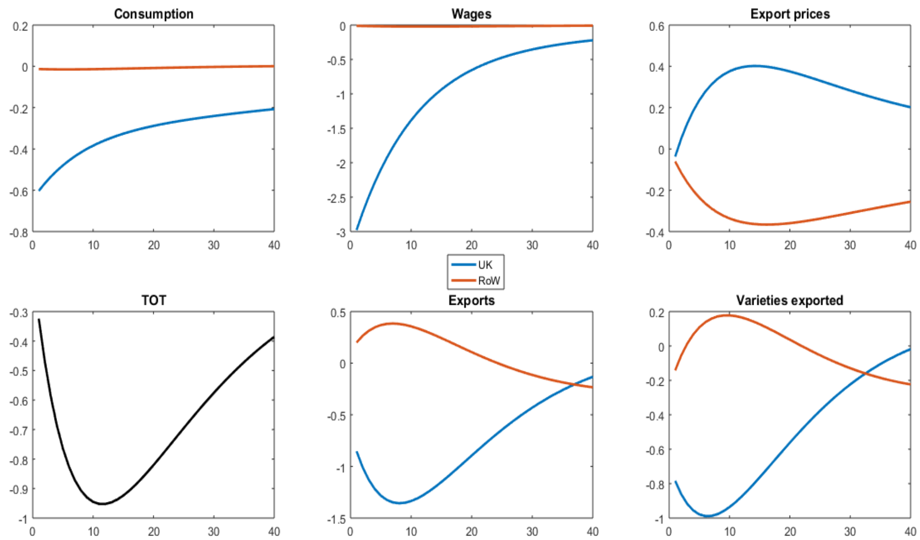
To sum up, following a negative UK-specific productivity shock, UK exports fall while imports increase. Export prices rise and import prices fall (i.e. the TOT improves). UK consumption falls, but RoW consumption is barely affected by the shock.

5.3 Demand shocks to UK exports

We here consider the effects of two shocks to the demand for UK exports: a global trade demand shock, Ψ_t and a shock to RoW households' preferences (home bias) which reallocates demand towards/away from imports in the RoW. Figure 3 shows the dynamic transmission of the global trade demand shock on the top panel and the home bias shock in the bottom panel. These shocks both hit the demand for UK exported goods, but they transmit through the UK in different ways.

[34]Several other papers building on that framework have also focused on productivity shocks, e.g. Fattal Jaef and Lopez (2014) and Liao and Santacreu (2015).

Figure 2: Effects of fall in UK productivity



Note: This figure depicts the percentage deviation from steady state of selected variables, over the first 40 quarters following a shock to UK productivity.

In particular, a negative shock to UK exports caused by a global trade demand shock will have similar effects on the UK and the RoW trade, and thus very little impact on the terms of trade, while a similar negative shock to UK exports caused by a home bias shock will impact the UK economy much more leading to a larger fall in UK export prices and thus an increase in the terms of trade.

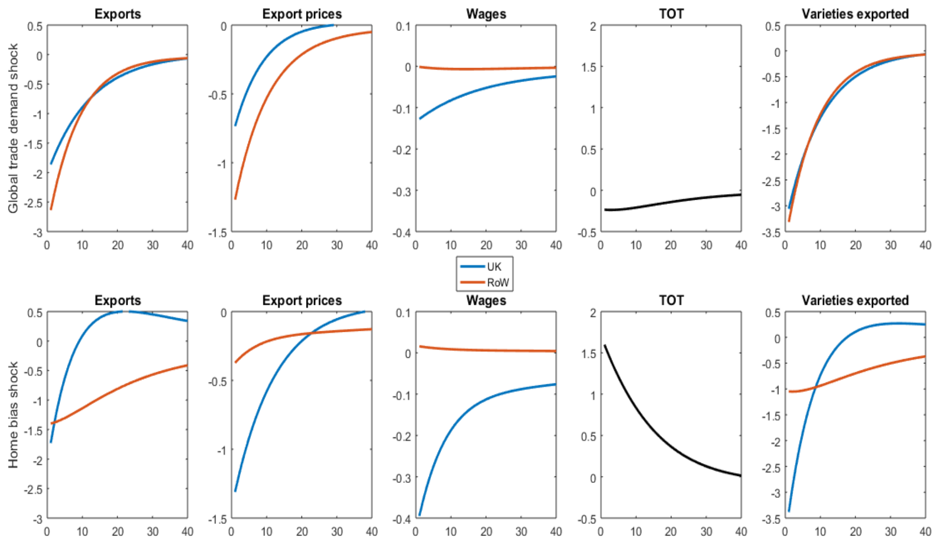
As a result of trade being an important part of the UK economy, but less so for the RoW, UK wages and consumption react much more to the shocks than the same RoW variables.

Finally, it is noteworthy that both these demand shocks lead to large falls in the extensive margin of exports relative to the fall in aggregate exports.

To sum up, these shocks to trade lead to a fall in both UK exports and imports and a fall in UK export prices. They differ in that the global trade demand shock leads leads to a small improvement in the terms of trade while the home bias shock leads to a sizeable deterioration in the terms of trade.

Table 6 shows that the shocks we consider are clearly different in terms of their qualitative effects on the variables we use to identify them in our estimation. This should give us confidence that we can identify them separately. The variables used for estimation, as well as our estimation technique, are detailed in the next sections.

Figure 3: Effects of a fall in export demand



Note: This figure depicts the percentage deviation from steady state of selected variables, over the first 40 quarters following shocks to export demand.

Table 6: Effect of shocks on selected variables

	Shocks UK productivity	UK preference	RoW preference	Global financial	Global trade	Row Home bias
UK exports	-	-	-	-	-	-
UK imports	+	+	+	-	-	-
UK export prices	+	+	-	+	-	-
UK TOT	-	+	+	+	0(-)	+
UK consumption	-	+	+	-	+	-
RoW consumption	0(-)	0(-)	-	-	+	+

Note: A "+" ("-") denotes a positive (negative) response of the variable on the left hand side to the shock described above.

6 Estimation

We are interested in understanding the role played by changes to exporters' financial conditions in the fall in exports following the Global Financial Crisis. We therefore focus on estimating the importance of shocks to the financial costs to exporting relative to other shocks that are likely to affect UK exports, either through demand or supply channels. The resulting historical shock decomposition helps identify the role played by financial costs to exporting in driving the fall in UK exports after the GFC.

There are six structural shocks in the model: a UK productivity shock, UK and RoW preference shocks, a global export demand shock, a global trade finance shock and a shock to preferences for UK exports. We estimate each of the six shocks' variance and persistence by using Bayesian methods. We obtain posterior distributions by running two parallel chains of 700000 replications of the Metropolis-Hastings algorithm and we discard half of the draws. Estimating the variance and persistence parameters associated with each shock allows us to understand which shocks matter most for UK exports dynamics; the role of supply and demand shocks; and the particular role of each shock in explaining export dynamics during the Great Trade Collapse.

6.1 Data and Observables

In our estimations, we use data for the UK and the RoW (OECD total) for the sample period from 1995:Q1 to 2018:Q4.

To match the number of shocks, we use six data series to inform the estimations. We use UK goods exports and imports, UK and OECD consumption, UK export prices (relative to the consumption deflator), as well as the terms of trade defined as the UK imports prices over exports prices. We HP-filter all the series to obtain fluctuations over the business cycle.[35] We list the source of our data in Appendix D and plot them in Figure A1. We allow for measurement errors to exports, imports, exports prices and the terms of trade.

We define data consistent measures of observables for a one-to-one mapping between our model and the data. For instance, take consumption: we first define a new variable that is deflated by the data consistent CPI:

$$C_{obs,t} = \Upsilon_t C_t$$

As observed series are logged and HP-filtered, we then define:

$$c^{UK}_{obs,t} = log(C_{obs,t}) - log(\overline{C_{obs}})$$

where $\overline{C_{obs}}$ is the steady state value of data consistent Home consumption. $c^{UK}_{obs,t}$ maps to the observed UK consumption series.

6.2 Priors

Table 7 summarizes the priors that we use to estimate the persistence and the variance of shocks. We choose relatively loose priors. We set the prior mean of the persistence of shocks to 0.5 with a standard deviation of 0.15. As the persistence varies between 0 and 1, we use a beta distribution for these parameters. The standard deviation of the shocks and measurement errors have an inverse gamma distribution with a prior mean that is equal to 0.01 and a standard deviation that is infinity.

6.3 Estimation Results

Table 8 presents the results from the estimation of the shock processes. We report the mode, the mean and the 10th and 90th percentiles of the posterior distribution. In Appendix E, Figure A2, we plot the density

[35] Since our data is at quarterly frequency, we set the smoothing parameter of the HP-filter to 1600.

Table 7: Priors

Description	Distribution	Mean	Standard Deviation
Ar(1) coefficients of shocks	Beta	0.5	0.15
Standard deviation of shocks	Inv. Gamma	0.01	infinity

of the prior and posterior distributions along with the posterior mode graphically.

The estimated persistence of all shocks is around 0.7 and 0.8 consistent with the calibrations of shock processes in the literature with one exception; we find that the persistence of the UK productivity shock is equal to 0.4 which is lower than the rest of the shocks. Since in the model productivity is endogenous, this helps generate persistence endogenously and might explain the relatively low estimated value of the AR(1) coefficient of the TFP shock. The standard deviation of shocks are also within reasonable range. Even though we allow measurement errors to be as large as the variance of the structural shocks, measurement errors are estimated to have much lower standard deviations. This might signal that our model does relatively well in explaining the dynamics of the observed variables.

Table 8: Posterior Distributions

Parameter	Description	Posterior distribution			
		Mode	Mean	10%	90%
ρ_χ	preference shock – UK	0.73	0.72	0.62	0.82
ρ_χ^*	preference shock – RoW	0.83	0.83	0.77	0.89
ρ_Z	productivity shock – UK	0.43	0.42	0.23	0.60
ρ_{rTF}	trade finance shock – Global	0.83	0.82	0.76	0.90
ρ_α^*	demand shifter – RoW	0.76	0.75	0.65	0.83
ρ_Ψ	trade demand shock – Global	0.75	0.74	0.65	0.83
ε_χ	preference shock – UK	0.015	0.015	0.013	0.017
ε_χ^*	preference shock – RoW	0.007	0.007	0.006	0.008
ε_Z	productivity shock – UK	0.064	0.065	0.047	0.084
ε_{rTF}	trade finance shock – Global	0.024	0.024	0.021	0.029
ε_α^*	demand shifter – RoW	0.021	0.021	0.017	0.025
ε_Ψ	trade demand shock – Global	0.021	0.022	0.018	0.025
ε_{ME_X}	measurement error – exports	0.017	0.017	0.012	0.022
ε_{ME_M}	measurement error – imports	0.009	0.009	0.006	0.014
$\varepsilon_{ME_{PX}}$	measurement error – exports prices	0.005	0.006	0.003	0.008
$\varepsilon_{ME_{ToT}}$	measurement error – tot	0.003	0.003	0.002	0.004

7 Results

7.1 Variance Decomposition

We first start by presenting the variance decomposition resulting from our estimation. The variance decomposition shows which shocks are the main drivers of fluctuations in the UK economy.

Table 9 presents the variance decomposition of UK exports, imports, number of varieties exported, consumption, terms of trade and the export prices as well as the RoW consumption. The productivity shock (ε_Z) is an important driver of domestic variables as expected. It explains around 35% of the fluctuations in exports and consumption and 26% of the price of exports. It is the main driving source of terms of trade fluctuations, as it explains 72% of its variance.

The UK preference shock (ε_χ) explains 42% of the variability in consumption but its' importance for other variables is minimal. Similarly the RoW preference shock (ε_χ^*) drives RoW consumption but has almost no impact on UK and trade-related variables.

Turning to the importance of financial costs to exporting, we find that shocks to these ($\varepsilon_{r^{TF}}$), summarising financial conditions for exporting, to be the main drivers of exports and imports dynamics. Over the sample period considered, financial conditions to exporting explain around 35% of UK export dynamics. Combined with the UK productivity shock, those two supply shocks explain more than 2/3 of exports fluctuations.

Demand shocks to exports, whether global (ε_Ψ) or focussed on UK exports (ε_α), are only responsible for around 20% of the variance of exports. These demand shocks seem to be more important for imports explaining around 40% of its variability. Number of exported varieties which captures the extensive margin of exports, on the other hand, is mainly driven by demand shocks to exports: these explain around 80% of the fluctuations in the extensive margin of exports.

Table 9: Variance decomposition (in percentages)

Vbl. Name	ε_Z	ε_χ	ε_χ^*	$\varepsilon_{r^{TF}}$	ε_Ψ	ε_α^*	ε_{ME_X}	ε_{ME_M}	$\varepsilon_{ME_{PX}}$	$\varepsilon_{ME_{ToT}}$
Exports	33.5	0.1	0.6	35	15.6	7.6	7.5	0	0	0
Imports	4.09	3.84	0.18	44.5	36.5	4.26	0	6.7	0	0
Number of varieties exported	14.4	0.24	1.64	4.79	48.1	30.9	0	0	0	0
UK Consumption	36.3	42.3	0.5	13.3	3.5	4.1	0	0	0	0
RoW Consumption	0.34	0.02	98.9	0.23	0.16	0.28	0	0	0	0
ToT	71.7	2.4	0.8	0.6	1.6	21.7	0	0	0	1.4
Export Prices	26.3	0.7	1.0	29.1	12.8	22.5	0	0	7.6	0

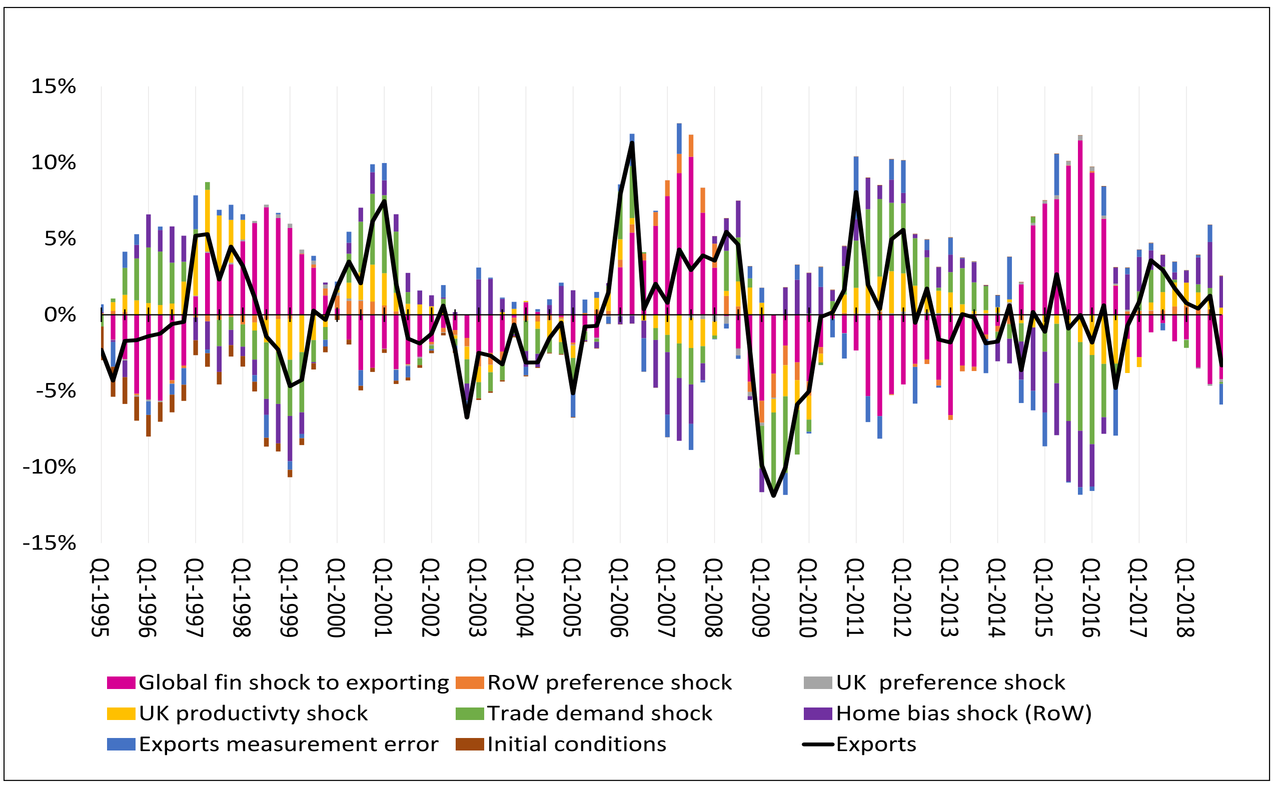
Note: We report the mean variance decomposition obtained from our estimation.

We conclude that over the business cycle, export fluctuations are mainly driven by supply shocks, with changes to the financial costs to exporting playing a very important role. We next focus on the great financial crisis period and dig deeper into the importance of financial conditions for UK exporters during this period.

7.2 Shock Decomposition Analysis: Exports

We use the historical shock decomposition to understand the driving sources of UK exports in the period after the GFC. Figure 4 shows the shock decomposition of UK exports that we obtain from our estimation. Each coloured bar corresponds to the contribution of a shock to the deviations of exports from its trend and the black line is the exports data. As can be seen, UK exports fell by around 12% with respect to its trend in 2009:Q2. That is a 17% fall from its peak value in 2008:Q2.

Figure 4: Exports – Shock Decomposition



Note: The black line depicts the logged and HP-filtered quarterly UK exports data.

The figure shows that, during this period, the global shock to the financial costs of exporting, shown by the pink bars, contributed to the fall in UK exports. During the first quarters of the collapse in exports, it is the main driver. In our model, the shock to the financial conditions for exporting at the start of the GFC corresponds to an increase in the annual interest rate faced by exporters of around 8 percentage points.

A fall in productivity (in yellow) subsequently becomes an important driver alongside a global fall in demand for traded goods (in green). The negative shock to financial conditions for exporting continues to pull down on UK exports for the years following the GFC, even as the effect of other shocks subside.

We conclude that financial conditions for exporting has played an important role in UK export dynamics over the last decades, and is crucial in explaining the initial period of the great trade collapse. Our results prove the importance of financial stability for the UK's export performance.

7.3 Extensive Margin of Trade

Our model can help shed light on the transmission of shocks to exports because it allows us to consider separately the extensive and intensive margins of trade. In particular, we can explore whether the main drivers of the number of exported varieties are similar to those driving aggregate export dynamics. We can also consider our model's implications for the extensive margin of exports during the GTC so as to understand the channel behind the collapse in exports after the GFC better, and compare to the data we have on this.

We start by looking at the UK's extensive margin of exports in the data. Figure 5a shows that the net extensive margin of UK exports, as proxied by the average number of varieties exported in each 4-digit industry, varies over the business cycle. The fall in the average number of varieties exported during the great trade collapse was around 10%, in line with the fall in UK exports over that period. This was by far the largest fall in the extensive margin during the period we consider.

Our variance decomposition shows that while aggregate exports are driven mainly by the financial shock and the productivity shock (i.e. supply shocks), the number of exported varieties is explained mainly by export demand shocks during the period considered in our estimation (see, Table 9). This implies that while supply shocks matter more for aggregate fluctuations in exports, the extensive margin is mainly driven by demand shocks.

This pattern also holds true during the GTC. Figure 5b shows our model's prediction of the extensive margin proxied by N_X, the number of varieties exported, and its drivers during the GFC based on our estimation. The coloured bars represent the contribution of each shock. The black line demonstrates the smoothed value of N_X given that we do not use data for the extensive margin as an observable for our estimation. Our model predicts roughly a 12% fall in number of exported varieties in 2009:Q2 from its trend which is similar to the magnitude seen in the data. This fall is mainly driven by the global shock to trade demand, alongside other demand shocks - the supply shocks that mainly drove aggregate exports do not play the same role in driving the extensive margin of exports.

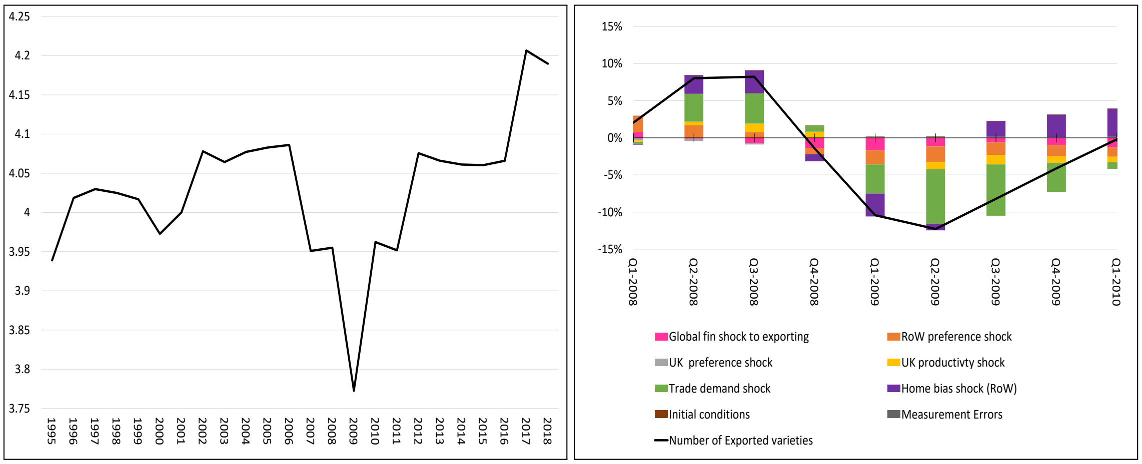
7.4 What does the estimated global shock to financial conditions capture?

In order to understand whether the estimated series of financial cost shocks to exporting are indeed capturing tightness in financial conditions, we compare the smoothed value obtained from our estimation of

Figure 5: Extensive Margin of Trade

(a) Average Number of Varieties Exported

(b) Number of Varieties Exported – Shock Decomposition



Note: Panel (a) displays the average number of varieties exported within a 4 digit industry. We use the data from UN Comtrade for UK exports. Data is at annual frequency. We treat 4-digit categories as goods and 6-digit categories as varieties.

r^{TF} with two key financial conditions indices.[36] Firstly, we utilize UK corporate credit spread data from "A Millennium of Macroeconomic Data" which stops at the end of 2016. Second, we consider the global financial cycle estimated by Miranda-Agrippino and Rey (2020). For ease of comparison across series, we adjust the global factor such that it increases in recession periods. We also rescale it to have it on the same scale as our estimated series. The three series are depicted in Figure 6. We are interested in the overall correlation between the three series.

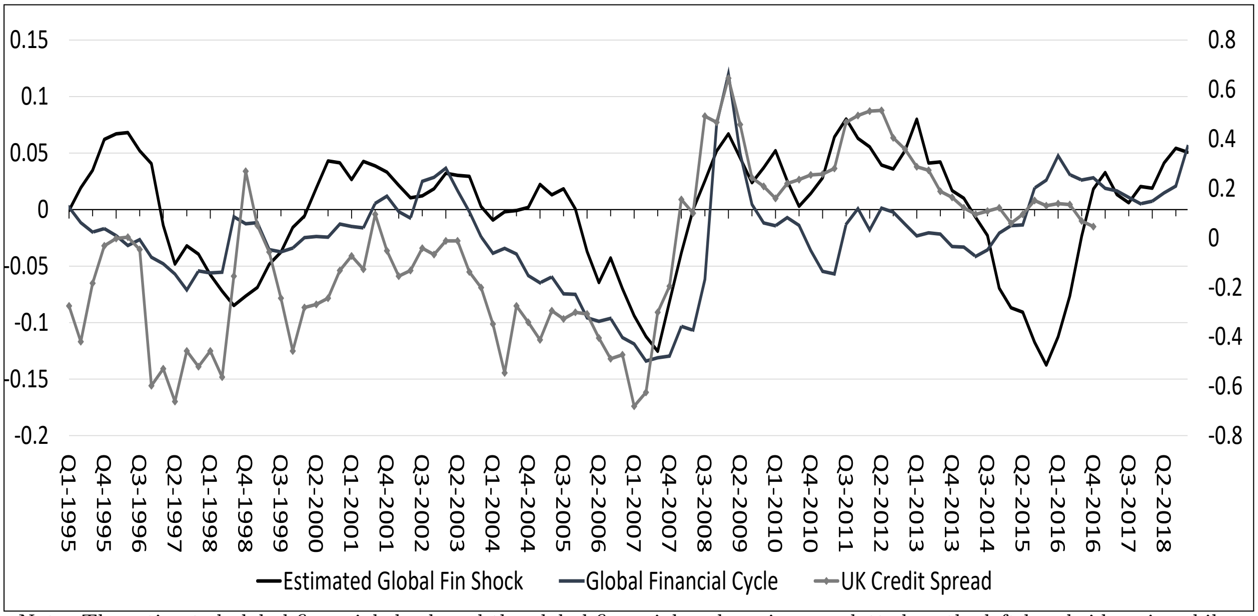
Although our estimated series does not exhibit perfect co-movement with the global financial cycle or the credit spread data, it is often picking up changes in one measure or the other. Moreover, our model predicts a comparable increase in financial costs during the GFC. This provides some reassurance that the model identification of shocks to the financial costs for exporting helps pick up some of the factors likely to affect these financial costs.[37]

We also examine whether our estimated shocks not only capture changes in financial conditions but are also affected by the fluctuations in trade costs, specifically temporary increases in transportation costs. In Figure 7, we display the Baltic Exchange Dry Index, which measures global shipping costs for goods. The index shows a notable spike in 2007. However, by early 2008, shipping costs return to normal levels, while exports collapse and the variable r^{TF} goes up. Generally, it seems that our measure of global financial shocks to exporting is not significantly influenced by overall changes in shipping costs.

[36] These estimates of r_t^{TF} differ from the contribution to exports of shocks to the global financial costs to exporting depicted in Figure 4 because of the delays with which export dynamics are affected by the shocks and because the effect of these on exports accumulate.

[37] Our estimated series of r_t^{TF} notably differs from the two other series in the period 2014-2015. One possible explanation for this relates to the appreciation of the pound over that period, likely easing financial conditions for UK exporters.

Figure 6: Global Financial Shock



Note: The estimated global financial shock and the global financial cycle series are plotted on the left-hand side axis, while the UK credit spread is plotted on the right-hand side axis. The UK corporate credit spread data is sourced from "A Millennium of Macroeconomic Data". We apply logarithms and de-mean the series. The global financial cycle series is obtained from Miranda-Agrippino and Rey (2020), and we convert it to quarterly data by taking three-month averages and scaling it to match the units of our estimated shock series.

7.5 Robustness

We now investigate the sensitivity of the findings we reported so far to alternative modelling assumptions and estimation strategy. For the sake of brevity, we only discuss the findings and report the shock decomposition of exports from each exercise in Appendix E.

Endogenous labour

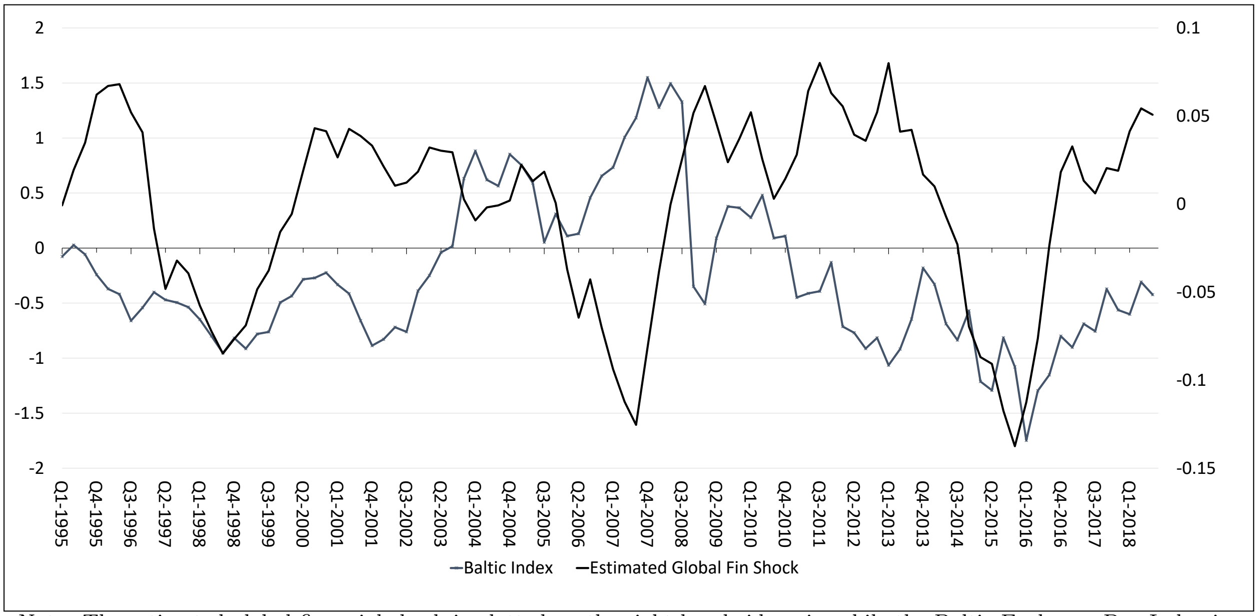
We first start by extending our model by endogenising the labour decision. In this set-up, in addition to receiving utility from consumption, households receive disutility from supplying labour. We assume that the utility is separable between consumption and leisure and has the following constant relative risk aversion functional form:

$$U_t = \mathrm{E}_t \sum_{t=0}^{\infty} \beta_t \, \chi_t \left[\frac{C_t^{1-\gamma} - 1}{1-\gamma} - \kappa \, \frac{L_t^{1+\eta}}{1+\eta} \right] \tag{23}$$

where κ is the weight of leisure in utility and η is the inverse of the Frisch elasticity of labour supply. We assume that η is equal to 2 and solve for κ such that the steady state value of labour is equal to 1.

We estimate our model following the procedure explained in Section 6 and check whether allowing for

Figure 7: Baltic Exchange Dry Index



Note: The estimated global financial shock is plotted on the right-hand side axis, while the Baltic Exchange Dry Index is plotted on the left-hand side axis. Data is taken from Refinitiv-Eikon. We convert it to quarterly data by taking three-month averages then we apply logarithms and de-mean the series.

fluctuations in labour change the predictions of our model. We find that the shock decomposition of UK exports does not change due to inclusion of labour decisions to our model. In fact Figure A3 in Appendix E shows that the shock decomposition with endogenous labour is virtually identical to the one obtained in our benchmark analysis.

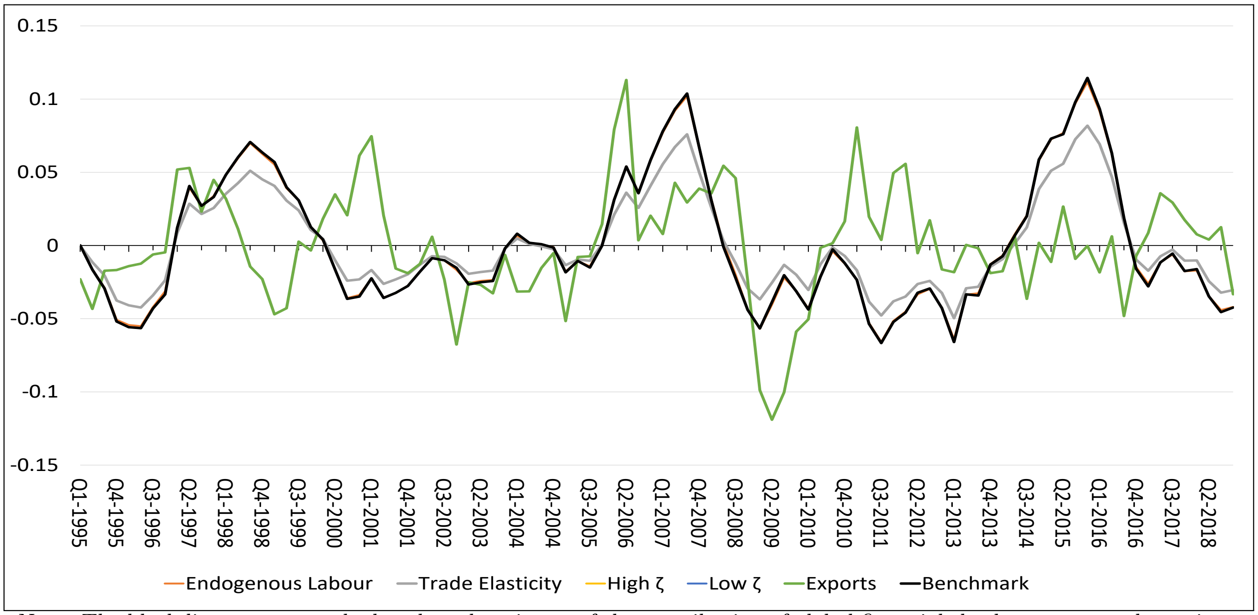
Average fraction of exporting costs paid in advance

In our model a fraction ζ of exporting costs must be paid in advance, and we calibrate ζ to 50% using micro evidence. However, our calibration might not capture the true average fraction of costs that needs to be paid in advance as we do not have data on fixed costs of exporting. To check the importance of the calibration of ζ, we perform two additional robustness exercises. First, we set ζ equal to 0.3 and then equal to 0.7. We find that if, exporters pay 30% or 70% of their exporting costs in advance using short term loans instead of 50%, the drivers of exports do not change, see Figures A4 and A5 in Appendix E. What changes is the size of the financial shock required to match the data.

Trade Elasticity

Following Backus et al. (1992) we set the elasticity of substitution between Home and Foreign goods, ϕ to 1.5. However, there is a large uncertainty around the true value of the trade elasticity. To check the sensitivity of our results to the value of ϕ, we repeat our estimation by setting it to 0.85 following Corsetti et al. (2008). Although the relative importance of UK productivity shocks seem to increase for export dynamics,

Figure 8: Robustness – Contribution of shock to financial costs of exporting to exports



Note: The black line represents the benchmark estimate of the contribution of global financial shocks to exports dynamics. The orange line shows the contribution of the estimated global financial shock when labour is considered endogenous. The yellow and blue lines correspond to the contribution of the estimated global financial shock with high and low values of ζ (the fraction of exporting costs that must be paid in advance), respectively. The grey line represents the contribution of the estimated global financial shock with a low trade elasticity ($\phi = 0.85$). The green line illustrates UK export data. The orange, yellow, and blue lines are not visible, as the contribution of estimated global financial shocks in these exercises are nearly identical to the benchmark.

our overall conclusions remains with an elasticity smaller than 1 (see Figure A6 in Appendix E).

To summarise the findings, we show in Figure 8 the contribution of the shock to the financial costs of exporting obtained from each robustness exercise in driving exports fluctuations. It is evident that all exercises predict an identical role for this global financial shock, with the exception of very small quantitative differences observed under the low trade elasticity exercise. All in all, we conclude that the role we find for financial conditions in driving UK export dynamics seems to be robust to changes to some of the main assumptions and modelling choices we've made.

8 Conclusion

Using firm level data on UK manufacturing firms, we show that exporting firms require more short term loans than non-exporting firms, and that these are related to their labour costs. Informed by these stylized facts, we set up a model in which exporters face variable and fixed trade costs as well as financial costs to exporting. We thus capture the presence of financial constraints to exporting, in line with a recent body of literature on trade finance, and consistently with our own findings. We calibrate and estimate the model using data for the UK and the RoW. We focus our study on understanding the role played by financial conditions, as proxied by changes to the financial costs of exporting, in export dynamics over the business cycle, and in the specific period of the GTC.

Our estimations uncover a crucial role for financial costs for exporting: they are the main driver of export dynamics, explaining more than 1/3 of UK export dynamics over the period 1995-2018. UK-specific productivity shocks also play a similarly important role in export dynamics over this period, indicating the importance of supply shocks for UK export dynamics.

In line with previous literature focusing on the causes of the GTC, we also find an important role for financial conditions in the fall in UK exports, especially in the early stages of the GTC. In the later stages, negative demand shocks to global trade and UK-specific productivity shocks also play important roles. However, once these forces subsided, our model indicate that global financial conditions for exporting contributed to the slow recovery in UK exports.

This paper uncovers a role for financial conditions for exporting, and shows its importance in driving UK export dynamics. To the extent that policy makers are able to affect these conditions, it may be beneficial to do so in some circumstances, so as to stabilise exports and output.

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Appendices

Appendix A Robustness - Motivational Evidence

Table 10: Regression results - with Total Assets

1995-2019 Dep. var: $STL_{i,t}$	**(1)**	**(2)**	**(3)**	**(4)**
Total Assets	0.2012***	0.2012***	0.2300***	0.2299***
	(0.0607)	(0.0607)	(0.0592)	(0.0593)
Total Assets x Export status	-0.0853***	-0.0853***	-0.0753***	-0.0753***
	(0.0283)	(0.0283)	(0.0242)	(0.0242)
Remuneration	0.8078	0.8096		
	(0.5389)	(0.5396)		
Remuneration x Export status	0.5403*	0.5412*		
	(0.3087)	(0.3091)		
No of employees			15.4602*	15.4700*
			(9.0344)	(9.0459)
No employees x Export status			20.5044*	20.4878*
			(10.7520)	(10.7321)
Time fixed effects	NO	YES	NO	YES
Firm fixed effects	YES	YES	YES	YES
No of obs.	78,121	78,121	78,121	78,121
R^2	0.9552	0.9513	0.9442	0.9442

Note: Results are from Equation (1). Total Assets and Remuneration are reported in units of £1000. The numbers reported are the central estimates, with the standard errors in parenthesis. *** indicates significance of the results at the 1% level, ** indicates significance at the 5% level and * indicates significance at the 10% level. Standard errors are clustered two-way at the time and firm level.

Table 11: Regression results - with industry-time fixed effects

1995-2019 Dep. var: $STL_{i,t}$	**(1)**	**(2)**	**(3)**	**(4)**
Turnover	0.1907***	0.1907***	0.2233***	0.2233***
	(0.0194)	(0.0189)	(0.0189)	(0.0197)
Turnover x Export status	-0.0466***	-0.0466***	-0.0188	-0.0188
	(0.0142)	(0.0142)	(0.0187)	(0.0187)
Remuneration	0.6933*	0.6933*		
	(0.3550)	(0.3550)		
Remuneration x Export status	0.6824***	0.6824***		
	(0.2062)	(0.2062)		
No of employees			4.7155	4.7155
			(10.7788)	(9.6500)
No of employees x Export status			24.3046**	24.3046**
			(10.1228)	(10.1107)
Time fixed effects	NO	YES	NO	YES
Firm fixed effects	YES	YES	YES	YES
Industry-time fixed effects	YES	YES	YES	YES
No of obs.	78,121	78,121	78,121	78,121
R^2	0.9587	0.9587	0.9442	0.9442

Note: Results are from Equation (1). Turnover and Remuneration are reported in units of £1000. The numbers reported are the central estimates, with the standard errors in parenthesis. *** indicates significance of the results at the 1% level, ** indicates significance at the 5% level and * indicates significance at the 10% level. Standard errors are clustered two-way at the time and firm level.

Appendix B List of Equilibrium Conditions

Price indices:

$$1 = \alpha_H \rho_{D,t}^{1-\phi} + \alpha_F \rho_{X,t}^{1-\phi} \tag{B.1}$$

$$1 = \alpha_F^* \rho_{D,t}^{*1-\phi} + \alpha_H^* \rho_{X,t}^{1-\phi} \tag{B.2}$$

$$\rho_{D,t} = N_{D,t}^{\frac{1}{1-\theta}} \tilde{\rho}_{D,t} \tag{B.3}$$

$$p\rho_{X,t} = N_{X,t}^{\frac{1}{1-\theta}} \tilde{\rho}_{X,t} \tag{B.4}$$

$$\rho_{D,t}^* = N_{D,t}^{*\frac{1}{1-\theta}} \tilde{\rho}_{D,t}^* \tag{B.5}$$

$$\rho_{X,t}^* = N_{X,t}^{*\frac{1}{1-\theta}} \tilde{\rho}_{X,t}^* \tag{B.6}$$

Prices:

$$\tilde{\rho}_{D,t} = \frac{\theta}{(\theta-1)} \frac{w_t}{Z_t \, z_{min} \nu} \tag{B.7}$$

$$\tilde{\rho}_{D,t}^* = \frac{\theta}{(\theta-1)} \frac{w_t^*}{Z_t^* \, z_{min}^* \nu} \tag{B.8}$$

$$\tilde{\rho}_{X,t} = \frac{\theta}{(\theta-1)} \frac{\tau \, w_t}{Q_t \, Z_t \, \tilde{z}_{X,t}} \left[(1-\zeta_t) + \zeta_t(1+r_t^{TF})\right] \tag{B.9}$$

$$\tilde{\rho}_{X,t}^* = \frac{\theta}{(\theta-1)} \frac{\tau \, Q_t w_t^*}{Z_t^* \, \tilde{z}_{X,t}^*} \left[(1-\zeta_t^*) + \zeta_t^*(1+r_t^{TF*})\right] \tag{B.10}$$

where $\nu \equiv \{k/(k-(\theta-1))\}^{1/(\theta-1)}$

Total profits of average firm (per capita!):

$$\widetilde{\Pi}_t = \widetilde{\Pi}_{D,t} + \left[\frac{N_{X,t}}{N_{D,t}}\right] \widetilde{\Pi}_{X,t} \tag{B.11}$$

$$\widetilde{\Pi}_{D,t} = \tilde{\rho}_{D,t} \, \widetilde{C}_{D,t} - \frac{w_t}{\nu z_{min} Z_t} \widetilde{C}_{D,t} \tag{B.12}$$

$$\widetilde{\Pi}_{X,t} = \frac{1-n}{n} \tilde{\rho}_{X,t} \, \widetilde{C}_{X,t} \, Q_t - \left[(1-\zeta) + \zeta(1+r_t^{TF})\right] \left[\frac{1-n}{n} \frac{w_t \tau}{\tilde{z}_{X,t} Z_t} \widetilde{C}_{X,t} - \frac{w_t f_X}{Z_t}\right] \tag{B.13}$$

$$\widetilde{\Pi}_t^* = \widetilde{\Pi}_{D,t}^* + \left[\frac{N_{X,t}^*}{N_{D,t}^*}\right] \widetilde{\Pi}_t^{X*} \tag{B.14}$$

$$\widetilde{\Pi}_{D,t}^* = \tilde{\rho}_{D,t}^* \, \widetilde{C}_{D,t}^* - \frac{w_t^*}{z_{min} Z_t^*} \widetilde{C}_{D,t}^* \tag{B.15}$$

$$\widetilde{\Pi}_{X,t}^* = \frac{n}{1-n} \tilde{\rho}_{X,t}^* \, \widetilde{C}_{X,t}^* \, \frac{1}{Q_t} - \left[(1-\zeta_t) + \zeta_t(1+r_t^*)\right] \left[\frac{n}{1-n} \frac{w_t^* \tau^*}{\tilde{z}_{X,t}^* Z_t^*} \widetilde{C}_{X,t}^* - \frac{w_t^* f_{X,t}}{Z_t^*}\right] \tag{B.16}$$

where the demand for domestic and exported goods from the average firm is given by

$$\widetilde{C}_{D,t} \;=\; \alpha_H \, N_{D,t}^{\frac{\theta-\phi}{1-\theta}} \; \tilde{\rho}_{D,t}^{-\phi} \, C_t \tag{B.17}$$

$$\widetilde{C}_{X,t} \;=\; \Psi_t \alpha_F^* \, N_{X,t}^{\frac{\theta-\phi}{1-\theta}} \; \tilde{\rho}_{X,t}^{-\phi} \, C_t^* \tag{B.18}$$

$$\widetilde{C}_{D,t}^* \;=\; \alpha_F \, N_{D,t}^{*\frac{\theta-\phi}{1-\theta}} \; \tilde{\rho}_{D,t}^{*-\phi} \, C_t^* \tag{B.19}$$

$$\widetilde{C}_{X,t}^* \;=\; \Psi_t \alpha_F \, N_{X,t}^{*\frac{\theta-\phi}{1-\theta}} \; \tilde{\rho}_{X,t}^{*-\phi} \, C_t \tag{B.20}$$

Free Entry:

$$\tilde{v}_t = w_t f_E / Z_t \tag{B.21}$$

$$\tilde{v}_t^* = w_t^* f_E / Z_t^* \tag{B.22}$$

Number of Firms:

$$N_{D,t} \;=\; (1-\delta)(N_{D,t-1} + N_{E,t-1}) \tag{B.23}$$

$$N_{D,t}^* \;=\; (1-\delta)(N_{D,t-1}^* + N_{E,t-1}^*) \tag{B.24}$$

Zero export profit cut-off:

$$\frac{1-n}{n} \, N_{X,t}^{\frac{\theta}{1-\theta}} \, C_{X,t} \, \tau \, \left[(1-\zeta) + \zeta(1+r_t^{TF})\right] \;=\; f_X \, \tilde{z}_{X,t} \, \frac{k(\theta-1)}{k-(\theta-1)} \left[(1-\zeta) + \zeta(1+r_t^{TF})\right] \tag{B.25}$$

Share of exporting firms:

$$\frac{N_{X,t}}{N_{D,t}} \;=\; \left(\frac{z_{min}\nu}{\tilde{z}_{X,t}}\right)^k \tag{B.26}$$

$$\frac{N_{X,t}^*}{N_{D,t}^*} \;=\; \left(\frac{z_{min}\nu}{\tilde{z}_{X,t}^*}\right)^k \tag{B.27}$$

Bond Euler Equations:

$$1 = \mathrm{E}_t \left[\beta \left(\frac{C_{t+1}}{C_t}\right)^{-\gamma} (1+r_t) \left(\frac{\chi_{t+1}}{\chi_t}\right)\right] \tag{B.28}$$

$$1 = \mathrm{E}_t \left[\beta \left(\frac{C_{t+1}^*}{C_t^*}\right)^{-\gamma} (1+r_t^*) \left(\frac{\chi_{t+1}^*}{\chi_t^*}\right)\right] \tag{B.29}$$

Share holdings Euler Equation:

$$\tilde{v}_t = \mathrm{E}_t \left[\beta(1-\delta) \left(\frac{C_{t+1}}{C_t}\right)^{-\gamma} (\tilde{v}_{t+1} + \widetilde{\Pi}_{t+1}) \left(\frac{\chi_{t+1}}{\chi_t}\right)\right] \tag{B.30}$$

$$\tilde{v}_t^* = \mathrm{E}_t \left[\beta(1-\delta) \left(\frac{C_{t+1}^*}{C_t^*}\right)^{-\gamma} (\tilde{v}_{t+1}^* + \widetilde{\Pi}_{t+1}^*) \left(\frac{\chi_{t+1}^*}{\chi_t^*}\right)\right] \tag{B.31}$$

UIP:

$$1 = \beta(1 + r^*_{t+1})\Theta\left(Q_t B_{F,t+1}\right) \mathrm{E}_t \left[\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma} \frac{Q_{t+1}}{Q_t} \right] \left(\frac{\chi_{t+1}}{\chi_t}\right) \tag{B.32}$$

Current Account:

$$\frac{Q_t B_{F,t}}{(1 + r^*_t)\Theta(Q_t B_{F,t})} - Q_t B_{F,t-1} = w_t L_t + N_{D,t}\widetilde{\Pi}_t - C_t - N_{E,t}\tilde{v}_t \tag{B.33}$$

$$\frac{B^*_{F,t}}{(1 + r^*_t)} - B^*_{F,t-1} + \frac{n}{1-n}\frac{B_{F,t}}{(1 + r^*_t)\,\Theta(B_{F,t})} = w^*_t L^*_t + N^*_{D,t}\widetilde{\Pi}^*_t - C^*_t - N^*_{E,t}\tilde{v}^*_t \tag{B.34}$$

where $B_{F,t} = -\frac{1-n}{n} B^*_{F,t}$.

Appendix C ABS weights

The weights, composed of a-weights correcting for the sample design and g-weights correcting for other potential sources of bias are calculated as follows. The a-weight of a firm in a specific SIC 2007 division i, employment band j, and region k, $w^a_{i,j,k}$, simply reflects the probability of that firm being selected for the sample, and is defined as the number of firms with those characteristics in the population of firms relative to the number of firms in the sample with those same characteristics:

$$w^a_{i,j,k} \equiv \frac{N_{i,j,k}}{n_{i,j,k}} \tag{C.1}$$

The g-weights correct for descrepancies between the average turnover within employment bands and industries in the sample and that observed in the IDBR data within those same employment bands and industries. In particular they weight the sample so that the weighted average turnover corresponds to the average turnover observed in the IDBR population. The g-weights are calculated as

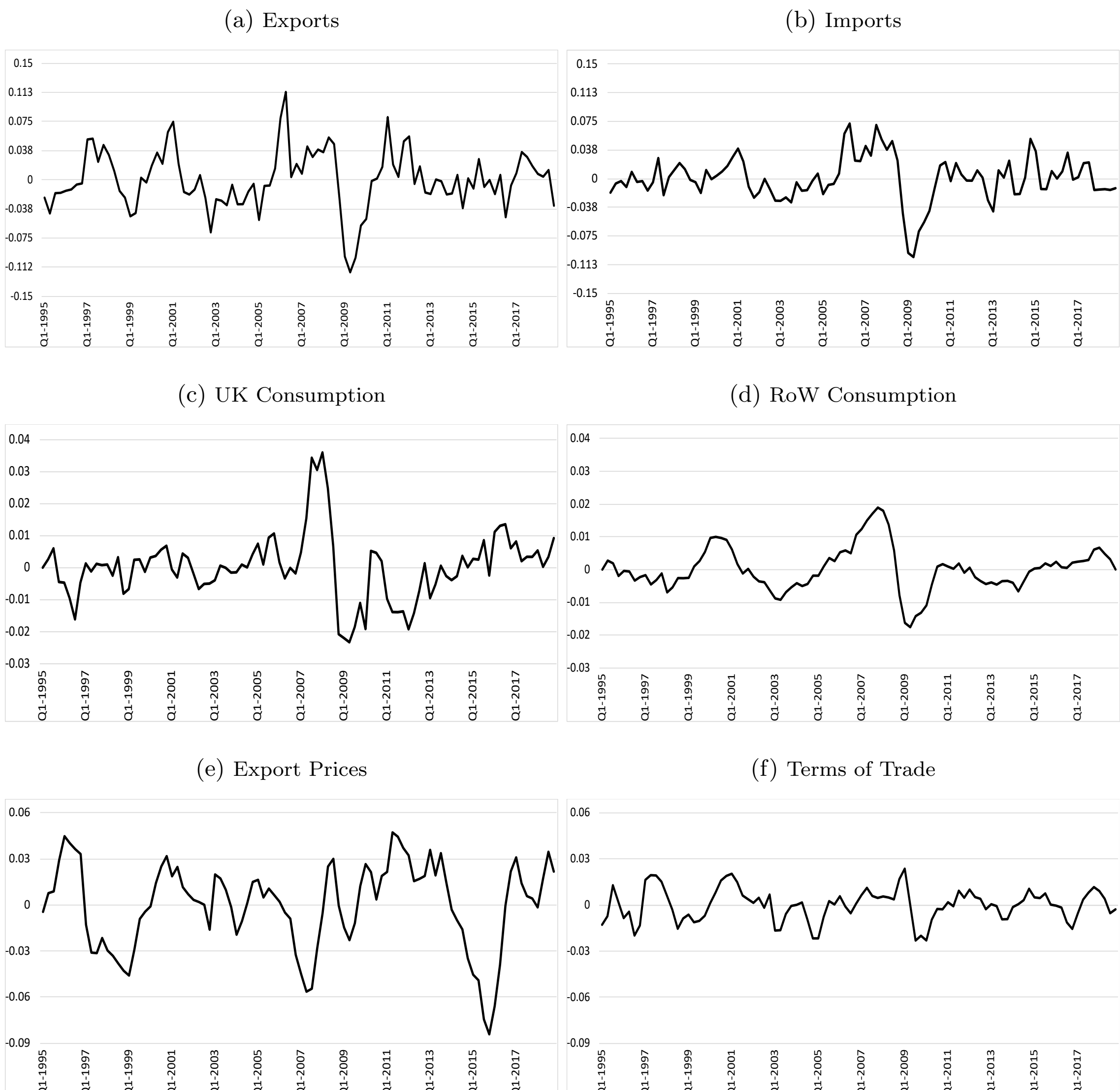
$$w^g_{i,j} \equiv \frac{\sum_{i,j} Y_{i,j}/N_{i,j}}{\sum_{i,j} y_{i,j}/n_{i,j}}, \tag{C.2}$$

where $Y_{i,j}$ denotes turnover in industry i and employment band j observed in the IDBR data and $y_{i,j}$ denotes turnover in the ABS sampled firms in the same industry and employment band. The weight applied to a firm within division i, employment band j and region k, $w_{i,j,k}$ is then $w_{i,j,k} \equiv w^a_{i,j,k} w^g_{i,j}$.

Appendix D Data

We use the private final consumption data from the OECD. Rest of the world is approximated by the OECD total. We calculate the terms of trade taking the ratio of OECD imports price deflator and exports price deflator. Exports prices is exports price deflator over the consumption deflator. Consumption deflator is taken from the ONS. Both exports and imports data are taken from the ONS. We use goods exports and imports that is adjusted for the MTIC fraud.

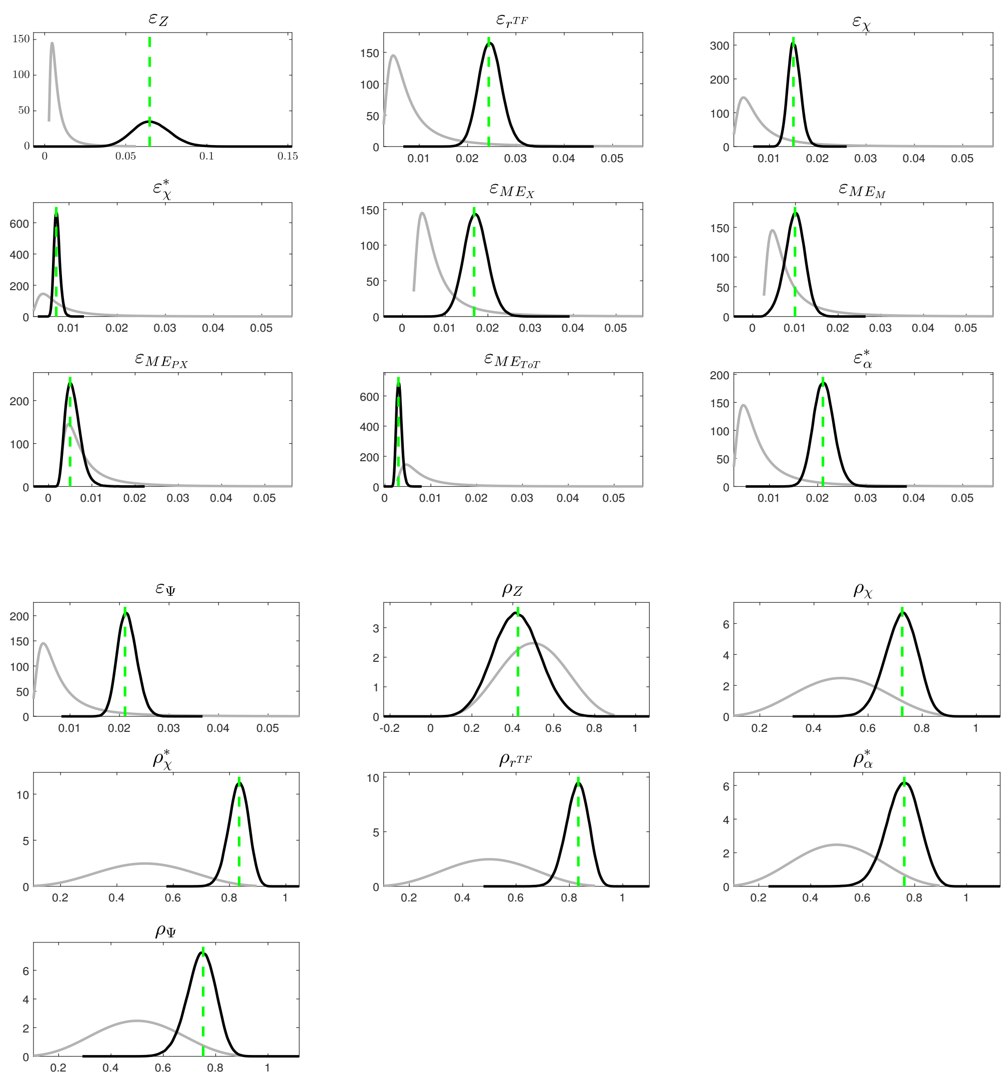
Figure A1: Observables



Note: All series are logged and HP-filtered using 1600 as the smoothing parameter.

Appendix E Additional Figures

Figure A2: Prior and posterior distributions of the estimated parameters



Note: Prior distributions are shown in grey and posterior distributions are shown in black. The green line is the posterior mode.

Figure A3: Exports Shock Decomposition – Endogenous Labour

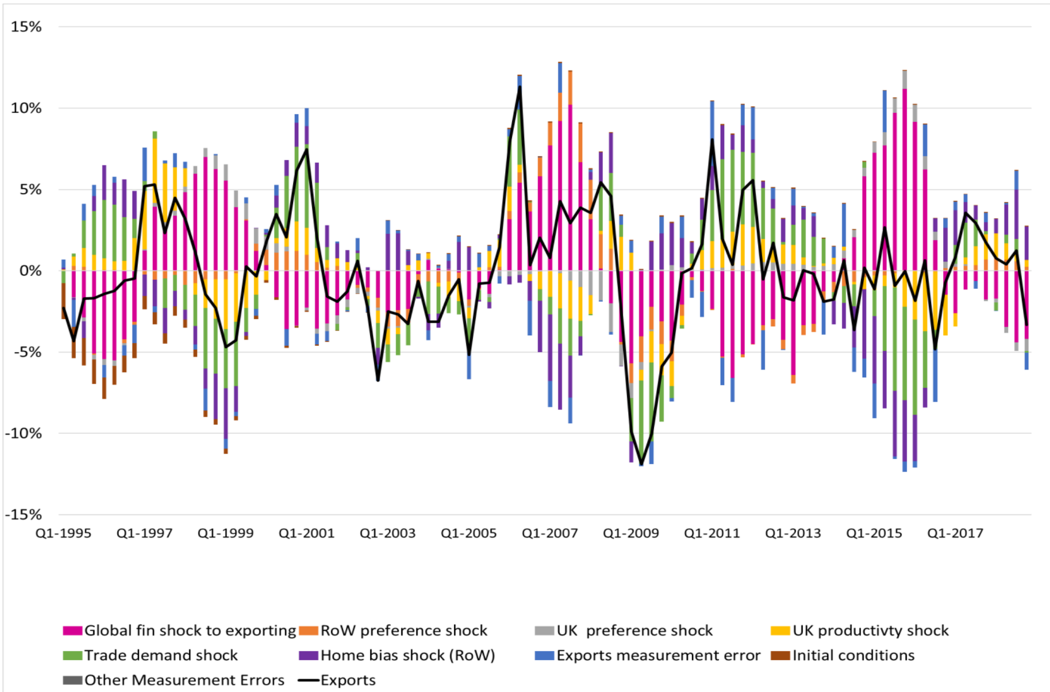


Figure A4: Exports Shock Decomposition – Low ζ

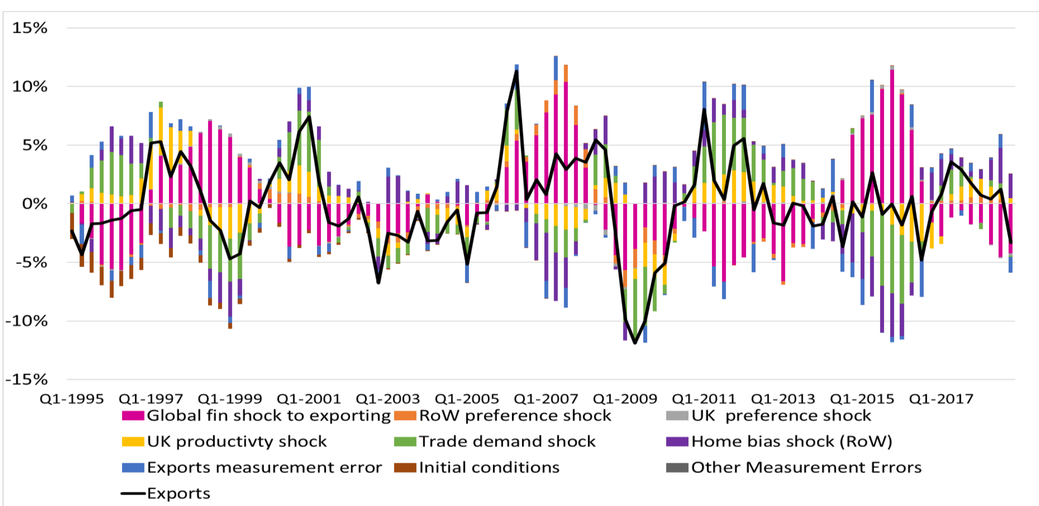


Figure A5: Exports Shock Decomposition – High ζ

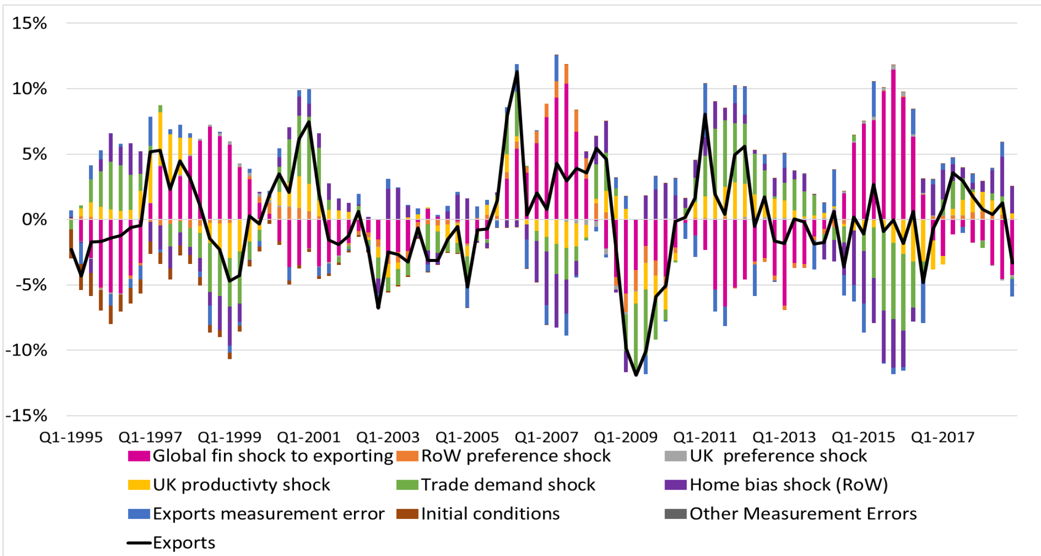


Figure A6: Exports Shock Decomposition – Low ϕ