Global value chains' position and value capture: Firm evidence in agri-food industry

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Abstract

Value creation forms the basis for the construction of global value chains (GVCs) and has received significant scholarly attention, yet the issue of value capture or power distribution along supply chains, "within" industries, is still unresolved. A recent framework of property rights (Antràs and Chor, 2013; Alfaro et al., 2019) highlights how final firms exert power over their suppliers to optimally organize their sequential production process. In such an environment, how can suppliers act strategically to counterbalance the power of the final firm? We contribute, theoretically and empirically, to a better understanding of the extent to which the division of surplus in the agri-food sector is affected by suppliers' positioning in GVCs. We argue that: (1) further upstream position of exports and further downstream position of imports, and consequently specialization of the production process along agri-food GVCs increase the bargaining power of suppliers; (2) these effects are more pronounced in more upstream position of suppliers production process in GVCs; (3) suppliers that specialize in the most downstream stages increase their bargaining power by importing further upstream and exporting further downstream, and thus performing more stages in GVCs; and (4) the mechanism is that the effects observed on surplus, whether in terms of upstream or downstream position of the production process, are mainly due to the upgrading of the product mix. Using the matched French Customs-AMADEUS 2002-2017 data, we build on the bilateral stochastic frontier model to measure the two-sided division of surplus of upstream/midstream suppliers and their export destination markets. We link this dataset to the U.S. input-output table converted to the NACE Rev.2 level, which identifies agri-food industries at a very detailed level, and compute upstreamness indicators for each industry and firms' exports and imports, following recent approaches in the literature. Our hypotheses (1), (2) and (4) are strongly supported, while hypothesis (3) is only weakly supported.

Keywords: Bargaining, Division of surplus, Global value chains, Property rights theory, Upstreamness, Firm boundaries, Agri-food industry.
JEL Codes: D20, D22, D23, D46, F10, L23, Q17.

1 Introduction

The emergence of gobal value chains (GVCs) raises the issues of how power is exerted, and how value is created, distributed, and captured along supply chains (De Marchi et al., 2020).

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The value capture, which is the set of activities that seize some part of the value created (Pham and Petersen, 2021), is mainly the expression of bargaining power, defined as the ability of a party to influence the terms and conditions of a contract in its favour (Argyres and Liebeskind, 1999). There is a long tradition in the literature on the supplier-buyer relationship that the most productive and strongest firms and those with critical resources in the supply chain obtain favourable terms of exchange and capture more value, which is reflected in the exertion of greater bargaining power (Emerson, 1962; Brandenburger and Stuart Jr, 1996; Crook and Combs, 2007; Hillman et al., 2009; Drees and Heugens, 2013). However, how position in GVCs affects value creation and value capture has received little attention (Dhyne et al., 2015; Mahy et al., 2021).

The GVCs analysis is identified as a science that allows for the identification of obstacles and opportunities between different stages of production or tasks, leading to the contractualization or integration of buyer-seller relations at the international level (Taglioni and Winkler, 2016). The prevalence of global production networks has led to the identification of uncertainty and incomplete contracts as the most important bottlenecks in international relations (Antràs, 2015). Accordingly, organizational choices along the value chain become a key decision faced by firms worldwide (Antràs and Chor, 2013; Alfaro et al., 2019). Furthermore, strong lock-in effects and high fixed costs due to search and matching frictions in GVCs lead to bilateral negotiation of transaction prices between exporters and importers Antràs (2020). Therefore, international prices are not fully disciplined by market-clearing conditions, so that the division of surplus along the chain is governed by bargaining and two-sided market power. Assuming a sequential production process, a recent framework of property rights (Antràs and Chor, 2013; Alfaro et al., 2019) highlights how final firms exert power over their suppliers to optimally organize their production processes. In such an environment, how can suppliers act strategically to counterbalance the power of the final firms?

This paper attempts to answer this question by assessing how upstream/midstream suppliers' boundaries and organizational choices affects power distribution and value capture along supply chains. Specifically we theoretically and empirically study the effects of the position of production process and the specialization (or expansion) along the value chains on the division of surplus of agri-food exporters in their cross-border supplier-buyer relationships in GVCs. Then, we explore the mechanisms through which position in GVCs affects the division of surplus among suppliers. The suppliers increases the value extracted, by increasing their bargaining power, so that the terms "bargaining power", "value capture", "division of surplus" and "extracted value" are used interchangeably.

Our first contribution is to build on a general Nash bargaining game to provide a baseline conceptual framework that can characterize firm interactions and price-setting under incomplete contracts in GVCs, where the supplier-buyer relationship is governed by bargaining. We focus on the problem of a exporter (supplier) producing and exporting a variety of differentiated semi-finished products. In their inputs market, each supplier is thus confronted with the make-or-buy decision of producers in a context of international trade demonstrated by Antràs and Helpman (2004). Then, we discuss theoretically a firm's decision over where to operate along the production chain and which production stages to perform in order to maximize its surplus, in an environment with contractual frictions. A key feature of our framework is that upstream/midstream firms made upstream and downstream organizational decisions and act strategically against a foreign final firm (importer) to reach consumers in foreign markets, whereas the property right model, for instance, focus on the final firm's organizational decisions.

We show that the price setting through the bilateral negotiations allows for variable markups due to two-sided bargaining power. Then, we argue that a supplier's decision to

export more upstream and to import more downstream allow it to achieve a functional specialization of the production process in the most upstream position. Consequently, the supplier undertakes knowledge-intensive activities, which lead to structural upgrading (product and process) with substantial productivity gains, thus considerably strengthening bargaining power. As a result, the supplier increases the share of its division of surplus. We also argue that further downstream suppliers are more productive and produce high quality products, so that they increase their bargaining power by exporting further downstream and importing further upstream, and thus performing more stages in GVCs. The mechanisms are as follows: suppliers specializing further upstream lead to structural upgrading (product and process) and control of key stages in upstream supply chains. Similarly, the most productive suppliers, which are much more likely to produce high-quality goods, specialize further downstream and control larger stages of production in GVCs. Overall, quality upgrading of the product mix is the main driver of the observed effects on surplus, whether in terms of upstream or downstream position of the production process.

Our second contribution is to match our theoretical framework to the patterns of our data. We use the detailed French agri-food firms trade data and the AMADEUS database over the 2002-2017 period. We distinguish a sample with re-exports excluded (Re-exports excluding sample) from the sample with all transactions (All transaction sample), in order to capture the actual processing activities of exporters in GVCs. We build on a two-tier stochastic frontier model, developed by Polachek and Yoon (1987, 1996) and adapted, as the bilateral stochastic frontier analysis model to the bilateral trade by Li et al. (2022), to estimate the two-sided division of surplus in GVCs of French agri-food firms (suppliers) and the countries of their trade partners (importers). We use the unit values as a proxy of the export product prices paid by the importers, in equilibrium, to estimate the two-sided division of surplus. Previous studies seek to identify the different sources of value added embedded in trade flows by using input-output table (Hummels et al., 2001; Johnson and Noguera, 2012; Koopman et al., 2014; Borin and Mancini, 2019). However, it is difficult, if not impossible, to apply these methods to firm data (Antràs, 2020). To measure firms' market power, most of the work in the literature estimates the markup (see for example De Vries et al., 2021; del Valle and Fernández-Vázquez, 2023). However, market power mainly implies unilateral strategic behavior, whereas bargaining power involves interactions between two agents (Bonanno et al., 2018). The two terms are therefore quite different and, as we have shown, relationships in GVCs involve interactions between agents and bilateral power relations. The use of bargaining power indicators is very limited in the literature, due to the lack of data on B2B transactions. We contribute to this growing empirical literature on GVCs and global production networks by identifying value capture at the micro level of the firm.

Then, we exploit the U.S. detailed input-output table in order to explore the richness of French firm-level data. We seek to identify suppliers' position in GVCs as the level of processing of the goods they purchase and/or sell abroad. The use of the U.S. input-output table for French firms is justified by the results of Antràs et al. (2012), which show a high degree of stability between the sectoral measures of the U.S. and some European countries economic production matrix. We confirm this relationship by performing the necessary empirical checks with the INSEE, OECD and GTAP input-output tables. Based on this finding, we assume that France and the U.S. share the similar technological frontier, or have the same production functions, or share the same pattern of input use for the production of a given good. For example, we assume that the production of cheese requires the same use of dairy products, salt and other inputs everywhere in the world. Based on this assumption, Alfaro et al. (2016) and Acemoglu et al. (2016) define the linkages between industries (vertical integration) with data on firms worldwide, using the U.S. input-output table.

Finally, we test empirically the relationship between the division of surplus and the position of suppliers in GVCs and we confirm our keys theoretical hypotheses. First, using the whole sample of Re-export excluded, we show that more upstream position of suppliers' exports and more downstream position of their imports, and consequently specialization along GVCs are associated with a higher division of surplus in agri-food GVCs, and that these results are more pronounced in the upstream sectors. Furthermore, additional heterogeneity results show that using a sub-sample regression of the most downstream and most upstream activities of the firms' core industry in the All transaction sample, we uncover a significant tendency of more value capture in the sub-sample of the most downstream firms, when exporting more downstream and importing more upstream, thus performing a higher number of production stages in GVCs. The predictions for more upstream position of the suppliers' production process in GVCs continues to hold in both samples (Re-exports excluded and All transaction samples), and with additional robustness tests, whereas the results for most downstream position of the suppliers' production process in GVCs are not robust in the data.

Our approach is closely related to the burgeoning literature that examined the positioning of firms in GVCs, productivity-heterogeneity and performance. According to this literature, the positioning of firms in GVCs is a key driver in value creation and distribution. Indeed, Mudambi (2008) shows that firms in the industries on the upper and lower end of the value chain generally create more value, highlighting the "smile curve" hypothesis. Rungi and Del Prete (2018) and Baldwin and Ito (2021) find empirical support to this hypothesis. Downstream firms may benefit directly from the interaction with final consumers to know in real-time their preferences and to undertake actions such as innovation and R&D activities to create adapted products. Thus, the intensive innovation and R&D activities of downstream firms could increase their control over the chain, through more bargaining power. Furthermore, as shown by Costinot et al. (2013), productivity is higher downstream than upstream. Consequently, being more upstream could prevent firms from increasing their bargaining power relative to more productive downstream firms. However, based on the "smile curve" hypothesis, it should be noted that engaging in upstream activities could also improve value capture, as the initial stages of the production process are associated with high-value-added activities such as innovation, R&D, design, marketing, branding, *etc.*. Mahy et al. (2021) and Ju and Yu (2015) find supportive evidence for this hypothesis by using Belgian and Chinese firms data respectively, through the "in-between" sectoral effect. Even if De Vries et al. (2021) confirm the fact that Dutch firms specialised in R&D and marketing experienced higher total factor productivity levels compared to the processing firms, the authors do not observe a significant relation between more upstream position and productivity, also after taking market power into account. del Valle and Fernández-Vázquez (2023) find a significantly decreasing and non-linear impact on market power of further upstream industries in GVCs. A main interest of this paper is to add to this burgeoning literature by focusing on distributional issues of value "within" sectors (agri-food industry) and upstream/midstream firms (processing firms).

This paper also deals with a recent theoretical and empirical literature testing various aspects of firms' organizational decisions in GVCs, via backward and/or forward integration in the supply chain. Antràs and Helpman (2004) and Berlingieri et al. (2021) study the make-or-buy decision of final firms under a contractual frictions in a context of international market uncertainty. The former show that low-productivity firms outsource whereas the high productivity firms source from affiliates suppliers, and the latter show that more important inputs are more likely to be sourced from affiliated. Conconi et al. (2012) examine how the liberalization of product affects the ownership structure of final firms in an contractual frictions environment. They show that the terms of trade in supplier markets and the price of output of firms crucially shape the organizational choices, due to their effect on the division

of surplus. The property right models developed by Antràs and Chor (2013) and Alfaro et al. (2019) provides theoretical basis for the final firm boundary choices and firm organizational decisions along the GVC, based on the transaction cost approach. They show that the *hold-up* situation shaped by the substitutability or complementarity of inputs, determines the firm's decision whether or not to integrate its suppliers. Del Prete and Rungi (2017) only partially confirm the results of the property right model and find that firms producing intermediate goods prefer to integrate production stages, either backward or forward, closer to those they already perform and with similar technological characteristics. our approach focus on upstream/midstream firms that make upstream and downstream organizational decisions over their boundaries in value chains, Similar to Del Prete and Rungi (2017). To the best of our knowledge, this is the first time in the literature that the upstream/midstream firms' boundary decisions have been modeled, in a context of contractual frictions, in relation to bilateral bargaining power.

More broadly, our paper is related to the literature where actors' behavior is guided by incentives indirectly related to profits and utility maximization, rather than imbalances of bargaining power resulting from differences in the dependency on potential economic partners. Based on power distribution along agri-food chains, James et al. (2013) rely on *network exchange theory* (NET) to explain the behavior of actors in the agri-food sector. According to this theory, economic transactions remain at the heart of the interaction between actors that are considered rational and seek the maximization of their profits. Furthermore, in the NET, the maximization of the benefits of actors mainly relies on increasing their bargaining power. Consequently, the behaviour of actors is essentially aimed at magnifying their bargaining power by increasing the level of dependence of potential economic partners. This theory enables to better account for heterogeneity in the positioning of firms in GVCs in order to capture more value in the agri-food chain, by increasing bargaining power.

The remainder of this paper is organised as follows. Section 2 sets the theoretical framework and provides keys intuitions from which we build our keys hypotheses; Section 3 outlines our empirical framework where we present the data explanations and our method. In Section 4, we report and explain the results and the mechanism that underlies them. Section 7 includes the discussion of the results and provides some concluding remarks, focusing on the policy implications.

2 Theoretical framework

This section provides a theoretical basis for equilibrium price-setting mechanisms through negotiations between exporters and importers in the global supply chain, and highlights the existence of bilateral market power. In other words, we describe a bargaining problem, based on the perspective of a lower and an upper bound of export product prices, that exporter and importer, respectively, have an incentive to negotiate in an industry global supply chain. This is similar to the problem of firm-to-firm trade with bilateral negotiations and two-sided bargaining power, as in Alviarez et al. (2023). Our bargaining model shows the extraction of the surplus of an agent, depending on his bargaining power. Then, in the presence of a sequential production process within a global supply chain and contractual frictions[1], we discuss how exporters adjust their position in GVCs to increase their bargaining power, and the mechanisms through which this occurs.

[1]Contractual incompleteness reflects the third parties' inability to ensure that the clauses are enforced or that the components are compatible or not (see Alfaro et al., 2019).

2.1 Exporter-Importer price setting

2.1.1 Consumers preferences and demand in the Downstream market

Consider a world consisting of J countries where consumers value a continuum of differentiated goods k. Preferences in country j are constant elasticity of substitution (CES) given by

$$\Upsilon_{jk} = \left[\int_{\Omega_{fjk}} \left[\lambda_{fjk}(\upsilon) q_{jk}(\upsilon) \right]^{\frac{\varepsilon_{jk}-1}{\varepsilon_{jk}}} \right]^{\frac{\varepsilon_{jk}}{\varepsilon_{jk}-1}} \tag{1}$$

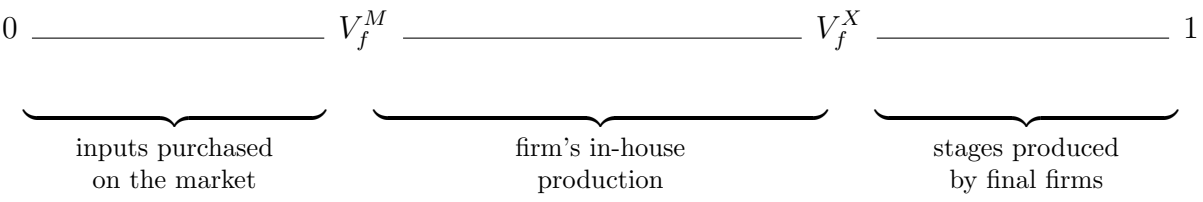
where Ω_{fjk} is the set of available varieties of products k in country j, $\varepsilon_{jk} > 1$ is the elasticity of substitution between different varieties that is common for all exporters, and Ω_{υ} is the set of products varieties available in country j. $q_{jk}(\upsilon)$ is the quantity purchased for each variety of product k and $\lambda_{fjk}(\upsilon)$ represents the quality perceived by consumers living in country j for variety υ of product k imported from firm f in country i. We assume that consumers value quality when $\lambda_{fjk}(\upsilon) > 1$, whereas $\lambda_{fjk}(\upsilon) = 1$ in the standard approach without vertical differentiation (Gaigné and Gouel, 2022). The resulting aggregate demand for variety υ of product k in country j faces by the importer in this country is given by

$$q_{jk}(\upsilon) = A_{jk} \left[\lambda_{fjk}(\upsilon) \right]^{\varepsilon_{jk}-1} \left[p_{jk}(\upsilon) \right]^{-\varepsilon_{jk}} \tag{2}$$

where $A_{jk} > 0$ indicates the market size in country j, and $p_{jk}(\upsilon)$ is the price of variety υ of product k paid by consumers in j. Note that demand is decreasing with price and increasing with market size, and quality when $\lambda_{fjk}(\upsilon) > 1$.

2.1.2 Technology in upstream/midstream sector

Consider the supply side of the model where a continuum of firms in country i produce a set of varieties Ω_{υ} of products k. Similarly to Antràs and Chor (2013) and Alfaro et al. (2019), we assume that the production of a final good in a given industry requires the completion of a continuum of production stages $\nu \in [0, 1]$ that are sequentially integrated from a technological point of view. Subscript ν reflects the inverse of the level of processing, *i.e.* the inverse of the *upstreamness* of the product in the value chain (Fally, 2012; Antràs et al., 2012; Antràs and Chor, 2013). A lower ν denotes a more upstream production stage, and $\nu = 1$ indicates the production of a final consumption good. The production process (value chain) of a final product can be synthesized by the following scheme:



All or part of the intermediate inputs of stages $\nu \in \left[0, V_f^M\right]$ are imported by firms f, located in country i, so that their production technology are characterized as follows: firm purchases on the market (imports) less processed intermediate inputs (up to upstreamness level V_f^M) that it combines in a CES manner with an internally intermediate stages inputs to produce output corresponding to more downstream stages (up to upstreamness level V_f). The obtained output

$$q_{fk} = \theta_f \left(\int_{V_f^M}^{V_f^X} x_f(\nu)^{\frac{\sigma-1}{\sigma}} d\nu + q_{-if}^{M\,\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{3}$$

is exported to country j and used as an input to produce semi-finished or final consumption goods. Because we focus on suppliers (exporters) of goods located in France, we omit hereafter index i for simplicity of exposition.

Exporter uses a quantity q_{-if}^M of intermediate products, completed up to stage V_f^M, purchased (imported) around the world at price p_{-if}^M, and quantities $x_f(\nu)$ of internally produced inputs $\nu \in [V_f^M, V_f^X]$ to produce a quantity q_{fk} of an output completed up to stage V_f^X, which it sells in country j at price p_{fjk} if it supplies a compatible good to the importer, $q_{jk} = q_{fk}$. We assume that more transformed products, *i.e.* goods in more downstream production stages face a higher market price: $p(\nu)' > 0$. The cost of inputs produced in-house is specific to each supplier. For each of these inputs $x_f(\nu)$, $\nu \in [V_f^M, V_f^X]$, the supplier incurs a variable cost $c_f(\nu)$, that can be view as the cost of labor inputs required to produce each unit of $x_f(\nu)$. Inputs are characterized by a constant elasticity of substitution $\sigma > 1$. Parameter θ_f reflects the productivity of exporter.

2.1.3 Exporter-Importer two-sided power: General Nash bargaining game

We consider that each variety υ of k is produced in country i and supplied to country j by a single firm f, so that the market structure of υ allows monopolistic competition, and there is free entry into the industry. Note that exporters can be multi-product, but we use the firm-product pair as the basic unit of our analysis in the empirical section, in line with our market structure hypothesis.

Neither consumers nor importers in country j know the conditions under which imported goods are produced and the inputs used.[2] Note also that the exporter f in country i does not invest in quality signalling, so that the importer and consumers in j discover quality when they handle the products. However, if exporter f supplies a compatible good to importer, the two agents establish a kind of relational GVC that may evolve over time. In such a case, the links between exporters in country i and importers in country j are characterized by supplier-buyer relationship that are conducted at arm's length and under a contractual frictions. The fixed and sunk costs of finding suitable suppliers of goods or suitable buyers of one's products implies that GVC participants are large with substantial bargaining power. Also, the prevalence of GVCs' trade is source of lock-in in cross-border supplier-buyer relationship (Monarch and Schmidt-Eisenlohr, 2017; Monarch, 2022; Martin et al., 2020; Antràs, 2020). As a result, transaction prices tend to be bilaterally negotiated and not fully disciplined by market-clearing conditions, so that the division of surplus along the chain is governed by two-sided market power.

Suppose that the exporting firm f in country i with bargaining power β_{fjk} and the importing country j with bargaining power $1-\beta_{fjk}$ are playing a general Nash bargaining game. The sequence of events in the game is as follows:

1. Exporter and importer bargain over exporter price (and therefore the quantity) that maximizes the total rents of the market.

2. Importer then takes the exporter price as given and maximizes its profits by choosing a price paid by consumers, and exporter takes as given exported quantity and chooses intermediate inputs that minimize its costs, simultaneously.

[2]This assumption may be invalid when standards exist.

We solve the game via backward induction, focusing on a single firm. At the second stage of the game, when $q_{jk} = q_{fk} = q_{fjk}$, the importer sets the selling price of the good to consumers on market j by maximizing its operating profit, related to the variety υ in j, given by

$$\pi_{jk} = p_{jk}q_{fjk} - p_{fjk}q_{fjk} \tag{4}$$

where $p_{jk}q_{fjk}$ is the total revenues associated with market j and $p_{fjk}q_{fjk}$ is the total value of the imported good from f in country i.

Maximizing π_{jk} with respect to p_{jk} yields the following equilibrium price and quantity of variety υ of product k paid by consumers to the importer in country j:

$$p^*_{jk} = \frac{\varepsilon_{jk}}{\varepsilon_{jk}-1} p_{fjk} \tag{5}$$

$$q^*_{fjk} = A_{jk}\lambda_{fjk}^{\varepsilon_{jk}-1}\left(\frac{\varepsilon_{jk}}{\varepsilon_{jk}-1}\right)^{-\varepsilon_{jk}} p_{fjk}^{-\varepsilon_{jk}} \tag{6}$$

It is worth noting that the equilibrium price of variety υ of product k in country j follows the standard pricing rule by applying a constant markup, $\varepsilon_{jk}/(\varepsilon_{jk}-1)$, over marginal cost whatever the nature of the goods. The marginal cost in market j corresponds to the unit value of the imported good paid by the importer to the exporter, p_{fjk}. $q*_{fjk}$ is increasing in perceived quality, λ_{fjk}, of foreign consumers.

Consider now the production technology of exporter. Notice that each exporter f in country i bears the trade cost, τ_{ijk}, modeled as iceberg costs, so that exporting the quantity q_{fjk} to j requires producing the quantity $\tau_{ijk}q_{fjk}$. Under the condition of certain outputs, the problem of exporter's cost minimization satisfies:

$$\min_{q^M_{-if}, x_f(\nu)} p^M_{-if}q^M_{-if} + \int_{V_f^M}^{V_f^X} c_f(\nu)x_f(\nu)d\nu \tag{7}$$

$$s.c. \qquad \overline{q}_{fjk} = \theta_f\left(\int_{V_f^M}^{V_f^X} x_f(\nu)^{\frac{\sigma-1}{\sigma}}d\nu + q_{-if}^{M\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$

Thus, technology is such that the cost function of firm f located in country i associated with its variety of product k and exported to country j implies:

$$C_{fjk} = \frac{\tau_{ijk}q_{fjk}}{\theta_f}\left(p_{-if}^{M^{1-\sigma}} + \int_{V_f^M}^{V_f^X} c_f(\nu)^{1-\sigma}d\nu\right)^{\frac{1}{1-\sigma}}, \tag{8}$$

Following Hallak and Sivadasan (2013), we decompose firm f productivity into two components: $\theta_f = \varphi_f\lambda_{fjk}^{-\gamma}$, with $0 \leq \gamma < 1$. Productivity increases with firm's efficiency φ, and decreases with the quality of produced goods λ_{fjk}. Then, the marginal cost of q_{fjk} units of exported good is:

$$Cm_{fjk} = \tau_{ijk}\frac{\lambda_{fjk}^{\gamma}}{\varphi_f}\left(p_{-if}^{M^{1-\sigma}} + \int_{V_f^M}^{V_f^X} c_f(\nu)^{1-\sigma}d\nu\right)^{\frac{1}{1-\sigma}}. \tag{9}$$

This expression permits to integrate the common assumption that high quality products are more difficult to produce and require more expensive inputs.[3] Previous research has shown

[3]Parameter γ is the elasticity of marginal cost with respect to quality. It reflects the industry-specific variable cost of quality.

that more productive firms produce and export higher quality goods (Johnson, 2012; Curzi and Olper, 2012; Curzi et al., 2015). The introduction of firm-specific efficiency (parameter φ_f) permits to reconcile this apparent contradiction.

We can observe that the marginal cost is independent of output size, so that the profit of the firm producing product k located in country i and exported to country j can be written as follows:

$$\pi_{fjk} = p_{fjk}q_{fjk} - Cm_{fjk}q_{fjk} \tag{10}$$

With the profit function of the exporter (4) and the importer ((10) in hand, we go back to the first stage of the game where we can obtain the equilibrium exchange price between the two agents, p_{fjk}, which solves the following generalized Nash product:

$$\max_{p_{fjk}} \left(p_{fjk}q_{fjk} - Cm_{fjk}q_{fjk} \right)^{\beta_{fjk}} \left(p_{jk}q_{fjk} - p_{fjk}q_{fjk} \right)^{1-\beta_{fjk}} \tag{11}$$

By the first derivatives and after some manipulation, we can obtain the full expression of optimal prices as follows

$$p^*_{fjk} = \frac{\varepsilon_{ft} + \beta_{fjk} - 1}{\varepsilon_{ft} - 1} \left(p_{-if}^{M^{1-\sigma}} + \int_{V_f^M}^{V_f^X} c_f(\nu)^{1-\sigma} d\nu \right)^{\frac{1}{1-\sigma}} \frac{\lambda_{fjk}^{\gamma}}{\varphi_f} \tau_{ijk}. \tag{12}$$

It is then straightforward to see that, as common in trade models, p^*_{fjk} shares the general form of prices paid by importer in equilibrium (Gaigné and Gouel, 2022). Hence, regardless of the market structure, the production technology and the characteristics of the destination market, exporters apply a markup, $(\varepsilon_{ft} + \beta_{fjk} - 1)/(\varepsilon_{ft} - 1)$, over the marginal cost, Cm_{fjk}. What's new is that the price policy set through the bargaining allows for variable markups due to the two-sided market power, β_{fjk}. It's imply that, although demands in market j are iso-elastic, the markup is not constant. Equation (12) is the observed export prices – *which are observed in the data* – of exporter in country i to destination market j, that can be view as the unit value of export.

As expected, the exchange price between exporter and importer is increasing in the perceived quality in country j, λ_{fjk}, and trade cost, τ_{ijk}, whereas its decreasing in the firm-specific efficiency, φ_f. Furthermore, our model makes explicit the direct relationship between export prices and input prices. However, the direction of this relationship is ambiguous. Focusing mainly on the imported inputs, on the one hand, foreign sourcing of low-priced inputs can decrease export prices of GVCs' firms by bringing cost savings to these firms (Li and Miao, 2023), and enhancing productivity (Bas and Strauss-Kahn, 2014). On the other hand, the cost savings effect of imported inputs (see for example Curzi et al. (2015), Curzi and Pacca (2015) and Ludema and Yu (2016) which use foreign tariff reductions) or the import of more expensive high-quality inputs (Manova and Zhang, 2012; Bas and Strauss-Kahn, 2015) could lead to the upgrading of product quality and higher export prices. Finally, other thing equal, performing more production stages, $\nu \in [V_f^M, V_f^X]$, in GVCs or using more expensive domestic inputs by the exporters increase export prices, as shown by (12). However, our aim is to explain the unexplained part of the price variation that is due to bilateral bargaining power, β_{fjk}. Equation (12) shows that p_{fjk} increases with β_{fjk}. Indeed, when $\beta_{fjk} = 1$, other things equal, exporter set their highest export price and maximizes their total revenues and profits, whereas importer pays their lowest import price to exporter for $\beta_{fjk} = 0$ (perfect competition).

2.2 Influencing factors of exporters bargaining power

Note that we are interested exclusively in firms or exporters participating in GVCs. Assuming that exporters f of product k in country i use the same types of inputs, the same production technology and face the same conditions on destination markets j, price variation from one exporter to another can only depend on their power relationship with importers in country j. This power relationship is expressed by the bilateral market power, β_{fjk}, between exporter and importer. It is assumed that β_{fjk} is exogenous, but exporting firms may attempt to capture part of the rent in their transactions with importers by adopting strategic behavior through traded quantity, quality of product mix and positioning in GVCs. As a result, all these strategies affect the exporter's ability to raise (or lower) his export price through β_{fjk}, by extracting a share of the importer's surplus during the negotiation. The question is how these mechanisms work.

2.2.1 Traded quantity and exporters bargaining power

The trade-off made by the exporter and the importer on the traded quantity could affect the exchanged prices, p_{fjk}, through β_{fjk}. Indeed, when β_{fjk} is relatively low, the importer has a strong incentive to import large quantities because markup and prices are low. However, the exporter does not, as it could gain on high demand but would ultimately obtain only a relatively small share of the rent. Thus, exporting a small quantity creates a negative supply shock in the market that gradually enhances the exporter's bargaining power vis-à-vis the importer. As a result, the exporter has a greater incentive to increase the quantity of supply if his bargaining power increases. Similarly, when β_{fjk} is relatively high, the exporter sets a high export price, which reduces the quantity imported by the importer. This means that the exporter can gain on the price but lose in terms of traded quantity. The reduction in the quantity imported by the importer leads to a negative demand shock in the market, which will increase the importer's bargaining power relative to the exporter and steadily reduce the exchange price. A median values of β_{fjk} could reflect a form of fairness in trade that is beneficial to all agents, by eliminating their strategic behavior. These mechanisms operate mainly if the importer and exporter are mutually interdependent.

2.2.2 Quality of product mix and exporters bargaining power

Given the form of preferences (1) in country j, foreign consumers may be more willing to pay for a high-quality food product if they value quality. Consequently, the The demand addressed to exporter f from country i by importers from country j for product k is higher for high-quality varieties. This mechanism has been widely demonstrated in the literature, as in Curzi and Olper (2012) and Crinò and Epifani (2012). Quality upgrading and product differentiation distort agricultural markets by generating greater concentration and vertical coordination, which leads to the violation of competition axioms (atomicity, product homogeneity and perfect information) (Sexton, 2013). These market conditions impact markets worldwide, leading to strategic pricing response and market power. Indeed, under imperfect competition, the rent (higher price, lower quantities) created by concentration in GVCs will be shared among agents (exporters and importers), and exporters will capture a large part of this rent by upgrading their product mix.

2.2.3 Positioning in global value chains and exporters bargaining power

Theoretical analysis of the relationship between positioning in GVCs and bargaining power is essentially based on resource dependency theory, which postulates that owners of critical

assets in the supply chain have more power and extract more value from transactions (Pfeffer and Salancik, 2003; Casciaro and Piskorski, 2005; Hillman et al., 2009; Drees and Heugens, 2013). On this basis, Mudambi (2008)'s pioneering work that highlight the existence of the *smile curve* has received several supports in the literature. Indeed, Rungi and Del Prete (2018) show a non-linear U-shaped relationship between value creation of a firm and it distance from final demand. Baldwin and Ito (2021) support this view at firm level. They show that value added has shifted from the manufacturing sectors to service sectors at the lower end and the upper end of the value chains. Indeed, on the one hand Mahy et al. (2021) and Ju and Yu (2015) show that more upstream firms could be expected to improve their bargaining power and value capture, as the initial stages of the production process are associated with critical and high-value-added activities such as innovation, R&D and design. On the other hand, as shown by Cox et al. (2001) and Burch and Lawrence (2005), a critical supply chain assets in agri-food suply chains are related to the final demand (sales space, information on consumer consumption patterns, brand). The downstream firms, like retailers, can capture a disproportionately share of the rent due to their proprietary access to private information about end-users that allow them to adopt a combination of strategies based on marketing, customized products, branding, improved distribution technology, premium access to niche markets and the offer of after-sales services (see Pham and Petersen, 2021).

The expected positive relationship between downstream position and bargaining power in the supply chain is supported by the Melitz (2003) model applied to the value chain framework. There is some evidence in the literature that the level of technology and production efficiency are among the main drivers of bargaining power (see Li et al., 2022). Costinot et al. (2013) show that in an environment where the production of the final good is sequential and subject to mistakes, their occurrence at a more downstream stages is much more costly (as they involve more upstream stages) and leads to a decrease in the intensity of value added along the value chains. As a result, only the most productive firms can position themselves downstream, resulting in higher productivity downstream than upstream. In addition, in agri-food industry, assuming that fixed capital stocks in more downstream are higher, the cutoff productivity for firms to operate more downstream will be higher. This context could lead to the exit of less productive firms and firms exhibiting higher productivity survive in more downstream markets. As a consequence, average productivity, and thus bargaining power in downstream firms, will be higher.

The property rights model, developed by Antràs and Chor (2013) and Alfaro et al. (2019), provides a rich set of theoretical predictions that explain the relationship between positioning in value chains and bargaining power. Indeed, the suppliers of sequentially complementary inputs upstream have great difficulty in valuing these inputs across producers of final goods. This makes the suppliers of these inputs dependent and less likely not to honour the contractual relationship with the final firm. The same situation prevails when inputs are substitutable with the possibility of making complete contracts. Under these conditions, the suppliers of inputs face a *hold-up* problem that could considerably reduce their bargaining power in relation to the final firm. Nevertheless, this prediction can be challenged under certain market conditions. Thus, as shown by the model, in a contractual relationship where a final good producer uses substitutable inputs, its supplier can easily value the inputs outside the contractual relationship with the final producer. This could gives greater bargaining power to the upstream supplier relative to the final producer. The same situation prevails when the inputs are sequentially complementary but it is possible to have complete contracts for the upstream inputs. A high level of contractibility reduces the *hold-up* problem for suppliers of sequentially complementary inputs and may increase their bargaining power with respect to final producers.

An empirical work by Del Prete and Rungi (2017) invalidated the property rights results in the case of upstream/midstream firms, i.e. producers of intermediate inputs can integrate either backward or forward along the chain, and that demand elasticities do not play a significant role in these integration choices. Furthermore, the results of the smile curve hypothesis, the Melitz framework applied to value chain perspectives and the property rights model correspond to analyses of the "in-between" industry, while the value created "in-within" sectors (agri-food processing sector) remains unexplored. These contrasting results in the literature on "in-between" industry analysis show that the link between firm position in GVCs and the division of surplus is an open and unresolved question. Our investigation of the sectoral effect "within" agri-food processors constitutes a notable distinction from these earlier works.

2.3 Discussion and implications

The empirical literature on the analyses on the power relations in GVCs uses mainly the markup to measure the market power. Indeed, De Vries et al. (2021) do not observe a significant relation between mark-ups and functional specialisation in GVCs, using Dutch firms. del Valle and Fernández-Vázquez (2023) use input-output table for 28 European countries and 14 manufacturing sectors between 2000 and 2014 and document the fact that the further upstream industries in GVCs have a significantly decreasing impact on market power and that this relationship is non-linear. It is worth noting that market power mainly involves unilateral strategic behavior aimed at manipulating the level of traded quantities, while bargaining power implies that two agents use a balance of power (or dependence) in their supplier-buyer relationship to influence the terms of trade (Bonanno et al., 2018). As our theoretical results show that international prices are set by negotiation, in the end, it's not the price levels that really matter, but the surplus extracted on both sides of the transaction. This is further proof of the existence of two-sided market power in international pricing mechanisms. As a result, it seems much more relevant to assess power relations in GVCs through bilateral bargaining power.

The main challenge is to empirically estimate bilateral bargaining power in cross-border relations. As it's common in the bargaining model apply to the supplier-buyer relationship, there is a perspective of a lower and an upper bound of prices, that buyer and seller, respectively, have an incentive to negotiate. From this perspective, Polachek and Yoon (1987, 1996) and Kumbhakar and Parmeter (2009) apply the bargaining model to the supplier-buyer relationship and estimate the extraction of the surplus on the value of an agent, depending on his bargaining power and information available. Using bilateral trade flows, Li et al. (2022) adapt the bargaining model approach to the context of international trade and compute the division of surplus of countries. This approach is very attractive, as it allows to estimate the bilateral division of the surplus at the firm-to-firm pair and product level. However, their use in the literature is very limited due to the unavailability of data on firm-to-firm transactions. Furthermore, the fact that the exporter or importer can unilaterally influence the quantity traded, as discussed above, reflects the exercise of market power (see Bonanno et al., 2018) on both sides of the transaction, which must be controlled to avoid bias in the estimation of bilateral bargaining power.

The findings by Del Prete and Rungi (2017) mean that upstream/midstream suppliers, such as processors in agri-food chains, could organize their GVCs both upstream and downstream to strengthen their bargaining position, regardless of demand elasticities faced by buyers. The industrial organization literature shows that vertical integration makes it possible to offer lower prices by eliminating the double marginalization problem (Gaigné et al., 2018). However, the emergence of GVCs, characterized by the division of the production pro-

cess among different countries, induces a form of hyper-specialization in functions and tasks and a governance approach based on the power distribution along supply chains. On the one hand, this hyper-specialization allows suppliers, mainly in high-income countries, to concentrate most of their resources on domestic added value, enabling them to position themselves in high-value-added activities (innovation, R&D, design, branding, marketing, management and so on). This leads to structural upgrading (product and process upgrading) within GVCs with substantial productivity growth, and participation in more sophisticated value chains and niche markets (Humphrey and Schmitz, 2002). Recent findings by Kordalska and Olczyk (2023) show a positive effect of wages and labor productivity on specialization in a R&D function. This virtuous circle between specialization, control of production networks, specialization in knowledge-intensive activities and productivity gains considerably increases the bargaining power of the supplier, which could capture high rents. In addition, in light of recent contributions in the GVCs and trade literature, Antràs and Chor (2022) argues that specialization reduces search frictions in GVCs, and could explains more bargaining power. Also, there is a mechanism, empirically validate by Rungi and Del Prete (2018), which is described as a phenomenon of domestic retention of added value, where "high-value activities are preferably kept in origin countries and performed either by independent buyers/suppliers or by domestic affiliates integrated by multinational enterprises (MNEs)". Based on the above considerations, we hypothesise that:

Hypothesis 1: *The division of surplus of a supplier in its export market is positively affected by:*

(i) further upstream position of its exports;

(ii) Further downstream position of its imports;

(iii) and, consequently, specialization along agri-food GVCs

In addition, when suppliers increase their surplus by exporting further upstream, it should be noted that the level of processing of their imports cannot be higher than that of their exports. Indeed, suppliers import less processed inputs to perform their production activities in GVCs, and export more processed output. As a result, suppliers that increase their surplus by specializing must necessarily specialize further upstream. This implies that suppliers can control key stages of input supply upstream, and thus reduce competition in these stages. The underlying intuition is that specializing the production process in a more upstream position allows suppliers to achieve functional specialization and perform knowledge-intensive activities such as innovation, R&D, design, branding and marketing. This leads to structural upgrading within GVCs, participation in more sophisticated value chains and niche markets, and control of upstream supply chain networks that reduce competition and increase bargaining power. Therefore, we hypothesise the following:

Hypothesis 2: *The specialization effect in GVCs is more pronounced in the most upstream position of the production process.*

On the other hand, the most downstream position in the production process is more specialized in low-skill, low-value-added activities, such as assembly and production of more generic goods, and faces stronger competition, which could reduce bargaining power. As a result, only most productive firms survive in most downstream stage, as discussed earlier (see Costinot et al., 2013). In addition, the property right models shows that when the *hold-up*

situation is less pronounced for the input suppliers with respect to the final producers (more downstream firms), the latter decide whether or not to integrate these suppliers. Of course, Alfaro et al. (2019) show that the most productive final firms integrate more production stages upstream, as well as Chor et al. (2021). As shown by Chor et al. (2021), increasing the number of production stages performed by firms in GVCs is associated with greater added value. This is because each additional stage performed in GVCs additively adds value to the firm. As average productivity is high in most downstream stages in GVCs, more downstream suppliers will perform more production stages, by exporting further downstream and importing further upstream (Chor et al., 2021), and will produce and export higher quality goods (Johnson, 2012; Curzi and Olper, 2012; Curzi et al., 2015). Consequently, average bargaining power in most downstream suppliers will be higher: the positive effect of productivity and quality upgrading will be higher than the negative effect of competition. We summarize by hypothesizing that:

Hypothesis 3: *Further downstream position of the suppliers' production process has an positive effect on the division of surplus in export markets by:*

(i) exporting more downstream;

(ii) importing more upstream;

(iii) and, thus performing a larger number of production stages in GVCs.

Throughout this discussion, we have shown that, whatever the positioning in GVCs, the positive effects on surplus division are mainly driven by a structural upgrading of the product mix.

3 Empirical strategy

3.1 The dataset: French agri-food industry firms and international trade statistics

The main data source used in our empirical analysis is French customs, which identifies firms through their SIREN number. French customs database reports annual information, over 2000-2018, on each firms' product-level bilateral imports and exports' value in Euro and their quantity, by partner. The products are described at a very detailed 8-digit of Combined Nomenclature (CN) and 6-digit of CPF classification. This level gives us a detailed picture of the product composition of international purchases and sales made by the firms. All the information in the customs database is collected at the border by the French customs services and can provide information on the international activities of firms. However, customs data do not allow the identification of agri-food firms. For the purpose of our study, we distinguish two main samples: sample with all transactions (All) and re-export excluding sample (Re-export Exclude)[4] at the 8-digit CN8 level. Re-exports account for a large share of transactions in our data (about 72% of the total value of exports) and are related in most cases to the main activity of exporters (about 73%). Excluding re-exports allows us to actually capture exporters' processing activities in GVCs.

[4]We identify as a re-export when a firm imports and exports the same product, defined at the most disaggregated level possible (CN8), in the same year. Then we just remove the product from the flow of goods imported and exported by the firm in that year.

Our second source of data is the AMADEUS database, which covers the 2000-2018 period. It allows to identify the firms of the French agri-food sector. It lists, with a good coverage of French firms, the main economic activity of each firm according to the NACE Rev.2 4-digit classification. The agri-food sector includes 32 NACE activity codes, all of which are present in the panel of French firms in the AMADEUS database. Limiting the analysis to a single sector – the agri-food – offers the advantage of reducing the effects of unobserved factors on firms' characteristics and decisions (strategies). Still, the data contains a certain degree of heterogeneity, due to the diversity of firms' economic activities (industries) in the agri-food sector. The indicator variable reflecting each firm's main type of economic activity permits us to capture the heterogeneity in the data. The AMADEUS database includes the turnover on the value in Euro, the number of employees, a unique identification number for firms - the SIREN number - which allows French firms to be tracked. All information on French firms in AMADEUS comes from DIANE, which is a database of Bureau Van Dijk. DIANE collects statistics from the annual accounts and balance sheets of French firms. Thus, AMADEUS provides annual data and includes only those firms that have published their annual accounts and balance sheets to the Registries of the Commercial Courts. However, AMADEUS data do not capture the domestic and international dimensions of firms' activities. This is why it is necessary to match the customs data with the AMADEUS database through the SIREN number of the Firms and the year, in order to identify agri-food firms and international dimensions of their activities.

3.2 Data explanation

3.2.1 Explained variables

The explained variables in this paper is the bargaining power parameter β_{fjk}. However, it is hardly possible to estimate this parameter. To do so, we use as a proxy the two-sided division of surplus, following Polachek and Yoon (1987, 1996), Kumbhakar and Parmeter (2009) and Li et al. (2022). Their estimates are based on the perspective of a lower and an upper bound of export product prices, depending on bargaining power of each agent. Its similar to the problem of matching prices in the supplier-buyer relationship, where the only thing each knows is the expected export product price, which is conditional on a vector of characteristics of each agent. We adopt this approach to estimate the two-sided division of surplus of exporters and their trade partners in foreign markets.

It would be better to know the identity of the actors in the cross-border supplier-buyer relationship. However, we only have information on French firms that import and/or export while the identity of their foreign trade partners is not known. Since we need to control the characteristics of the actors in the supplier-buyer relationship, we will use the attributes of French firms and the economic characteristics of the countries of firms' trade partners.

In the supplier-buyer relationship in international trade, each exporter seeks to have a high export product prices and exchange price is determined through bargaining. When market conditions remain unchanged, firms with the greatest bargaining power extract more value in transactions. Suppose that firms f, located in country i, export at price p_{fjk} depending on the destination j and product type k. we drop index i to ease notation in the following equations. According to Polachek and Yoon (1987, 1996) and Kumbhakar and Parmeter (2009), p_{fjk} can be expressed as below:

$$p_{fjk} = \underline{p_{fjk}} + \beta_{fjk}\left(\overline{p_{jfk}} - \underline{p_{fjk}}\right) \tag{13}$$

where $\underline{p_{fjk}}$ is the lowest export price that the exporter can accept, and $\overline{p_{jfk}}$ is the highest import price that the importer is willing to pay. β_{fjk} ($0 \leq \beta_{fjk} \leq 1$), respectively $1 - \beta_{fjk}$, represents the bargaining power of the exporter, respectively importer. When the export price is reached as a result of bargaining, $\beta_{fjk}\left(\overline{p_{jfk}} - \underline{p_{fjk}}\right)$ represents the surplus extracted by the exporter. Based on the basic characteristics of exporter and importer, x, one can reach the export price, $\mu_{fjk}(x)$, regardless the influence of the bargaining power of the negotiating agents. $\mu_{fjk}(x)$ is considered as the benchmark export price. Consequently, $\left(\mu_{fjk}(x) - \underline{p_{fjk}}\right)$, respectively $(\overline{p_{jfk}} - \mu_{fjk}(x))$ corresponds to the expected surplus of the exporter, respectively importer, when the final price is reached. Note that Equation (13) only captures the impact of exporter's bargaining power, and can be rewritten to capture importer's bargaining power as well:

$$p_{fjk} = \mu_{fjk}(x) + \beta_{fjk}\left(\overline{p_{jfk}} - \mu_{fjk}(x)\right) - (1 - \beta_{fjk})\left(\mu_{fjk}(x) - \underline{p_{fjk}}\right) \tag{14}$$

where $\beta_{fjk}\left(\overline{p_{jfk}} - \mu_{fjk}(x)\right) \geq 0$ is the capability of the exporter to increase their export price by extracting a share of the importer's surplus, while $(1 - \beta_{fjk})\left(\mu_{fjk}(x) - \underline{p_{fjk}}\right) \geq 0$ is the capability of the importer to lower their purchase price by extracting a share of the exporter's surplus. The net surplus $NS_{fjk} = \beta_{fjk}\left(\overline{p_{jfk}} - \mu_{fjk}(x)\right) - (1-\beta_{fjk})\left(\mu_{fjk}(x) - \underline{p_{fjk}}\right)$ describes the global effect of the bargaining on the final export price.

Based on price equation (12), we derive the following log-linear form to estimate at the firm product-destination level

$$\begin{aligned} \ln p_{fjkt} &= \mu_{fjkt}(x) + \xi_{fjkt}, \qquad (15)\\ \text{with } \mu_{fjkt}(x) &= \alpha_f \text{Controls}_{ft} + \alpha_j \text{Controls}_{jt} + \alpha_b b_{fjkt} + \alpha_s s_{fjkt} + FE_t + FE_k + FE_r + FE_j \\ \text{and } \xi_{fjkt} &= \omega_{fjkt} - u_{fjkt} + \nu_{fjkt} \end{aligned}$$

Equation (15) is similar to (14). $\ln p_{fjkt}$ is the outcome variable, in this case the firm f's export price of a good, k, to the destination j in a given year t. We use the unit values as a proxy of the product export prices. To do this, we use the detailed firm-product-country-year level French customs trade data. To describe the product, we use the 8-digit of CN classification. x is the vector of covariates, including three types of control variables: the basic characteristics of the exporter, importer and variables that reflect the interdependence between importers and exporters in each product.

We use the time-varying characteristics, Controls_{ft}, of French exporters like log productivity computed as turnover per worker, size (small: 1 to 49 employees - mid: 50 to 499 employee - large: 500 employees or more) as the attributes of French firms. We control for the time-varying economic characteristics, Controls_{jt}, of destination markets of French exporters by including the countries' GDP per capita, industrial added value as a percentage of GDP, and agricultural added value as a percentage of GDP taken from the World Bank's WDI and CEPII database. In addition, the regression controls for permanent observed and unobserved firm's main industry- (control for technology of production in a given industry), product- (control for the markup), year- and country- (control for trade cost) specific supply and demand shocks, by including firm's main activity as the NACE Rev.2 4-digit industry code, HS 4-digit of products, year and country of trade partners fixed effects.

As indicated in section 2.2.1, we need to control for market power on both sides of the transactions in order to accurately estimate bilateral bargaining power. To do so, we include

the factors that reflect the relationship between importers and exporters. Similar to Alviarez et al. (2023), we use the importer's buyer share (b_{fjkt}), defined as the share of importer j's quantity from f over the total quantity supplied by exporter f; and the exporter's supplier share (s_{fjkt}), defined as the share of exporter f's sales to j over importer j's total imports, for a given product k. In addition, the regression controls for permanent observed and unobserved firm's main industry- (control for σ, ε and the markup), product- (control for ε and the markup), year- and country- (control for trade fixed cost) specific supply and demand shocks, by including firm's main activity as the NACE Rev.2 4-digit industry code, HS four-digit of products, year and country of trade partners fixed effects. δ is the parameters vectors to be estimated.[5]

To estimate Equation (15), we use a two-stage two-tier stochastic frontier. The first stage allows us to address the standard endogeneity bias associated with OLS regressions of prices on market shares (importer's buyer share and exporter's supplier share). We follow the approach adopted by Alviarez et al. (2023) to construct instrumental variables (IVs) for the bilateral shares exploiting the network structure of intermediate input trade: for the exporter's supplier share, we consider the sales of j's other exporters to importers other than j, and for the importer's buyer share, we consider the purchases of f's other importers from exporters other than f, for a given product k.

We use the predictions from the first stage in the two-tier stochastic frontier model estimate in the second stage, following Polachek and Yoon (1987, 1996) and Kumbhakar and Parmeter (2009). The two-stage estimation controls for the endogeneity of the bilateral shares and assumes that the error, ξ_{fjkt}, components are distributed independently of each other and from the regressors, x. The second stage of the model is then estimated by the maximum likelihood (ML) method, assuming that ν_{fjkt} is normally distributed ($\nu_{fjkt} \sim i.i.d.\ N(0, \delta_\nu^2)$, and that ω_{fjkt} and u_{fjkt} follow an exponential distribution ($\omega_{fjkt} \sim i.i.d.\ Exp(\delta_\omega, \delta_\omega^2)$ and $u_{fjkt} \sim i.i.d.\ Exp(\delta_u, \delta_u^2)$).

The division of surplus captured by exporters is $\omega_{fjkt} = \beta_{fjkt}\left(\overline{P_{fjkt}} - \mu(x)\right)$, while $u_{fjkt} = (1 - \beta_{fjkt})\left(\mu(x) - \underline{P_{fjkt}}\right)$ is the division of surplus captured by importers, and ν_{fjkt} is the classical error term. The net surplus corresponds to

$$NS_{fjkt} = \omega_{fjkt} - u_{fjkt}. \tag{16}$$

The higher this index is, the higher the bargaining power of exporting firms, and the higher the ability of firms to capture the surplus relative to their buyers abroad.

The results of estimating Equation (15) are showed in Table C.1 in Appendix C. We are particularly interested in the parameter estimates ω_{fjkt} and u_{fjkt}. Taken individually, their high level of significance indicates the presence of bargaining in the cross-border supplier-buyer relationship in both sample. A quick analysis of the variance of firms' export prices in Table 1 confirms that a large part of the variation is due to bargaining. Indeed, in the Re-export excluding sample, the unexplained variation in log price is 66.59%, of which 74.70% is due to bargaining, and these results are close to those of the All transaction sample. How bargaining affects prices or not, and if so, in what direction varies by market and by firm-country pair.

Bargaining affects price, at the mean, insofar as surplus extracted by exporter is higher than surplus extracted by importer leading to an increase in export price of exporter by 14.78% relative to benchmark prices, *ceteris paribus*, in the Re-export excluding sample. In

[5]The best way to capture the effects of unobservable factors is to include firm- and CN8 product-level fixed effects. We cannot implement this solution because of the large number of firms and CN8 product in our sample and the difficulty of convergence of a maximum likelihood (ML) model, that we will use, with a so many fixed effects.

Table 1: Summary of surplus extracted and variance analysis– Two-stage Two-tier frontier

Sample	Panel A: Re-exports excluded			Panel B: All		
Summary	# observations= 178,805			# observations= 323,557		
	ω_{fjkt} (Firms)	u_{fjkt} (Countries)	NS_{fjkt}	ω_{fjkt} (Firms)	u_{fjkt} (Countries)	NS_{fjkt}
Mean	56.71	41.93	14.78	59.88	41.90	17.99
Q1	29.37	25.77	-16.49	30.23	25.97	-15.26
Q2	40.39	31.82	8.56	41.96	31.78	10.18
Q3	65.01	45.86	39.24	69.30	45.48	43.33
			Variance analysys			
$\delta^2_\omega + \sigma^2_u + \delta^2_\nu$		66.59			69.85	
$(\delta^2_w + \delta^2_u)/(\delta^2_\omega + \delta^2_u + \delta^2_\nu)$		74.70			76.47	
$\delta^2_w/(\delta^2_\omega + \delta^2_u)$		64.66			67.14	
$\delta^2_u/(\delta^2_\omega + \delta^2_u)$		35.34			32.86	

Notes: Value expressed in percent.

the All transaction sample, the net surplus is 17.99% which means that firms' exports prices are, on average, at least 17.99% above the expected value of the match for the sample.

3.2.2 Core explanatory variables

The core explanatory variables of the work are the upstreamness of imports and exports of firms. First, we use methodology developed by Fally (2012), Antràs et al. (2012) and Antràs and Chor (2013) to calculate the upstreamness of an industry in production chain. Assuming an economy with S ($S \geq 1$) industries, industry r's *upstreamness* is computed as:

$$U_r = 1.\frac{F_r}{Y_r} + 2.\frac{\sum_{s=1}^{S} d_{rs}F_s}{Y_r} + 3.\frac{\sum_{s=1}^{S}\sum_{k=1}^{S} d_{rk}d_{ks}F_s}{Yr} + 4.\frac{\sum_{s=1}^{S}\sum_{k=1}^{S}\sum_{l=1}^{S} d_{rl}d_{lk}d_{ks}F_s}{Y_r} + \dots \tag{17}$$

where F_r is the value of industry r used for final consumption , d_{rs} is the value of the output of industry r needed to produce one unit of the output of industry s, i.e. the *direct requirements* coefficient, Y_r is the gross output of industry r.

U_r is the weighted average of the number of stages from final demand (consumption or investment) at which r enters as an input in production processes. The weights correspond to 1 for the part of r's output that goes to final consumption, 2 for the part of r's output used in another industry before being absorbed by final consumption and so on. The weights in expression (17) permit the definition of the importance of industry r's share in the total output of r at each production stage. This indicator is calculated from an input-output table. Focusing on a single industry (agri-food sector), we need a highly disaggregated input-output table to identify the level of transformation of each product in order to explore the richness of French firm-level data. Since the French input-output table comes at a very high level of industry aggregation (only 2 industries identify the agri-food sector in most available tables for France except the GTAP table which identifies about 20), we use the U.S. input-output table that uses a much more narrow definition of industries (405, of which 42 agri-food), and correspondences between U.S. and French industry codes to build a highly disaggregated table

(604 4-digit NACE Rev.2 industries, of which 88 agri-food) using the exact industry codes that identify French firms' main economic activity in our data. However, this brings an important challenge because of multiple correspondences in both directions between U.S. and French industry codes. We solve this problem by allocating equal weights to all correspondences within each pair industry codes (see Appendix A fo more details).

Table 2 reports some examples from the 604 NACE Rev.2 industries identified. Not surprisingly, among the most downstream industries are retail and services industries that are close to final demand. The most upstream industries tend to be related to the agricultural and farming activities which provide raw products that mainly used in the agri-food sector.

Table 3 shows some summary statistics of the upstreamness index, comparing the agri-food industry to the other industries.

Firm's position in global value chains Following Ju and Yu (2015) and Chor et al. (2021), we consider that the level of transformation (processing) of goods used and produced by a firm indicates its position in the value chain.

Once the *upstreamness* indicators U_r are computed at industry level, we use Chor et al. (2021)'s approach to compute this indicator at firm level. We assume that all products in a given industry share the same level of upstreamness. We compute the *upstreamness* of exports (U_{ft}^X) for each firm f as the weighted average *upstreamness* of industries to which belong the products imported by the firm. We use a similar approach to compute the *upstreamness* of imports (U_{ft}^M). For our empirical analysis, we take the inverse of U_{ft}^X and U_{ft}^M to obtain $\nu \in [0,1]$, which is consistent with our theoretical framework. The difference $V_{ft}^X - V_{ft}^M$ reflects the number of production stages performed by the supplier in the global production line. We refer to it as the *intensity of GVC participation* of the firm. More specifically:

$$\begin{aligned} U_{ft}^X &= \sum_r^S \frac{X_{frt}}{X_{ft}} U_r \Rightarrow V_{ft}^X = \frac{1}{U_{ft}^X} \\ U_{ft}^M &= \sum_r^S \frac{M_{frt}}{M_{ft}} U_r \Rightarrow V_{ft}^M = \frac{1}{U_{ft}^M} \\ GVC_{ft} &= V_{ft}^X - V_{ft}^M \end{aligned} \tag{18}$$

where M_{frt} and X_{frt} are the value of imports, respectively exports, of firm f of products in industry r in period t. $M_{ft} = \sum_r^S M_{frt}$ and $X_{ft} = \sum_r^S X_{frt}$. Intuitively, the level of processing of sold (exported) products is higher than the level of processing of purchased (imported) products ($U_{ft}^X < U_{ft}^M$), as the sold products are closer to final consumption.

We present some stylized facts using only the Re-export excluding sample, but we obtain a similar picture with the All transaction sample. Figure 1a reports the aggregate trends of import- and export- *upstreamness* over the 2000-2018 period in the French agri-food sector. This figure illustrates the weighted average level of import- and export- *upstreamness* of all firms, computed at sector-level:

$$U_t^M = \sum_f \frac{M_{ft}}{M_t} U_{ft}^M, \text{ and } U_t^X = \sum_f \frac{X_{ft}}{X_t} U_{ft}. \tag{19}$$

We use firms' imports and exports as weights. $M_t = \sum_f M_{ft}$ and $X_t = \sum_f X_{ft}$ are total sector-level imports and exports in year t.

Two observations emerge from the analysis of Figure 1. First, the imports of French agri-food firms are persistently more upstream than their exports. This reflects the fact that firms tend to import intermediate goods, less processed, which they use to produce goods with a higher level of transformation (Figure 1a). A similar pattern was shown by Chor et al. (2021) in the case of China. Note that countries that mainly export primary goods and import final products may present different situations. Chor (2014) illustrates the examples of Brunei, Myanmar, Australia,

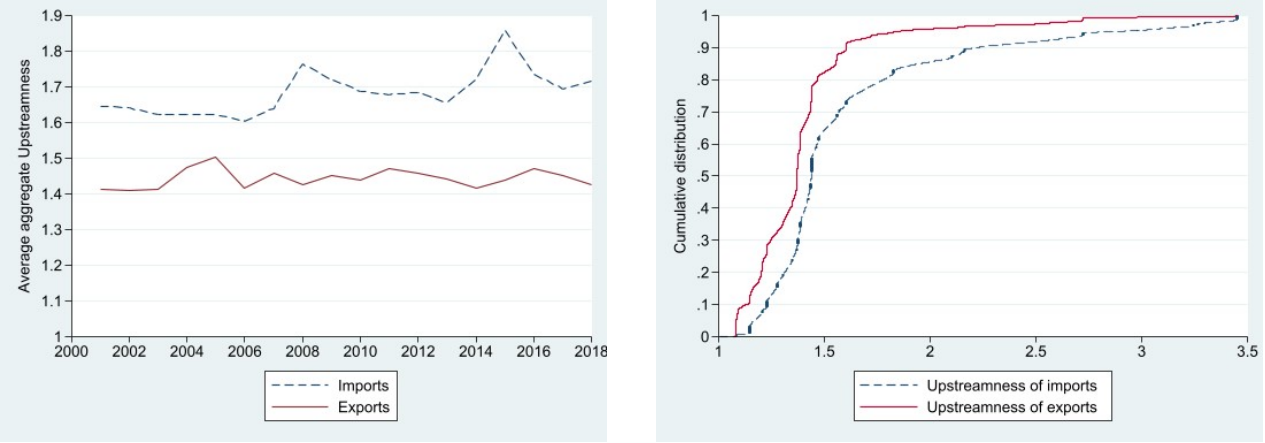
Table 2: Industry upstreamness (selection)

NACE industry	Upstreamness
Retail sale of fruit and vegetables in specialised stores	1.01
Retail sale of meat and meat products in specialised stores	1.01
Retail sale of fish, crustaceans and molluscs in specialised stores	1.01
Retail sale of bread, cakes, flour confectionery and sugar confectionery	1.01
Retail sale of beverages in specialised stores	1.01
Manufacture of rusks and biscuits; of preserved pastry goods and cakes	1.08
Manufacture of soft drinks; of mineral waters and other bottled waters	1.09
Manufacture of bread; manufacture of fresh pastry goods and cakes	1.10
Manufacture of macaroni, noodles, couscous and similar farinaceous products	1.15
Manufacture of beer	1.19
Manufacture of prepared meals and dishes	1.20
Manufacture of grain mill products	1.21
Restaurants and mobile food service activities	1.22
Manufacture of wine from grape	1.23
Growing of vegetables and melons, roots and tubers	1.28
Processing and preserving of poultry meat	1.31
Manufacture of condiments and seasonings	1.35
Production of meat and poultry meat products	1.37
Operation of dairies and cheese making	1.38
Manufacture of cocoa, chocolate and sugar confectionery	1.39
Manufacture of sugar	1.42
Processing and preserving of meat	1.44
Growing of perennial crops	1.46
Processing of tea and coffee	1.47
Manufacture of fruit and vegetable juice	1.47
Processing and preserving of fish, crustaceans and molluscs	1.60
Marine fishing	1.66
Freshwater fishing	1.69
Freshwater aquaculture	1.86
Sewerage	1.89
Growing of sugar cane	2.07
Marine aquaculture	2.10
Raising of swine/pigs	2.10
Raising of other animals	2.15
Raising of poultry	2.16
Manufacture of starches and starch products	2.16
Manufacture of oils and fats	2.72
Raising of dairy cattle	2.98
Manufacture of prepared feeds for farm animals	3.24
Raising of other cattle and buffaloes	3.30
Growing of rice	3.38
Growing of cereals (except rice), leguminous crops and oil seeds	3.45
Post-harvest crop activities	3.61
Seed processing for propagation	3.61

Notes: Computed by authors from the U.S. input-output table converted to NACE Rev.2 4-digit.

Table 3: Summary statistics of upstreamness index according to the type of industry

	Frequency	Min	Max	Mean	Std. dev.
Upstreamness - all industries	604	1.00	4.51	1.88	0.75
Upstreamness - agrifood	88	1.08	3.61	1.85	0.72



(a) Average import and export upstreamness

(b) Cumulative distribution of French firms

Figure 1: The *Upstreamness* of French agri-food firms

and New Zealand, whose exports are more upstream (mainly concentrated in agriculture and primary products) than imports. Second, the cumulative distribution of the *upstreamness* of French agri-food firms displays a similar pattern (Figure 1b). The gap between the import and export curves reflect an average span of production stages performed by these firms.

Second, we observe a slight widening of the span of production stages performed by firms in Figure 1a. This means that the French agri-food sector can be considered as an important contributor to the domestic value added of French exports.

Table B.1 in Appendix B summarizes the statistics of variables used in the empirical analysis for GVCs' (both importing and exporting firms) firms in French agri-food industry, and for the Re-export excluding sample.

3.3 Empirical modelling

The paper focus on the effects of upstreamness of exports and imports of agri-food exporter on the bilateral division of surplus. We seek to test three main theoretical predictions that the division of surplus is affected by the upstreamness of exports, and imports, and the number of production stages performed in GVCs by suppliers. Accordingly, we set the linear forms as follows:

$$NS_{fjkt} = \alpha_0 + \alpha_\nu\{\{\boldsymbol{V}^X_{ft}, \boldsymbol{V}^M_{ft}\}, \boldsymbol{V}^X_{ft} - \boldsymbol{V}^M_{ft}\} + \alpha_c \text{Controls}_{ft} + FE_f + FE_{rt} + FE_{rj} + FE_{jk} + \epsilon_{fjkt}, \tag{20}$$

where NS_{fjkt} is the outcome variable, obtained from (16), which captures the surplus obtained by supplier f in its export transaction to country j of product k in year t. The key regressors of interest are in turn the inverse of the two upstreamness measures (export upstreamness, V^X_{ft}, and import upstreamness, V^M_{ft}) which capture heterogeneity in the boundaries of French suppliers in GVCs, and the difference between the two, $V^X_{ft} - V^M_{ft}$ which is informative about the number of stages performed by the suppliers in GVCs, domestically. Our theoretical predictions suggest that

α_ν should be negative and positive for V_{ft}^X and V_{ft}^M, respectively, and consequently negative for $V_{ft}^X - V_{ft}^M$.

In regression (20), we includes time-varying firm characteristics, Controls_{ft}, such as productivity and size group. Coefficient estimates of interest vary only marginally and all results are robust to the omission of these controls. We also control for permanent observed and unobserved firm characteristics with firm fixed effects, FE_f, and industry-specific supply and demand shocks with industry-by-year dummies, FE_{rt}, where r denotes the NACE Rev.2 4-digit industry code which correspond to the firm f's primary activity. Likewise, countries of trade partners of French agri-food firms are very diverse. To ensure that we do not mistake any other destination country × industry, we control for their specific supply and demand shocks, as well as institutional context (financial development and financial constraints, comparative advantage) by using industry-country fixed effects, FE_{rj}. We also control for country-specific and product-specific characteristics through the country-product fixed effects (FE_{jk}). These estimates are therefore not affected by the cross-border integration decisions or the intra-firm trade that could affect product price (Berlingieri et al., 2021; Alfaro et al., 2019). These fixed effects also control for trade costs that vary by product and destination country, product market concentration, gravity factors (distance, market size, multilateral resistance, etc.), specificity of some product according to the codifiability or task required for their production, and so on.

We run regressions (20) by using ordinary least squares (OLS) to assess primarily robust correlations. Given the skews of the division of surplus, we drop firms in the top two and bottom two percentiles of the measure of the net surplus from the samples in all regressions. All standard errors are clustered by country in order to take into account the interdependence between firms in each specific market.

As we control for firm, industry-by-year, industry-by-country and product-by-country fixed effects (FE_f, FE_{rt}, FE_{rj} and FE_{jk}), and also including time-varying control variables in the regression, we compare changes within firm-country-product over time. Furthermore, our rich set of fixed effects allows us to control for the potential omitted variable bias. Therefore, the signs and sizes of the coefficients of interest α_{V_n} capture the within firm-country-product heterogeneous effects of the GVCs' position and the number of stages performed by French agri-food exporters on the bilateral division of surplus.

4 Empirical results

4.1 How do positioning and specialization along GVCs affect the division of surplus?

Following our theoretical discussion, we have hypothesized that the further upstream export and further downstream import, and consequently specialization of the production process along agri-food GVCs increase increase the suppliers' division of surplus (H1). In this section, we test these hypotheses by estimating Equation (20), with V_{ft}^X and V_{ft}^M, and $V_{ft}^X - V_{ft}^M$ as the key regressors of interest. Results are reported, respectively, Table 4. Specifications in Columns 1 and 3 do not include the time-varying firm characteristics, Controls_{ft}, unlike in Column 2 and 4. In Panel A, we consider the Re-export excluding sample, while Panel B deals with the All transaction sample. In all specifications, we use our set of fixed effects (firm, industry-year, industry-country and country-product) to make it possible to compare the effects of our variables of interest within suppliers, for a given destination-product and year.

Concerning our key variables in Columns 1-2 in the Re-export excluding sample (Panel A), we show that the coefficients of the variable V_{ft}^X and V_{ft}^M are negative and positive, respectively, and highly significant. This means that more upstream position of suppliers' exports and more downstream position of their imports are associated with significantly higher division of surplus, in their export market. In terms of magnitudes, this means that each additional production stage

Table 4: Firm's position in GVCs and division of surplus

Sample	Panel A: Re-exports excluded				Panel B: All			
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
V_{ft}^X	-0.2533***	-0.2258***			0.0755	0.0816		
	(0.0547)	(0.0528)			(0.0576)	(0.0560)		
V_{ft}^M	0.0375**	0.0431**			0.0053	0.0130		
	(0.0169)	(0.0175)			(0.0165)	(0.0177)		
$(V_{ft}^X - V_{ft}^M)$			-0.0659***	-0.0672***			0.0058	-0.0000
			(0.0158)	(0.0167)			(0.0175)	(0.0183)
ln Productivity$_{ft}$		0.0919***		0.0923***		0.1028***		0.1028***
		(0.0084)		(0.0084)		(0.0033)		(0.0033)
Firm size:								
Small$_{ft}$		reference		reference		reference		reference
Medium$_{ft}$		0.1070***		0.1084***		0.1369***		0.1366***
		(0.0082)		(0.0084)		(0.0048)		(0.0048)
Large$_{ft}$		0.1892***		0.1909***		0.1452***		0.1444***
		(0.0137)		(0.0138)		(0.0087)		(0.0087)
Fixed effects	firm, industry-year, industry-country, product-country							
Observations	107,994	107,994	107,994	107,994	258,160	258,160	258,160	258,160
R^2	0.684	0.685	0.684	0.685	0.660	0.662	0.660	0.662

Notes: Small: 1 to 49 employees; Medium: 50 to 499 employees; Large: 500 employees or more. The sample comprises the matched French Customs-AMADEUS 2002-2017 data. Observations with bargaining power smaller than the 2st percentile or larger than the 99th percentile are dropped. Standard errors clustered by country in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

outsourced by the suppliers upstream in their inputs market increases their division of surplus by 3.75-4.31 p.p. Also, an additional production stage outsourced by the suppliers downstream in their export market enhances their surplus by 25.33-22.58 p.p.. These findings are all in accordance with our theoretical hypotheses H1(i) and H1(ii).

As discussed earlier, the surplus captured by a supplier in its export market increases as it specializes in GVCs. Note that specialization means that $V_{ft}^X - V_{ft}^M$ becomes increasingly narrow. The estimated coefficients of the $V_{ft}^X - V_{ft}^M$ term are all negative and significant (Columns 3-4 in Panel A). This fully confirms the theoretical assumption, H1(iii), that the division of surplus of suppliers in their export market, increases as they specialize in GVCs.

We turn now to assess the validity of our hypotheses in the All transaction sample in Panel B of Table 4. We show that the coefficients of V_{ft}^X and V_{ft}^M are all not significant. Furthermore, the sign of the coefficients of V_{ft}^X, become positive (compared to the results in Panel A).This means that taking re-exports into account, which are preponderant in our data, shows that the suppliers making them may have a greater interest in exporting further downstream and closer to final consumption, in order to capture more value. The effects for more upstream suppliers and those for more downstream suppliers may cancel each other out, hence these results. Indeed, to capture more rents, upstream suppliers have no interest in re-exporting and will have every interest in specializing in the production of goods further upstream, while downstream suppliers will have every interest in producing and re-exporting goods closer to final consumption. These two effects are opposite in the sample of all transactions, and would be at the source of the results we observe in Columns 1-2 in panel B. These comments are in line with H3's claims, and we can empirically test these hypotheses in our data with sub-sample regressions.

Similarly, the coefficients of $V_{ft}^X - V_{ft}^M$ are also not significant in the All transaction sample (Columns 3-4 in Panel B). In addition to the previous comments, these results show that when re-exports are taken into account, the importance of processing activities in GVCs, and thus specialization, in increasing surplus is ambiguous, as we do not control for the position of the production process along GVCs. There could therefore be heterogeneity between production processes fur-

ther upstream and further downstream, which needs to be taken into account through sub-sample regressions.

4.2 Does upstream or downstream specialization have a greater impact on value capture?

According to the fact that specialization along GVCs by importing further downstream and exporting further upstream, the effects of supplier position in GVCs and specialization along the chain on the division of surplus are more pronounced with the more upstream position of the production process (H2). However, as the most productive producers are further downstream in the GVCs, suppliers of high-quality products also specialize in these stages. They perform a larger number of production stages in GVCs, by importing more upstream and exporting more downstream, and therefore capture more rents (H3). To test for these patterns, we deal with core activity heterogeneity of suppliers by generating sub-samples of more downstream and more upstream position depending on whether the upstreamness of the NACE Rev.2 4-digit industry code of a supplier's main activity is below or above the sample median.

Using a sub-sample regression in the data, we estimate Equation (20) with V_{ft}^X and V_{ft}^M, and $V_{ft}^X - V_{ft}^M$ as key variables, respectively. Table 5 shows the results with V_{ft}^X and V_{ft}^M as key regressors of interest, while Table 6 presents the results with $V_{ft}^X - V_{ft}^M$ as key variable. Once again, specifications in Columns 1 and 3 do not include the time-varying firm characteristics, Controls_{ft}, unlike in Columns 2 and 4, and we use our set of fixed effects, as previously, in all specifications.

Table 5: Firm's position in GVCs and division of surplus – low versus high level of upstreamness of the core activity of firms

Sample	Panel A: Re-exports excluded				Panel B: All			
Sub-sample	More downstream firms		More Upstream firms		More downstream firms		More Upstream firms	
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
V_{ft}^X	0.0052	0.0131	-0.5522***	-0.4988***	0.2520***	0.2453***	-0.1920**	-0.1723**
	(0.0536)	(0.0540)	(0.0969)	(0.0931)	(0.0574)	(0.0567)	(0.0879)	(0.0823)
V_{ft}^M	0.0177	0.0040	0.0465	0.0743***	-0.0329**	-0.0345**	0.0398	0.0745**
	(0.0205)	(0.0208)	(0.0285)	(0.0277)	(0.0146)	(0.0155)	(0.0314)	(0.0320)
$\ln \text{Productivity}_{ft}$		0.1029***		0.0869***		0.0947***		0.1063***
		(0.0140)		(0.0082)		(0.0063)		(0.0051)
Firm size:								
Small_{ft}		reference		reference		reference		reference
Medium_{ft}		0.1004***		0.1232***		0.1100***		0.1673***
		(0.0103)		(0.0123)		(0.0078)		(0.0084)
Large_{ft}		0.1947***		0.1995***		0.1425***		0.1546***
		(0.0166)		(0.0225)		(0.0099)		(0.0154)
Fixed effects	firm, industry-year, industry-country, product-country							
Observations	52,725	52,725	52,977	52,977	120,880	120,880	133,401	133,401
R^2	0.735	0.736	0.684	0.685	0.727	0.728	0.641	0.643

Notes: Small: 1 to 49 employees; Medium: 50 to 499 employees; Large: 500 employees or more. The sample comprises the matched French Customs-AMADEUS 2002-2017 data. Observations with bargaining power smaller than the 2st percentile or larger than the 99th percentile are dropped. Standard errors clustered by country in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Panel A in Table 5 shows that, in the Re-export excluding sample, our theoretical hypothesis, H2, hold only in the sub-sample of the most upstream suppliers (Columns 3-4), and mainly when we control for the time-varying controls (Column 4). The coefficients have almost doubled for the

variables V_{ft}^X and V_{ft}^M, respectively, compared to the results for the whole Re-export excluding sample in Columns 1-2 of Panel A in Table 4.

The results in All transaction sample (Panel B) uncover a certain heterogeneity by taking into account the upstreamness of the suppliers' main activity in sub-sample regression. The negative and positive signs of coefficients of V_{ft}^X and V_{ft}^M, respectively, hold only in the sub-sample of most upstream position (Columns 3-4), according to our theoretical hypothesis, H2. We obtain inverse effects in the sub-sample of most downstream position, in line with H3. The coefficients of V_{ft}^X and V_{ft}^M are mostly highly significant (Columns 1-4). This shows that, although we found non-significant coefficients for V_{ft}^X and V_{ft}^M for the whole All transaction sample (Columns 1-2 of Panel B in Table 4), the heterogeneity in core activities has significant effects. Therefore, more downstream suppliers that re-export have a strong interest to export more downstream, in order to capture more value. In addition, importing more upstream also had a significantly positive impact on the division of surplus among more downstream re-exporting suppliers. These results are perfectly in line with expectations (H3). Indeed, suppliers that re-export essentially seek to maximize their control over the upstream supply chain, creating a situation of upstream oligopsony and downstream monopsony. This can result in significant re-exporting activities, where suppliers import large quantities of the goods they produce, which are then re-exported. This rationale is entirely consistent with what we observe in the data, since re-exports account for a large share of transactions and are linked, in most cases, to the suppliers' core activity. More importantly, the negative relationship between V_{ft}^M and the division of surplus among more downstream re-exporting suppliers means that re-exporting activities are complementary to suppliers' processing activities in GVCs, and not a substitute for them. This further reinforces the aim of suppliers to control the upstream supply chain in order to strengthen their bargaining power downstream. In summary, our theoretical assumptions, H2, H3*i* and H3*ii*, are empirically validated in both samples and, more specifically, for suppliers further downstream in the All transaction sample, that capture more value by exporting closer to final consumption and importing further upstream.

Table 6: Firm's expansion along GVCs and division of surplus – low versus high level of upstreamness of the core activity of firms

Sample	Panel A: Re-exports excluded				Panel B: All			
Sub-sample	More downstream firms		More Upstream firms		More downstream firms		More Upstream firms	
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
$(V_{ft} - V_{ft}^M)$	-0.0149	-0.0020	-0.1115***	-0.1293***	0.0591***	0.0600***	-0.0633**	-0.0896***
	(0.0169)	(0.0177)	(0.0247)	(0.0245)	(0.0164)	(0.0169)	(0.0295)	(0.0299)
ln Productivity$_{ft}$		0.1029***		0.0892***		0.0954***		0.1066***
		(0.0140)		(0.0085)		(0.0063)		(0.0052)
Firm size:								
Small$_{ft}$		reference		reference		reference		reference
Medium$_{ft}$		0.1004***		0.1285***		0.1087***		0.1672***
		(0.0103)		(0.0131)		(0.0078)		(0.0084)
Large$_{ft}$		0.1948***		0.2111***		0.1397***		0.1548***
		(0.0166)		(0.0238)		(0.0098)		(0.0154)
Fixed effects	firm, industry-year, industry-country, product-country							
Observations	52,725	52,725	52,977	52,977	120,880	120,880	133,401	133,401
R^2	0.735	0.736	0.683	0.685	0.727	0.728	0.641	0.643

Notes: Small: 1 to 49 employees; Medium: 50 to 499 employees; Large: 500 employees or more. The sample comprises the matched French Customs-AMADEUS 2002-2017 data. Observations with bargaining power smaller than the 2st percentile or larger than the 99th percentile are dropped. Standard errors clustered by country in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

We next move to test the effects of the specialization position along GVCs, focusing on $V_{ft}^X - V_{ft}^M$

as key regressor of interest and using a sub-sample regression. We therefore follow the same procedure as before, estimating (20), using a sub-sample of the most downstream and most upstream activities of the supplier's core industry. The results are reported in Table 6. In line with the theoretical hypothesis, H2, baseline results in Re-export excluding sample hold only in the sub-sample of the most upstream position of suppliers (Columns 3-4 in Panel A). These results are also observed in the sub-sample of most upstream position in the All transaction sample (Columns 3-4 in Panel B). Indeed, above all, our prediction (H2) continue to hold in both samples and the same conclusions apply, as before. In columns 1-2 in Panel B (All transaction sample), the estimates indicate a significant tendency to capture more value by expanding both upstream and downstream of most downstream suppliers, in line with H3. Consequently, more downstream suppliers need to perform more production stages in GVCs in order to capture more value, confirming H3*iii*. These results are very similar to the previous ones in Table 5, and mainly confirm what we said earlier, that re-export activities are complements to suppliers' processing activities in GVCs, among most downstream suppliers in the All transaction sample.

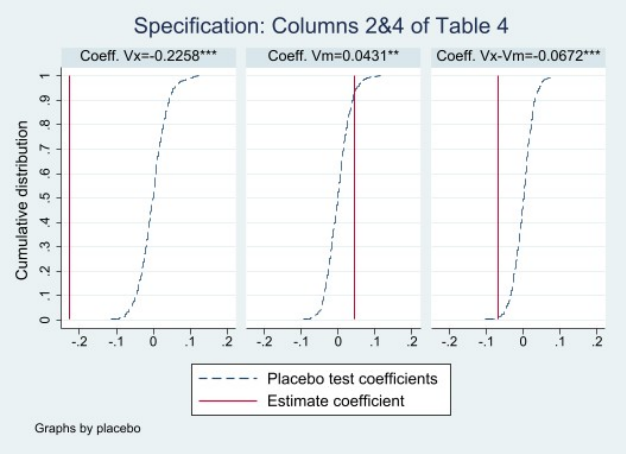
5 Robustness check

The above theoretical and empirical evidence indicates that further upstream position of exports and further downstream position of imports, and consequently specialization of the production process in more upstream position along agri-food GVCs increase the bargaining power of suppliers. However, suppliers that specialize in the most downstream stages increase their bargaining power by importing further upstream and exporting further downstream, and thus performing more stages in GVCs. We have performed three exercises to test the robustness of these results: (1) we conduct a placebo test by considering endogeneity or random effects; (2) we compute the industry- and firm-level upstreamness, following the methodology described in Section 3.2.2, using French IO tables from GTAP database; and (3) we test the heterogeneity related to the upstreamness of the exports of suppliers.

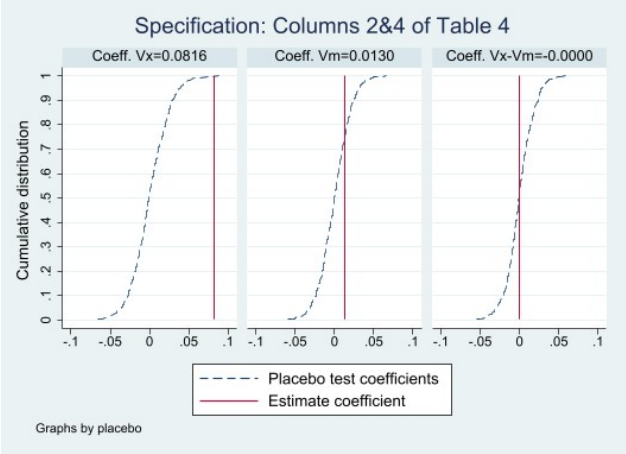
5.1 Placebo test

The OLS estimations of Equation (20) may be subject to a classic endogeneity problem as a common set of determinants, that cannot be observed and captured, affects both the GVC bargaining power indices and the GVCs' position patterns of suppliers. Although we absorb permanent observed and unobserved firm characteristics, sector-, product- and country-specific supply and demand shocks with firm fixed effects, sector-by-year, country-by-product and country-by-year dummies respectively, other time-varying firm features may not be observed and controls may not be sufficient to capture all the influencing factors. Also, the relationship between the GVCs' position patterns and the GVC bargaining power indices may be due to random effects. We try to test the absence of these biases by constructing a counterfactual placebo test. More specifically, using the existing data, we randomize the value of the GVCs' position measures to firms and then regress the equation (20). We randomly selected 500 times, and are mainly interested in the position of the estimated coefficients of the variables of interest V_{ft}^X and V_{ft}^M, and $V_{ft}^X - V_{ft}^M$ in sub-sample regressions (Tables 5 and 6), relative to the distribution of the estimated coefficients from the placebo samples. If the main results presented in Tables 4, 5 and 6 are established, the placebo coefficients will not significantly deviate from the 0 point, and the estimated coefficients of V_{ft}^X and V_{ft}^M, and $V_{ft}^X - V_{ft}^M$ will be at or beyond the tails of the distribution of coefficients estimated from the randomly generated pseudo-treatment groups.

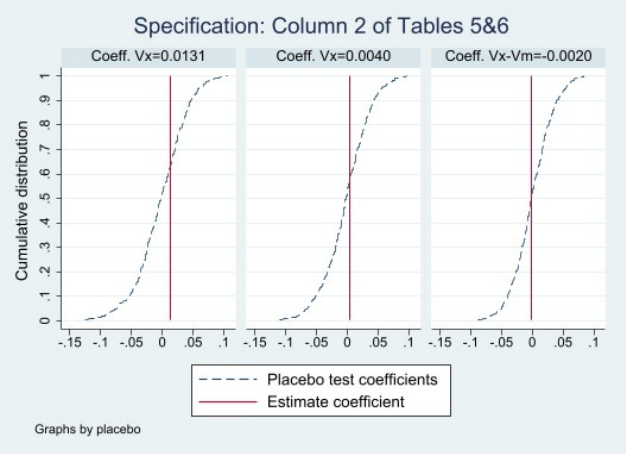
Figures 2 show the results of placebo test. As expected, most of the placebo coefficients are very close to 0 and normally distributed. The only times the tested coefficients are found at the heart of the distributions of coefficients estimated with placebo samples (Figures 2b and 2c) correspond to the moment they (tested coefficients) are not significant, and are close to 0 as well. Thus, all results indicate that there is no recognition bias in the model setting and the baseline results do not



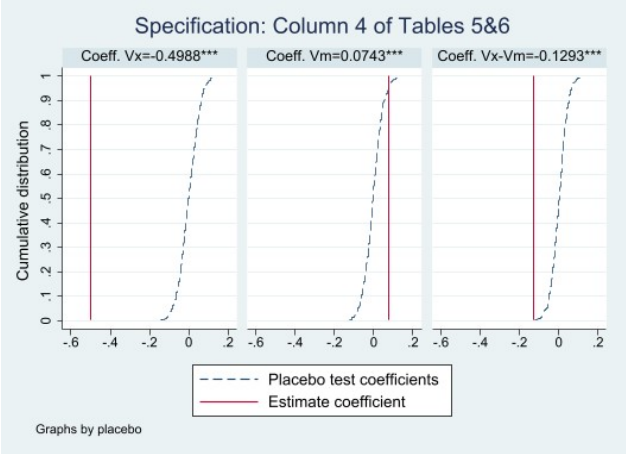
(a) Regressions with whole Re-export excluded sample



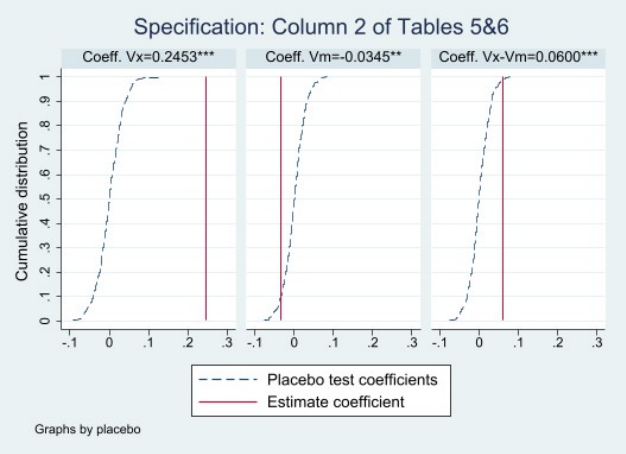
(b) Regressions with whole All transaction sample



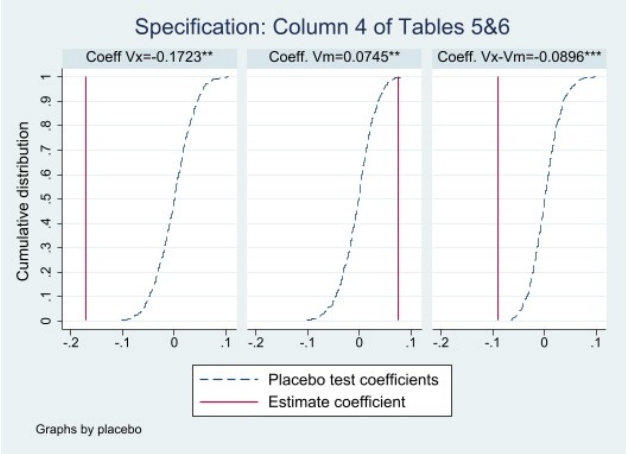
(c) Sub-sample regressions on more downstream firms in the Re-export excluded sample



(d) Sub-sample regressions on more upstream firms in the Re-export excluded sample



(e) Sub-sample regressions on more downstream firms in the All transaction sample



(f) Sub-sample regressions on more upstream firms in the All transaction sample

Figure 2: Distribution of V_{ft}^X and V_{ft}^M, and $V_{ft}^X - V_{ft}^M$ placebo coefficients versus estimated coefficients

produce serious errors. These results are also confirmed by the mean values of the coefficients of the placebo treatment variables which do not significantly deviate from the 0 point.

5.2 Upstreamness from GTAP input-output table of France

The level of aggregation of the French IO tables available led us to rely on the US IO table, assuming a high degree of stability in production structures in the US and France. Nevertheless, the questioning of this hypothesis may alter our basic results. To test this, we rely on the GTAP IO table for France. First, we match the 4-digit NACE Rev.2 industrial codes to the industries in the GTAP database for France, using the NACE, HS6 and GTAP code correspondence tables. we check the consistency of industry upstreamness across the two input-output table, by performing a Spearman rank correlation test. The correlation is 0.70, and shows that the two IO tables match well. Then, we compute the firm-level upstreamness and use them as explained variables in the regression (20). We expect that, although the GTAP IO table is highly aggregated, the results obtained will not be fundamentally different from our baseline results.

As in Tables 4, 5 and 6, Columns 1 and 3 of Tables 7, 8 and 9 do not include the time-varying firm characteristics, Controls_{ft}, unlike Columns 2 and 4, and all specifications include our set of fixed effects. Panel A refer to Re-export excluded sample, while Panel B deals with the All transaction sample. The results in Table 7, across whole samples, confirm our hypothesis, H1, whether in the Re-export excluded sample or in the All transactions sample, whereas this hypothesis was confirmed by our baseline results in the Re-export excluded sample only (panel A in table 4). Furthermore, the coefficients of the variables of interest are very close in the estimates with the Re-export excluded sample (Panel A) in Tables 4 and 7.

On the one hand, the results of the sub-sample regressions (Tables 8 and 9) confirm the hypothesis, H2, in columns 3 and 4 of panels A and B, for suppliers that position and specialize further upstream, as in our baseline results (columns 3 and 4 of panels A and B in Tables 5 and 6). In contrast, we are unable to confirm our hypothesis, H3, either in the Re-export excluded sample or in the All transaction sample. On the other hand, the results of our robustness tests show almost full confirmation of the H1 hypothesis, whatever the sample or sub-sample considered in the Tables 7, 8 and 9. To summarize, using GTAP IO to compute upstreamness, we confirm our baseline results only for the theoretical hypotheses H1 and H2, whereas the baseline results for H3 cannot be confirmed.

Table 7: Robustness test II: Firm's position in GVCs and division of surplus

Sample	Panel A: Re-exports excluded				Panel B: All			
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
V_{ft}^X	-0.2207***	-0.1326*			-0.1685	0.0132		
	(0.0713)	(0.0714)			(0.1073)	(0.1090)		
V_{ft}^M	0.0357	0.0405*			0.1626***	0.1631***		
	(0.0221)	(0.0219)			(0.0308)	(0.0298)		
$(V_{ft}^X - V_{ft}^M)$			-0.0531**	-0.0491**			-0.1631***	-0.1493***
			(0.0208)	(0.0204)			(0.0326)	(0.0314)
ln Productivity$_{ft}$		0.0917***		0.0920***		0.1027***		0.1023***
		(0.0084)		(0.0085)		(0.0032)		(0.0033)
Firm size:								
Small$_{ft}$		reference		reference		reference		reference
Medium$_{ft}$		0.1081***		0.1083***		0.1376***		0.1373***
		(0.0084)		(0.0084)		(0.0048)		(0.0048)
Large$_{ft}$		0.1909***		0.1914***		0.1469***		0.1464***
		(0.0138)		(0.0138)		(0.0086)		(0.0087)
Fixed effects	firm, industry-year, industry-country, product-country							
Observations	107,994	107,994	107,994	107,994	258,160	258,160	258,160	258160
R^2	0.684	0.685	0.684	0.685	0.660	0.662	0.660	0.662

Notes: Small: 1 to 49 employees; Medium: 50 to 499 employees; Large: 500 employees or more. The sample comprises the matched French Customs-AMADEUS 2002-2017 data. Observations with bargaining power smaller than the 2st percentile or larger than the 99th percentile are dropped. Standard errors clustered by country in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: Robustness test II: Firm's position in GVCs and division of surplus – low versus high level of upstreamness of the core activity of firms

Sample	Panel A: Re-exports excluded				Panel B: All			
Sub-sample	More downstream firms		More Upstream firms		More downstream firms		More Upstream firms	
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
V_{ft}^X	-0.3688***	-0.2472**	-0.1188	-0.0997	-0.1565	0.1496	-0.0480	-0.0356
	(0.1274)	(0.1203)	(0.1161)	(0.1159)	(0.1567)	(0.1576)	(0.1801)	(0.1800)
V_{ft}^M	-0.0225	0.0028	0.1151***	0.1232***	0.1135***	0.1033***	0.2748***	0.2940***
	(0.0320)	(0.0299)	(0.0400)	(0.0390)	(0.0324)	(0.0319)	(0.0562)	(0.0528)
ln Productivity$_{ft}$		0.0496***		0.1015***		0.0969***		0.1028***
		(0.0138)		(0.0067)		(0.0062)		(0.0033)
Firm size:								
Small$_{ft}$		reference		reference		reference		reference
Medium$_{ft}$		0.1573***		0.1029***		0.1435***		0.1356***
		(0.0194)		(0.0086)		(0.0114)		(0.0050)
Large$_{ft}$		0.2832***		0.1614***		0.1532***		0.1438***
		(0.0311)		(0.0183)		(0.0157)		(0.0114)
Fixed effects	firm, industry-year, industry-country, product-country							
Observations	43,278	43,278	63,305	63,305	112,362	112,362	143,654	143,654
R^2	0.751	0.752	0.646	0.648	0.738	0.739	0.613	0.615

Notes: Small: 1 to 49 employees; Medium: 50 to 499 employees; Large: 500 employees or more. The sample comprises the matched French Customs-AMADEUS 2002-2017 data. Observations with bargaining power smaller than the 2st percentile or larger than the 99th percentile are dropped. Standard errors clustered by country in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: Robustness test II: Firm's expansion along GVCs and division of surplus – low versus high level of upstreamness of the core activity of firms

Sample	Panel A: Re-exports excluded				Panel B: All			
Sub-sample	More downstream firms		More Upstream firms		More downstream firms		More Upstream firms	
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
$(V_{ft}^X - V_{ft}^M)$	-0.0044	-0.0190	-0.1155***	-0.1203***	-0.1160***	-0.0891***	-0.2486***	-0.2640***
	(0.0308)	(0.0287)	(0.0397)	(0.0399)	(0.0330)	(0.0329)	(0.0591)	(0.0560)
$\ln$ Productivity$_{ft}$		0.0530***		0.1015***		0.0949***		0.1029***
		(0.0143)		(0.0067)		(0.0066)		(0.0033)
Firm size:								
Small$_{ft}$		reference		reference		reference		reference
Medium$_{ft}$		0.1600***		0.1029***		0.1415***		0.1354***
		(0.0194)		(0.0086)		(0.0116)		(0.0050)
Large$_{ft}$		0.2886***		0.1614***		0.1505***		0.1439***
		(0.0313)		(0.0183)		(0.0162)		(0.0114)
Fixed effects	firm, industry-year, industry-country, product-country							
Observations	43,278	43,278	63,305	63,305	112,362	112,362	143,654	143,654
R^2	0.751	0.752	0.646	0.648	0.738	0.739	0.613	0.615

Notes: Small: 1 to 49 employees; Medium: 50 to 499 employees; Large: 500 employees or more. The sample comprises the matched French Customs-AMADEUS 2002-2017 data. Observations with bargaining power smaller than the 2st percentile or larger than the 99th percentile are dropped. Standard errors clustered by country in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5.3 Sub-sample regressions using upstreamness of exports

To validate the hypotheses H2 and H3, we used sub-sample regressions based on suppliers' main activities. However, in most cases, suppliers are multi-product firms, making it difficult, if not impossible, to classify them. The only way to get a relatively precise idea of the firms' activities is to observe their production. Assuming that export of goods does indeed reflect a firm's production activities, we can capture its position in supply chains with greater precision, thanks to the upstreamness of exports indicator. To test our baseline results in Tables 5 and 6, we use heterogeneity in the processing levels of goods exported by firms. To do this, we construct quintiles of the upstreamness of exports and consider the sub-samples of observations that lie in the first and last quintiles to run the regression (20). The sub-sample in the first quintile corresponds to firms producing goods further upstream in GVCs, while the last quintile corresponds to firms producing goods closer to final consumption. We expect the hypotheses H2 and H3 to be confirmed in the first and last quintile sub-samples, respectively, and in line with results in Tables 5 and 6, respectively.

Columns 3-4 in Tables 10 and 11 present the results, and as expected, confirm our baseline results for the hypothesis H2, for the most upstream firms. Once again, we are unable to confirm our baseline results for the hypothesis H3, particularly in the All transaction sample in Tables 10 and 11.

6 Mechanism test

In this section, we explore why positioning in GVCs has these effects on the division of surplus. As emphasized by the theoretical hypotheses, three main factors determine the distribution of surplus for firms participating in GVCs: market power through the manipulation of traded quantities, efficiency and product mix upgrading and GVC positioning. Theoretical discussions also highlight that the effects of positioning in GVCs are mainly due to efficiency and quality upgrading. Since we control for two-sided market power and efficiency when estimating bargaining power, by including in the

Table 10: Robustness test III: Firm's position in GVCs and division of surplus – low versus high level of upstreamness of exports

Sample	Panel A: Re-exports excluded				Panel B: All			
Sub-sample	More downstream firms		More Upstream firms		More downstream firms		More Upstream firms	
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
V_{ft}^X	-0.3327	-0.3736	-0.4498***	-0.3573***	0.0743	-0.1570	-0.4182***	-0.0851
	(0.2832)	(0.2700)	(0.1241)	(0.1271)	(0.2264)	(0.2163)	(0.0980)	(0.1045)
V_{ft}^M	-0.0356	-0.0613**	0.1937***	0.1903***	0.0066	0.0039	0.1443***	0.1160**
	(0.0321)	(0.0302)	(0.0386)	(0.0385)	(0.0210)	(0.0216)	(0.0539)	(0.0521)
ln Productivity$_{ft}$		0.1068***		0.0569***		0.1110***		0.0926***
		(0.0179)		(0.0170)		(0.0083)		(0.0080)
Firm size:								
Small$_{ft}$		reference		reference		reference		reference
Medium$_{ft}$		0.0601***		0.1469***		0.0977***		0.1487***
		(0.0170)		(0.0261)		(0.0142)		(0.0178)
Large$_{ft}$		0.1594***		0.0777		0.1373***		0.1327***
		(0.0316)		(0.0526)		(0.0222)		(0.0307)
Fixed effects	firm, industry-year, industry-country, product-country							
Observations	18,055	18,055	21,476	21,476	41,802	41,802	53,414	53,414
R^2	0.729	0.730	0.741	0.741	0.715	0.717	0.725	0.726

Notes: Small: 1 to 49 employees; Medium: 50 to 499 employees; Large: 500 employees or more. The sample comprises the matched French Customs-AMADEUS 2002-2017 data. Observations with bargaining power smaller than the 2st percentile or larger than the 99th percentile are dropped. Standard errors clustered by country in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 11: Robustness test III: Firm's expansion along GVCs and division of surplus – low versus high level of upstreamness of exports

Sample	Panel A: Re-exports excluded				Panel B: All			
Sub-sample	More downstream firms		More Upstream firms		More downstream firms		More Upstream firms	
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
$(V_{ft} - V_{ft}^M)$	0.0250	0.0494	-0.2271***	-0.2112***	-0.0063	-0.0046	-0.2016***	-0.1101**
	(0.0322)	(0.0299)	(0.0339)	(0.0353)	(0.0209)	(0.0214)	(0.0451)	(0.0446)
ln Productivity$_{ft}$		0.1053***		0.0603***		0.1107***		0.0920***
		(0.0178)		(0.0167)		(0.0082)		(0.0075)
Firm size:								
Small$_{ft}$		reference		reference		reference		reference
Medium$_{ft}$		0.0628***		0.1513***		0.0972***		0.1476***
		(0.0174)		(0.0269)		(0.0142)		(0.0176)
Large$_{ft}$		0.1619***		0.0859		0.1366***		0.1313***
		(0.0316)		(0.0538)		(0.0224)		(0.0300)
Fixed effects	firm, industry-year, industry-country, product-country							
Observations	18,055	18,055	21,476	21,476	41,802	41,802	53,414	53,414
R^2	0.729	0.730	0.741	0.741	0.715	0.717	0.725	0.726

Notes: Small: 1 to 49 employees; Medium: 50 to 499 employees; Large: 500 employees or more. The sample comprises the matched French Customs-AMADEUS 2002-2017 data. Observations with bargaining power smaller than the 2st percentile or larger than the 99th percentile are dropped. Standard errors clustered by country in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

regression (15) the importer's buyer share, the exporter's supplier share and productivity, we can

assume that the effects of GVC positioning on the division of surplus could be mainly due to quality upgrading. Therefore, this part tests this assumption.

To do so, we follow Khandelwal et al. (2013) and Fan et al. (2015) and purge the export unit prices, and thus the division of surplus from quality components. The methodology proceeds in three steps. First, we estimate the quality of each firm-product-destination-year observation by running the following linear form:

$$\ln q_{fjkt} + \varepsilon_k \ln p_{fjkt} = FE_{jkt} + e_{fjkt} \tag{21}$$

where FE_{jkt} are country-product-year fixed effects, which capture heterogeneity in destination-product-year triplets (consumer preferences, trade costs, markup, and market structure); q_{fjkt} is the quantity of product k exported by firm f to country j in year t; p_{fjkt} is the price (unit value) of product k exported by firm f to country j in year t and ε are the estimated trade elasticities at product level from Ossa (2015). The quality measure is computed from residual e_{fjkt} after estimating (21) with OLS:

$$\ln \widehat{\lambda}_{fjkt} = \frac{\widehat{e}_{fjkt}}{\varepsilon_k - 1} \tag{22}$$

Consequently, quality-adjusted prices are $\ln \tilde{p}_{fjkt} = \ln p_{fjkt} - \ln \widehat{\lambda}_{fjkt}$. Indeed, given that suppliers further upstream and further downstream are more efficient and produce higher quality products, our estimates of the coefficients V_{ft}^X and V_{ft}^M, and $V_{ft}^X - V_{ft}^M$ will be biased upwards, in absolute terms. To control for this bias, we replace the outcome variable $\ln p_{fjkt}$ in Equation (15) by the quality-adjusted prices, $\ln \tilde{p}_{fjkt}$, then re-estimate the equation using a two-stage two-tier stochastic frontier. The new indicators of the division of surplus are therefore quality-adjusted.

By re-estimating equation (20) with the new quality-adjusted surplus indicators, we expect the effects obtained in Sections 4.1 and 4.2 to be strongly reduced in absolute terms, disappear or change sign. In such cases, we can safely conclude that the effects of GVC positioning on the division of surplus in GVCs are mainly due to quality upgrading, as underlined by the theoretical hypotheses.

Table 12 shows the results for the whole Re-export excluding and the All transaction samples. Compared to the results in Table 4, the estimates of the coefficients V_{ft}^X and V_{ft}^M, and $V_{ft}^X - V_{ft}^M$ have decreased considerably in both samples, in absolute terms (panel A and panel B). Furthermore, the coefficient $V_{ft}^X - V_{ft}^M$ is still not significant in the All transaction sample (Panel B). In the re-export excluded sample, although the effects of V_{ft}^X and $V_{ft}^X - V_{ft}^M$ remain significant, the significant effects of V_{ft}^M disappear completely. All these results highlight the key role played by the quality of imported inputs in upgrading the quality of exported products (Manova and Zhang, 2012; Bas and Strauss-Kahn, 2015), so that when surplus is quality-adjusted, the effect of GVC positioning on the division of surplus becomes weaker. Since the coefficients V_{ft}^X and $V_{ft}^X - V_{ft}^M$ are significant in panel A, this means that in addition to quality, strategic positioning upstream by exporting goods further upstream also enables suppliers to improve their bargaining power, by controlling key stages in the upstream supply chain.

The role of quality upgrading is most obvious when we run sub-sample regressions based on the 4-digit NACE Rev. 2 industrial code upstream of suppliers' main activity. Using V_{ft}^X and V_{ft}^M, and $V_{ft}^X - V_{ft}^M$ as key regressors, the results of the sub-sample regressions presented Tables 13 and 14 show a more pronounced reduction, in absolute terms, in the coefficients V_{ft}^X and V_{ft}^M, and $V_{ft}^X - V_{ft}^M$, compared with the results for the whole sample (Tables 4 and 12), and those in Tables 5 and 6, with the exception of the coefficients V_{ft}^X and V_{ft}^M, and $V_{ft}^X - V_{ft}^M$ in columns 1-2 of Panel A of both Tables 13 and 14, which have completely changed sign. The significant effects of V_{ft}^X and V_{ft}^M, and $V_{ft}^X - V_{ft}^M$, observed in Panel B of the All transaction sample in Tables 5 and 6 have for the most part disappeared completely in Panel B in Tables 13 and 14.

Building on these findings, we can safely conclude that our theoretical hypotheses H1, H2 and H3 are primarily driven by the product mix upgrade, and are fully consistent with theoretical discussions.

Table 12: Firm's position in GVCs and quality-adjusted surplus

Sample	Panel A: Re-exports excluded				Panel B: All			
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
V_{ft}^X	-0.1470***	-0.1303***			0.0159	0.0343		
	(0.0477)	(0.0465)			(0.0353)	(0.0353)		
V_{ft}^M	0.0102	0.0138			0.0073	0.0214		
	(0.0144)	(0.0141)			(0.0163)	(0.0162)		
$(V_{ft}^X - V_{ft}^M)$			-0.0286*	-0.0294**			-0.0040	-0.0134
			(0.0150)	(0.0146)			(0.0163)	(0.0162)
ln Productivity$_{ft}$		0.0302***		0.0307***		0.0469***		0.0468***
		(0.0049)		(0.0049)		(0.0030)		(0.0030)
Firm size:								
Small$_{ft}$		reference		reference		reference		reference
Medium$_{ft}$		0.0631***		0.0641***		0.0899***		0.0897***
		(0.0095)		(0.0096)		(0.0059)		(0.0059)
Large$_{ft}$		0.1067***		0.1078***		0.1471***		0.1466***
		(0.0110)		(0.0110)		(0.0063)		(0.0063)
Fixed effects	firm, industry-year, industry-country, product-country							
Observations	104,656	104,656	104,656	104,656	250,451	250,451	250,451	250,451
R^2	0.457	0.458	0.457	0.458	0.415	0.416	0.415	0.416

Notes: Small: 1 to 49 employees; Medium: 50 to 499 employees; Large: 500 employees or more. The sample comprises the matched French Customs-AMADEUS 2002-2017 data. Observations with bargaining power smaller than the 2st percentile or larger than the 99th percentile are dropped. Standard errors clustered by country in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 13: Firm's position in GVCs and quality-adjusted surplus – low versus high level of upstreamness of the core activity of firms

Sample	Panel A: Re-exports excluded				Panel B: All			
Sub-sample	More downstream firms		More Upstream firms		More downstream firms		More Upstream firms	
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
V_{ft}^X	-0.1446*	-0.1408*	-0.1353***	-0.1036**	0.0265	0.0367	0.0196	0.0386
	(0.0783)	(0.0763)	(0.0410)	(0.0406)	(0.0596)	(0.0590)	(0.0560)	(0.0525)
V_{ft}^M	0.0222	0.0148	0.0100	0.0218	-0.0128	-0.0065	0.0404	0.0672**
	(0.0287)	(0.0281)	(0.0194)	(0.0200)	(0.0194)	(0.0192)	(0.0270)	(0.0266)
ln Productivity$_{ft}$		0.0418***		0.0244***		0.0526***		0.0453***
		(0.0100)		(0.0059)		(0.0055)		(0.0037)
Firm size:								
Small$_{ft}$		reference		reference		reference		reference
Medium$_{ft}$		0.0708***		0.0594***		0.0847***		0.0985***
		(0.0120)		(0.0095)		(0.0093)		(0.0077)
Large$_{ft}$		0.1136***		0.1085***		0.1412***		0.1610***
		(0.0172)		(0.0125)		(0.0115)		(0.0143)
Fixed effects	firm, industry-year, industry-country, product-country							
Observations	50,396	50,396	51,911	51,911	116,225	116,225	130,249	130,249
R^2	0.465	0.466	0.514	0.514	0.445	0.447	0.450	0.452

Notes: Small: 1 to 49 employees; Medium: 50 to 499 employees; Large: 500 employees or more. The sample comprises the matched French Customs-AMADEUS 2002-2017 data. Observations with bargaining power smaller than the 2st percentile or larger than the 99th percentile are dropped. Standard errors clustered by country in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 14: Firm's expansion along GVCs and quality-adjusted surplus – low versus high level of upstreamness of the core activity of firms

Sample	Panel A: Re-exports excluded				Panel B: All			
Sub-sample	More downstream firms		More Upstream firms		More downstream firms		More Upstream firms	
Variable	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
$(V_{ft} - V_{ft}^{M})$	-0.0365	-0.0295	-0.0273	-0.0332*	0.0145	0.0104	-0.0304	-0.0496**
	(0.0280)	(0.0272)	(0.0174)	(0.0179)	(0.0194)	(0.0191)	(0.0249)	(0.0248)
ln Productivity$_{ft}$		0.0418***		0.0251***		0.0527***	0.0447***	
		(0.0100)		(0.0059)		(0.0056)	(0.0037)	
Firm size:								
Small$_{ft}$		reference		reference		reference		reference
Medium$_{ft}$		0.0710***		0.0605***		0.0846***		0.0984***
		(0.0120)		(0.0096)		(0.0092)		(0.0077)
Large$_{ft}$		0.1129***		0.1108***		0.1408***		0.1605***
		(0.0172)		(0.0124)		(0.0114)		(0.0142)
Fixed effects	firm, industry-year, industry-country, product-country							
Observations	50,396	50,396	51,911	51,911	116,225	116,225	130,249	130,249
R^2	0.465	0.466	0.513	0.514	0.445	0.447	0.450	0.452

Notes: Small: 1 to 49 employees; Medium: 50 to 499 employees; Large: 500 employees or more. The sample comprises the matched French Customs-AMADEUS 2002-2017 data. Observations with bargaining power smaller than the 2st percentile or larger than the 99th percentile are dropped. Standard errors clustered by country in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

7 Discussion and concluding remarks

The present paper contributes to the existing debate on the power distribution, value creation and value capture along supply chains. We provide a novel and original contribution to the existing literature on firms' upstream or downstream positions in the production process and the value capture in agri-food supply chains, and test the mechanisms underlying these relationships. In our theoretical framework, we highlight the formation of product prices paid by importers at equilibrium in international trade, in an environment of contractual frictions and of existence of market power on both sides of the transaction. We show that the markup is not constant, depending on two-sided bargaining power. Concerning the position of firms in GVCs, we argue that: (*i*) further upstream position of exports and further downstream position of imports, and consequently specialization of the production process along agri-food GVCs increase the bargaining power of suppliers; (*ii*) these effects are more pronounced in more upstream position of suppliers production process in GVCs; (*iii*) suppliers that specialize in the most downstream stages increase their bargaining power by importing further upstream and exporting further downstream, and thus performing more stages in GVCs; (*iv*) the mechanism is that the effects observed on surplus, whether in terms of upstream or downstream specialization, are mainly due to the upgrading of the product mix.

To assess the evidence, we use the sample comprises the matched French Customs-AMADEUS 2002-2017 data and the U.S. input-output table from the Bureau of Economic Analysis (BEA). We distinguish a sample with Re-exports excluded from the sample with All transactions. The former allows us to capture the actual processing activities of suppliers in GVCs, compared to the latter. Considering that a firm-country trade at the product level is similar to the problem of search/matching/bargaining framework in the supplier-buyer relationship, following Polachek and Yoon (1987, 1996), Kumbhakar and Parmeter (2009) and Li et al. (2022), we estimate the two-sided division of surplus of exporters and importers on the export markets of exporters, using a two-stage two-tier stochastic frontier model. Then, Building on Chor et al. (2021), we determine the indirect position of suppliers in GVCs by taking into account the position of their imported and exported products. The main features of our theoretical framework, namely hypotheses (*i*), (*ii*) and (*iv*),

explain the full patterns observed in the data, while hypothesis (*iii*) is only weakly supported.

Thus, the validation of the main theoretical hypothesis of this paper clearly highlight the important role of the firms' position in improving performance in GVCs. The present results are in line with the "smile curve" hypothesis, both in terms of the position of suppliers further upstream and further downstream in GVCs. Indeed, in both the most upstream and most downstream sectors, our results show that excluding or taking into account re-exports tend to confirm the validity of the "smile curve" hypothesis. This shows that there would be no difference of the "in-between" industries nature of the results of the "smile curve" hypothesis compared to the "within" sectors (agri-food sector) nature of the present results, mainly when re-exports are taken into account.

In the GVC literature, discussions of value creation and value capture have focused on the distribution of power in the relations between lead firms and suppliers or buyer-driven GVCs (Gereffi, 1994; Burch and Lawrence, 2013; Dallas et al., 2019). As shown by Cox et al. (2001) and Burch and Lawrence (2005), a critical supply chain assets in agri-food industry are related to the final demand (sales space, information on consumer consumption patterns, brand). Therefore, more upstream firms may face productive disadvantage that unable them to control the entire value chain, whereas more downstream firms, close to final demand, increase their bargaining power. On this basis, Giovannetti and Marvasi (2018) show that Italian firms that are buyers of intermediate inputs and suppliers of final goods are more productive than midstream firms that are both buyers and suppliers of intermediate products, which in turn are more productive than upstream firms that produce intermediate products for other firms. In the similar vein, del Valle and Fernández-Vázquez (2023) documents the fact that industries further upstream in GVCs have a negative impact on markup. This suggests that more downstream firms in the supply chain create and capture more value, than further upstream. Our results weakly confirm these findings, only taking into account re-export and considering the sub-sample of the most downstream position of the firms' core activity. Conversely, suppliers that position and specialize further upstream can act strategically by integrating narrow production stages upstream, while at the same time undertaking high value-added activities, leading to a structural upgrading and a strengthening of their market power Ju and Yu (2015) and Mahy et al. (2021) find similar results.

Regarding the relationship between the specialization in GVCs and the value capture, Krugman et al. (1995), Fernandez-Stark and Gereffi (2019) and Antràs (2020) stated that production processes occurs through a number of stages, adding a little bit of value at each stage. Therefore, Chor et al. (2021) show that increasing the number of production stages performed by firms in GVCs is associated with greater added value. This is because each additional stage performed in GVCs additively adds value to the firm. Our work tackles this issue and shows that the nature of the tasks performed by firms in CVGs matters, and calls for a phenomenon of domestic retention of added value (see Rungi and Del Prete, 2018) that stipulates keeping high value-added activities domestically.

More interestingly, we show that firms' specialization along supply chains within France by exporting more upstream and importing more downstream, is associated with a considerable increase in bargaining power and value capture. We found that it is preferable for firms to engage in a strategy of specialization along value chains by integrating narrow upstream production stages, unless re-exports are taken into account. In the latter case, suppliers that specialize further downstream could increase their surplus by performing more stages in GVCs. Our findings may be of interest to policymakers and industrial strategy of countries as our conclusions contribute to discussions on GVC resilience and re-shoring (see Marvasi, 2023) and on a phenomenon of domestic retention of value added (see Rungi and Del Prete, 2018). Indeed, the succession of international crises (Brexit, US-China trade war, Covid-19, war in Ukraine) increases geopolitical and foreign market uncertainties. For example, the Covid-19 pandemic unveiled the high fragility of the supply chain due to the reliance on offshore supplies in many countries, and thus a high degree of exposure of firms and countries to foreign shocks. Some recent evidence show that participation in GVCs through re-shoring could increase the resilience of GVCs by reducing exposure to foreign shocks, but at the cost of increased exposure to domestic shocks (Giroud and Ivarsson, 2020; Marvasi, 2023). Our

results show, furthermore, that this strategy could also prevents firms from structural upgrading by reducing their market power, and thus their value capture, if the suppliers is specialized in the supply of intermediate goods that are less processed (more upstream stages). As our results also suggest, re-shoring could be more attractive and relevant if the suppliers control a larger part of the production process in GVCs, creating an upstream oligopsony and downstream monopsony situation, which could offer additional benefits by increasing their bargaining power. However, the question of whether it could help to reduce foreign dependency is still open.

Our findings also contribute to the discussions of the industrial policy in the EU countries. Over the past decades, EU industrial policy strategies have focused on segmenting European industries into "headquarters" economies, which host high value-added activities and service units, and "factory" economies, which deal with the lower segments of value chains (Megyeri et al., 2023). In this respect, some countries such as Portugal or Greece are confined to a peripheral position in the sense that they are assumed to participate in the lower segments of GVCs and less integrated into international production networks, while others such as France or Germany participate in the higher segments of GVCs. These strategies are essentially based on the "between" industry heterogeneities that can inaccurately reflect the role of some countries in international markets and distorts the understanding of international integration. Our analysis highlights that the "within" industry heterogeneity, and especially the positioning of firms in a supply chain, also matters. Thus, industrial policies should focus not only on the characteristics of the country's economy, but also on the characteristics of each industry and in particular of tasks, in order to identify high value-added activities in a supply chain.

We are aware that the bilateral bargaining power index is assumed to be exogenous in the Nash bargaining framework. However, in our theoretical discussions and empirical analysis of the determinants of the division of surplus, we consider the bargaining power index to be endogenous. Although we have shown valid arguments that explain the determinants of surplus, the use of the Nash bargaining game to support the existence of bilateral bargaing power in international pricing mechanisms and our treatment of it in our work can be discussed and represent a potential limitation for our work. Therefore, theoretical works with endogenous bargaining power index, as in the framework of property rights for example, represent a relevant avenue for future research.

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Appendices

A Input-output table

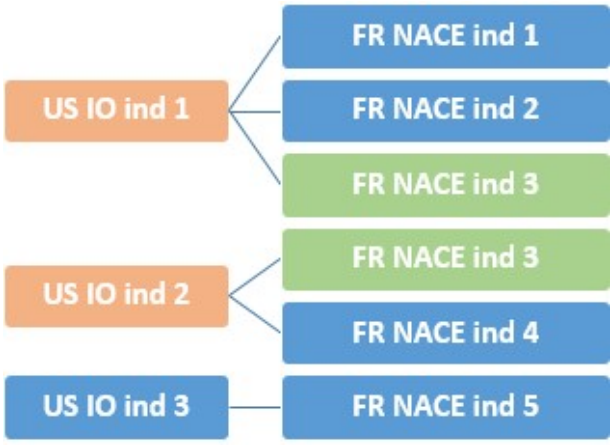
The measurement of the level of processing of products traded by firms relies on the information provided by the input-output table. The availability of these tables at detailed levels for each country remains an important challenge in carrying out this work. Moreover, our interest in the agri-food sector further complicates this task insofar as the European input-output tables are established at high levels of aggregation. In France, for example, the input-output tables provided by the OECD Structural Analysis database (OECD STAN) include only thirty industries, and only one concerns the agri-food industry. To overcome this issue, we use as a starting point the US input-output table, developed by the Bureau of Economic Analysis (BEA), which is available online, in open access[6]. More specifically, we rely on the most recent Use Table after redefinition at producer prices for 2012.

The US input-output table has the advantage to include information on production linkages between industries at a high level of disaggregation. It includes 405 industries (identified by individual 6-digit I-O codes) of which 42 are in the agri-food sector. It is important to take into account all the industries in the economy because the production of agri-food goods involves the use of inputs, raw materials and intermediate products from other sectors (for example, packaging). However, using the U.S. input-output table for an application on French data presents significant classification and matching challenges. We have developed a methodology to convert the U.S. input-output table to the 4-digit NACE Rev.2 codes level, reported for French firms.

The entries a_{ij} in Figure A.1.a report the value of intermediate goods of industry i used in the production of goods of industry j. In addition, there is a column (F_i) that reports the value of products i that goes into aggregate final uses, such as final consumption, investment, changes in inventories and net exports.

		Used inputs and value added			Final use	Total use
		US IO ind 1	US IO ind 2	US IO ind 3		
Supply of inter-medi-ate inputs	US IO ind 1	a_{11}	a_{12}	a_{13}	F_1	Y_1
	US IO ind 2	a_{21}	a_{22}	a_{13}	F_2	Y_2
	US IO ind 3	a_{31}	a_{21}	a_{33}	F_3	Y_3
Value added		VA_1	VA_2	VA_3		
Total output		Y_1	Y_2	Y_3		

(a) US input-output table



(b) Multiple industry correspondences

Figure A.1: US input-output table structure and correspondences with NACE Rev.2

The main challenge in using the U.S. I-O table on French data is that there is not a one-to-one correspondence between the U.S. IO and the NACE Rev.2 industries. Note that the U.S. IO codes are specific to the 2012 North American Industry Classification System (NAICS) structure. An U.S. IO code can correspond to one or more NAICS codes. The NAICS codes in turn have different levels of aggregation, from 2 digits (most aggregated level) to 6 digits (least aggregated level). We have mapped the U.S. IO codes to NACE Rev.2 codes using the links between the U.S.

[6] `https://www.bea.gov/industry/input-output-accounts-data`

		US IO ind 1			US IO ind 2		US IO ind 3
		FR NACE ind 1	FR NACE ind 2	FR NACE ind 3	FR NACE ind 3	FR NACE ind 4	FR NACE ind 5
US IO ind 1	FR NACE ind 1	$\frac{1}{9}a_{11}$	$\frac{1}{9}a_{11}$	$\frac{1}{9}a_{11}$	$\frac{1}{6}a_{12}$	$\frac{1}{6}a_{12}$	$\frac{1}{3}a_{13}$
	FR NACE ind 2	$\frac{1}{9}a_{11}$	$\frac{1}{9}a_{11}$	$\frac{1}{9}a_{11}$	$\frac{1}{6}a_{12}$	$\frac{1}{6}a_{12}$	$\frac{1}{3}a_{13}$
	FR NACE ind 3	$\frac{1}{9}a_{11}$	$\frac{1}{9}a_{11}$	$\frac{1}{9}a_{11}$	$\frac{1}{6}a_{12}$	$\frac{1}{6}a_{12}$	$\frac{1}{3}a_{13}$
US IO ind 2	FR NACE ind 3	$\frac{1}{6}a_{21}$	$\frac{1}{6}a_{21}$	$\frac{1}{6}a_{21}$	$\frac{1}{4}a_{22}$	$\frac{1}{4}a_{22}$	$\frac{1}{2}a_{13}$
	FR NACE ind 4	$\frac{1}{6}a_{21}$	$\frac{1}{6}a_{21}$	$\frac{1}{6}a_{21}$	$\frac{1}{4}a_{22}$	$\frac{1}{4}a_{22}$	$\frac{1}{2}a_{13}$
US IO ind 3	FR NACE ind 5	$\frac{1}{3}a_{31}$	$\frac{1}{3}a_{31}$	$\frac{1}{3}a_{31}$	$\frac{1}{2}a_{21}$	$\frac{1}{2}a_{21}$	a_{33}

(a) Equal weights for all correspondences within each pair of industry codes

	FR NACE ind 1	FR NACE ind 2	FR NACE ind 3	FR NACE ind 4	FR NACE ind 5
FR NACE ind 1	$b_{11}=\frac{1}{9}a_{11}$	$b_{12}=\frac{1}{9}a_{11}$	$b_{13}=\frac{1}{9}a_{11}+\frac{1}{6}a_{12}$	$b_{14}=\frac{1}{6}a_{12}$	$b_{15}=\frac{1}{3}a_{13}$
FR NACE ind 2	$b_{21}=\frac{1}{9}a_{11}$	$b_{22}=\frac{1}{9}a_{11}$	$b_{23}=\frac{1}{9}a_{11}+\frac{1}{6}a_{12}$	$b_{24}=\frac{1}{6}a_{12}$	$b_{25}=\frac{1}{3}a_{13}$
FR NACE ind 3	$b_{31}=\frac{1}{9}a_{11}+\frac{1}{6}a_{21}$	$b_{32}=\frac{1}{9}a_{11}+\frac{1}{6}a_{12}$	$b_{33}=\frac{1}{9}a_{11}+\frac{1}{6}a_{12}+\frac{1}{6}a_{21}+\frac{1}{4}a_{22}$	$b_{34}=\frac{1}{6}a_{12}+\frac{1}{4}a_{22}$	$b_{35}=\frac{1}{3}a_{13}+\frac{1}{2}a_{13}$
FR NACE ind 4	$b_{41}=\frac{1}{6}a_{21}$	$b_{42}=\frac{1}{6}a_{21}$	$b_{43}=\frac{1}{6}a_{21}+\frac{1}{4}a_{22}$	$b_{44}=\frac{1}{4}a_{22}$	$b_{45}=\frac{1}{2}a_{13}$
FR NACE ind 5	$b_{51}=\frac{1}{3}a_{31}$	$b_{52}=\frac{1}{3}a_{31}$	$b_{53}=\frac{1}{3}a_{31}+\frac{1}{2}a_{21}$	$b_{54}=\frac{1}{2}a_{21}$	$b_{55}=a_{33}$

(b) Group weights across NACE industries

Figure A.2: Convert the US I-O table to the NACE Rev.2 4-digit level

IO codes and the NAICS 2012 codes and the correspondence table between NAICS 2012 and NACE Rev.2 provided by Eurostat [7]. However, there are several concerns with this mapping. As shown by Figure A.1.b, a 6-digit IO code may correspond to several 4-digit NACE Rev.2 codes. Similarly, a 4-digit NACE Rev.2 code may be associated with several 6-digit U.S. IO codes. Out of the the 1,547 U.S. IO-NACE Rev.2 code combinations, only 31 industries, (and 2 in the agri-food sector), had a one-to-one correspondence. In these circumstances, we chose to divide each a_{ij} entry in the U.S. I-O table equally among all (r, s) combinations of NACE Rev.2 codes to which the (i, j) entry corresponds (Figure A.2.a). We then simply take the sum of the (r, s) entries that are identical to obtain the entries b_{rs} of the new input-output table at NACE Rev.2 level. We end up with the table in Figure A.2.b.

For example, in Figure A.1.b the U.S. IO1, respectively IO2 codes correspond to 3, respectively 2 NACE codes and the NACE3 code corresponds to 2 I-O codes. Thus, in order to convert the structure of the U.S. I-O table from the level of U.S. IO codes (Figure A.1.a) to the level of NACE

[7] `http://ec.europa.eu/eurostat/ramon/documents/NACE_REV2-US_NAICS_2012.zip`.

Rev.2 codes (Figure A.2.b), we formally have performed the following transformations:

$$b_{rs} = \sum_{i,j} \frac{a_{ij}}{n_i \times n_j}, \text{with } (i \supseteq r \text{ or } i \subseteq r) \text{ and } (j \supseteq s \text{ or } j \subseteq s)\,. \tag{A.7}$$

where n_i, respectively n_j represent the number of different NACE Rev.2 codes associated with input i (in rows in Figure A.1.a), respectively, output j (in columns in Figure A.1.a). This transformation makes it possible to remain as close as possible to the structure of the initial U.S. I-O table, i.e. at the level of U.S. IO codes. This permits us to build a highly detailed input-output table for 604 4-digit NACE Rev.2 industries, of which 88 agri-food. Once this transformation has been carried out, we only need to compute the *upstreamness* indicator for the 4-digit NACE Rev.2 industries.

We check the stability of the *upstreamness* measure of industries between U.S. and France in order to test the relevance of using the U.S. table on French data. To do so, we use French input-output data from several sources: the OECD STAN database and the INSEE input-output table. Note that the OECD STAN database include 34 industries and the INSEE input-output contain 15 industries. Given the high level of aggregation of these two tables, we aggregate the input-output table constructed above, so as to have respectively the 34 industries present in the OECD STAN database - Aggregate NACE (34 industries) - and the 15 industries present in the INSEE table - Aggregate NACE (15 industries) . After that, we check how *upstreamness* computed from the French table in the STAN database, respectively in the INSEE database, compares with the Aggregate NACE (34 industries), respectively Aggregate NACE (15 industries). To verify the consistency of industry *upstreamness* across industries in different input-output table, we conduct a Spearman rank correlation test.

Table A.1 reports the Spearman rank correlation. We are particularly interested in the correlation between *upstreamness* from the pairs Aggregate NACE (34 industries) and OECD STAN database which are 0.65; Aggregate NACE (15 industries) and INSEE table which are 0.68. It useful to note that the rank correlation is always large and significantly different from zero at a p-value of 0.01.

Table A.1: Spearman (Pearson) correlation

	Aggregate NACE (34 industries)	Aggregate NACE (15 industries)	OECD STAN database (34 industries)	INSEE table (15 industries)
Aggregate NACE (34 industries)	1			
Aggregate NACE (15 industries)	-	1		
OECD STAN database (34 industries)	0.65 (0.66)	-	1	
INSEE table (15 industries)	-	0.68 (0.67)	-	1

Notes: Pearson correlation in brackets. Authors' own calculations based on U.S. input-output table converted to the 4-digit NACE Rev.2 level, French original input-output tables from OECD STAN database and INSEE.

The cross-industry variation of the *upstreamness* measure between French original input-output tables (OECD STAN database and INSEE table) and our constructed NACE level input-output table from U.S. table is largely consistent with the range of values reported by Fally (2012) for a subset of EU countries (Czech Republic, Luxembourg, Germany, Spain, *etc.*). In sum, this evidence gives us great confidence that the industry measures are stable across U.S. and France, at least at the higher level of aggregation, and confirm the relevance of using the U.S. table on French data.

B Descriptive statistics of variables

Table B.1: Summary statistics: Firms in GVCs

	Frequency	Median	Mean	Standard deviation
Panel A: Re-export excluding sample				
ln Productivity$_{ft}$	115,043	5.7746	5.8283	0.7971
Small firms (1 to 49 employees)	24,617	-	-	-
Middle-size firms (50 to 499 employees)	60,886	-	-	-
Large firms (500 employees or more)	29,540	-	-	-
NS_{fjkt}	115,043	0.0770	0.1170	0.4571
Export *upstreamness* (V_f^X)	115,043	0.7308	0.7346	0.0954
Import *upstreamness* (V_f^M)	115,043	0.6982	0.6642	0.1363
$V_f^X - V_f^M$	115,043	0.0253	0.0704	0.1392
Panel B: All transaction sample				
ln Productivity$_{ft}$	267,116	5.8633	5.9105	0.7541
Small firms (1 to 49 employees)	56,455	-	-	-
Middle-size firms (50 to 499 employees)	132,592	-	-	-
Large firms (500 employees or more)	78,069	-	-	-
NS_{fjkt}	267,116	0.0971	0.1604	0.4926
Export *upstreamness* (V_f^X)	267,116	0.7275	0.7287	0.1040
Import *upstreamness* (V_f^M)	267,085	0.7098	0.6876	0.1236
$V_f^X - V_f^M$	115,043	0.0253	0.0704	0.1392

C Estimate from the two-stage two-tier frontier function

Table C.1: Two-stage two-tier stochastic frontier estimates of French agri-food firms' export market log price regression

Sample	Re-exports excluded			All		
	Fist stage		Second stage	Fist stage		Second stage
Variables	ln (x_{fjkt}) (1)	ln (s_{fjkt}) (2)	ln p_{fjkt} (3)	ln (x_{fjkt}) (1)	ln (s_{fjkt}) (2)	ln p_{fjkt} (3)
ln $Inst_{fjkt}(x_{fjkt})$	-0.3288***	0.0989***		-0.3488***	0.1023***	
	(0.0026)	(0.0026)		(0.0021)	(0.0021)	
ln $Inst_{fjkt}(s_{fjkt})$	0.1118***	-0.4017***		0.1276***	-0.4250***	
	(0.0024)	(0.0026)		(0.0018)	(0.0020)	
ln Productivity$_{ftft}$	-0.0500***	0.3408***	-0.0927***	-0.0364***	0.4437***	-0.0894***
	(0.0073)	(0.0080)	(0.0028)	(0.0055)	(0.0061)	(0.0022)
Small$_{ft}$	reference	reference	reference	reference	reference	reference
Medium$_{ft}$	-0.2707***	0.4584***	-0.0672***	-0.2938***	0.6497***	-0.0759***
	(0.0119)	(0.0131)	(0.0047)	(0.0095)	(0.0104)	(0.0038)
Large$_{ft}$	-0.6613***	0.9529***	-0.0736***	-0.7773***	1.4124***	0.0349***
	(0.0160)	(0.0175)	(0.0067)	(0.0113)	(0.0124)	(0.0053)
ln GDP per capita	-0.0916*	-0.8456***	-0.0271	0.0550*	-0.6976***	-0.0651***
	(0.0469)	(0.0514)	(0.0181)	(0.0332)	(0.0364)	(0.0126)
Share of industrial value added	-0.0004	0.0066**	-0.0030***	0.0004	0.0084***	-0.0002
in GDP	(0.0028)	(0.0031)	(0.0011)	(0.0020)	(0.0022)	(0.0007)
Share of agricultural value added	0.0142*	0.0011	-0.0144***	-0.0040	-0.0067	-0.0090***
in GDP	(0.0082)	(0.0090)	(0.0032)	(0.0055)	(0.0060)	(0.0021)
ln Buyer share (b_{fjkt})			0.0825***			0.1179***
			(0.0030)			(0.0022)
ln Supplier share (s_{fjkt})			-0.0946***			-0.0888***
			(0.0022)			(0.0016)
Error term decomposition						
ω_{fjkt}			0.5671 ***			0.5988***
			(0.0000)			(0.0000)
u_{fjkt}			0.4193***			0.4190***
			(0.0000)			(0.0000)
ν_{fjkt}			0.4105***			0.4054***
			(0.0000)			(0.0000)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm's main activity fixed effects	YES	YES	YES	YES	YES	YES
Country fixed effets	YES	YES	YES	YES	YES	YES
4-digit product fixed effets	YES	YES	YES	YES	YES	YES
Observations	181,571	183,165	181,562	329,652	331,762	329,638
R^2	0.279	0.341		0.312	0.372	
Partial R^2	0.0825			0.0801		
F-stat	6007.1002			11457.0474		
Endogeneity test	6922.0862			15743.7082		
p-value	0.0000			0.0000		

Notes: Small: 1 to 49 employees; Medium: 50 to 499 employees; Large: 500 employees or more. The sample comprises all importers and all exporters of French agri-food industry firm-year observations between 2002-2017. Standard errors in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$