Multinational firms' organisational dynamics*

Leandro Navarro†

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Abstract

I analyse the organisational choices of heterogeneous firms in a model of incomplete contracts under uncertainty about foreign institutions. Under institutional uncertainty, only the most productive firms offshore production but other firms sequentially follow as uncertainty reduces through learning. The process intensifies competition among final good firms, which impacts the optimal organisation of the firm: firms initially choose vertical integration, but the stronger competition tilts the balance towards outsourcing. Thus, the least productive offshoring firms sequentially shift to outsourcing. A test with sector-level data for the US manufacturing sectors provides supportive evidence of the model's main predictions.

Keywords: *Multinational firms, incomplete contracts, global sourcing, uncertainty, institutional shocks.*

JEL: *D23, D81, D83, F14, F23*

1 Introduction

The increasing importance of intermediate inputs in international trade and the growing role of multinational firms in the organisation of global value chains have captured the attention of many scholars.[1] A growing literature on global sourcing has focused on the determinants of firms' organisational choices under incomplete contracts, with a particular emphasis on the role of institutions in the organisation of

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†Johannes Gutenberg University Mainz. Email: lenavarr@uni-mainz.de. Johannes-von-Müller-Weg 2, Office 01-421. Mainz (55118), Germany.

[1] Grossman and Helpman (2002, 2004, 2005); Antràs and Helpman (2004); Helpman (2006); Alfaro and Charlton (2009); Johnson and Noguera (2012); Antràs and Chor (2013). For literature review, see Antràs (2015) and Antràs and Chor (2021).

supply chains.[2] Recent events, such as Brexit and US-China trade war, have intensified the attention on the consequences of those events in the reorganisation of global value chains and the relocation of suppliers to new countries.[3]

Firms face uncertainty about institutional conditions when deciding on reorganising the supply chains to new foreign sourcing locations. For example, when firms lack previous experience in foreign countries, they form beliefs about institutional conditions by using external information sources and observing other firms active in those locations. Institutional uncertainty also emerges when foreign governments announce the implementation of deep institutional reforms, but firms do not fully believe in the scope of the reforms.

I extend a model of global sourcing to analyse the effects of institutional uncertainty on the organisational dynamics of global value chains.[4] In the model, the presence of uncertainty implies that, initially, only the most productive firms in the market explore offshoring. These firms' actions reveal information about the foreign institutions (*information externalities*), allowing other firms to learn and reduce their prior uncertainty. As more firms explore their offshoring potential, more information is revealed. Uncertainty progressively erodes, and more firms sequentially follow, resulting in a progressive expansion of the sectoral offshoring activity. The model predicts that the lower prices of the offshoring firms cause a progressive increase in the competition intensity in the final goods market, which impacts the dynamic organisational structure of the supply chains.[5] On the offshoring side, the more intense competition implies that the least productive firms among the vertically integrated offshoring firms sequentially reorganise the supply chains to arm's length trade.

The baseline model of global sourcing defines two countries (North-South) and multiple differentiated final good sectors.[6] As in Antràs and Helpman (2004), the final good producers are located in the North, and they can decide on contracting either with northern or southern manufacturers to supply the intermediate inputs. The location dimension of the decision balances the trade-off between exploiting the advantage of lower marginal costs in the South to produce intermediate inputs and the higher organisational fixed costs of offshore operations. Under incomplete contracts, the sourcing decision also involves an organisational dimension (*integration* vs *outsourcing*). It balances the trade-off between min-

[2]See Antràs and Helpman (2008); Yeaple (2006); Levchenko (2007); Nunn (2007); Nunn and Trefler (2013). For the analysis of the role of FTAs and multilateral agreements on the organisation of global value chains, see Ornelas and Turner (2008, 2012); Antràs and Staiger (2012); Ornelas et al. (2020); Handley et al. (2020).

[3]See Head and Mayer (2019); Blanchard (2019); Van Assche and Gangnes (2019); Grossman and Helpman (2020); Gereffi et al. (2021) and Bown et al. (2021).

[4]For a close reference to the perfect information benchmark, see Antràs and Helpman (2004).

[5]Higher competition intensity in final goods market impacts on dynamic allocation of property rights along the value chain.

[6]The characterisation of the benchmark perfect information equilibrium is based on a generalisation of the global sourcing model in Antràs and Helpman (2004). I discuss below the extent, features, and consequences of the generalisation.

imising the hold-up by vertical integration and increasing the per-period organisational fixed costs due to managing a larger and more complex organisation.[7]

I characterise uncertainty about the institutional conditions in foreign locations as uncertainty in the per-period organisational fixed costs of offshore operations. The northern final good producers face uncertainty about the new institutional regime abroad, but they can learn from offshoring producers and progressively reduce the prior uncertainty. As in Larch and Navarro (2021), in each period t, the producers under domestic sourcing face a trade-off situation. They can delay exploring their offshoring potential (i.e. wait) and receive new information that reduces the exploration risk. The delay involves lower expected profits by sourcing domestically during the waiting period. If they explore, they have to pay an offshoring sunk cost, and the institutional fundamentals are revealed to them.[8] Thence, they can choose with certainty the optimal organisational form. The sectoral equilibrium path is characterised by a Markov decision process, in which the final good producers update their prior uncertainty through a Bayesian learning mechanism.[9]

The main prediction of the model concerning the organisational dynamics is: the increase in offshoring activity progressively lowers the sector's price index, implying a higher intensity in the competition in the final goods market. Thus, it induces a progressive vertical disintegration of the supply chains. I call this prediction the *first channel of the competition effect on vertical disintegration*.[10]

Zooming in on the vertical disintegration dynamics, the model shows that the most productive final good producers lead the offshoring exploration and initially choose foreign integration as the optimal organisational form. However, as the competition in the final goods market endogenously intensifies, the least productive among them begin to sequentially reorganise the supply chains to independent foreign suppliers.[11] To illustrate the process, consider the dynamic organisational path of one final good producer H. Initially, the expected gains from waiting surpass the expected gains from exploring for H. Therefore, H decides to wait under domestic sourcing. As other more productive final good producers explore

[7]Different ownership structures lead to different distortions in ex-ante investments. The hold-up is minimised by the allocation of property rights on the party that contributes more (Grossman and Hart, 1986; Hart and Moore, 1990). About organisational fixed costs, integrated structures impose additional costs due to the more complex structure of a larger and more diversified organisation (Grossman and Helpman, 2002). They are governance related to the integration of two independent parties into a hierarchical structure within the firm boundaries (Coase, 1937; Williamson, 1979, 1985).

[8]The offshoring sunk cost refers to feasibility studies that analyse all the possible organisational structures of offshoring in the South. Thus, after paying it, they discover the institutional fundamentals in the foreign location for all the offshoring types. There is no remaining uncertainty for those producers. Nevertheless, it remains as private information to them.

[9]The characterisation of the learning mechanism and the exploration decision is based on Larch and Navarro (2021). Other references are Rob (1991) and Segura-Cayuela and Vilarrubia (2008).

[10]Lower marginal costs in the South imply that, as more firms offshore, the competition in the final goods market intensifies.

[11]Technically, the productivity cutoff for foreign integration has a non-monotonic behaviour over time. It decreases in early periods of the dynamic offshoring path, as the leading final good producers choose foreign integration. In later periods, the productivity cutoff increases as the more intensive competition in the final goods market deteriorates the benefits of integration and induces a sequential vertical disintegration.

the offshoring potential, H receives new information, reducing H's exploration risk. At a later date, H finds it profitable to explore, pays the offshoring sunk cost and chooses foreign integration as the optimal offshoring type. However, as the exploration sequence continues, the sectoral offshoring activity increases and more producers exploit the marginal costs advantages of offshoring. Thus, the price index progressively reduces and the competition in the final goods market intensifies, leading to a progressive deterioration in the gains from integration. Eventually, H finds it more profitable to vertically disintegrate the supply chain towards foreign outsourcing.[12]

I test the main theoretical prediction of the model, i.e. *the first channel of the competition effect on vertical disintegration*, using sector-level data of US manufacturing sectors for the period 2002-2016. To that aim, I use the related-trade party import data provided by the US Census Bureau, which distinguishes import flows between related and non-related parties.[13] To obtain information on the input-output relationships, I merge this data with the BEA input-output matrix linking the import data at the supplier sector with the final good producer sectors that use these intermediate inputs in their respective production processes. Additional data on the final good producer sectors comes from the manufacturing survey of the US Census Bureau.[14]

I work with sector-level data. Thus, I aggregate the firm-level theoretical predictions of the model to obtain the respective sector-level organisational dynamics. I derive a structural two-stage empirical model that identifies the mechanism of the *first channel of the competition effect on vertical disintegration*. In the first stage, I derive a log-linear empirical model that estimates the effects of the final good producer sector offshoring activity (*offshoring share*) on the respective final goods market price index. In the second stage, I derive a fractional logit model that estimates the effect of the predicted changes in the price index on the intra-firm intensity of the final good producer sector.[15] The empirical results show that an increase in a final good producer sector's offshoring activity is associated with a reduction in the respective price index. The latter, in turn, leads to a reduction in the intra-firm intensity of the sector.[16]

To analyse firms' organisational dynamics in the context of location and relocation decisions of off-

[12]On the domestic side, the increase in competition intensity leads to vertical disintegration of domestic supply chains.

[13]The data on imports does not identify the type of integration (forward or backward). Therefore, I generalise the organisational choice model in Antràs and Helpman (2004) by allowing for both types of integration. Thus, I derive firm and sectoral organisational dynamics that allows me to overcome the data limitations. Nevertheless, I show that the model's predictions are also consistent with an organisational decision space as defined by Antràs and Helpman (2004).

[14]I use Rauch (1999)'s classification of commodities to build differentiation indices for final good producer and supplier sectors. They reflect the intensity of the sectors in relationship-specific investments. i.e. the contract-dependency of the sector and thus the exposure to hold-up (Nunn, 2007). For similar input-output matrix approach, see Antràs (2015).

[15]The sector offshoring share captures the offshoring activity in the final good sector. It is computed by the total imports of the final good sector divided by the total sales of the respective sector. The intra-firm intensity measures the intensity of intra-firm trade (i.e. imports from related parties) relative to the total sales of the final good sector.

[16]I also introduce a set of reduced-form empirical models that capture different features of the organisational dynamics consistent with the model's theoretical predictions.

shore suppliers across heterogeneous foreign countries, I follow by extending the theoretical model to multiple countries. In a multi-country setup under institutional uncertainty, information shocks (e.g. institutional reforms) may cause the exploration of new countries and thus promote the relocation of offshore suppliers across foreign locations. I analyse the case of a low-wage foreign country (East) that experiences a favourable institutional information shock (e.g. generated by institutional reform). When the shock impacts on the prior beliefs about eastern institutions, it may trigger a sequential offshoring exploration to the East, resulting in a full or partial relocation of offshore (southern) suppliers to East. As the sequential offshore relocation advances, it reduces the sector's price index and increases the competition intensity in the final goods market. As in the two-country model, this effect leads to a progressive vertical disintegration of the supply chains in the sector. I define the relocation of offshore suppliers to low wage foreign countries as the *second channel of the competition effect on vertical disintegration*.

I test the prediction of the multi-country model by analysing the effects of a particular institutional information shock: the accession of China to the WTO. The initial conditions are characterised by a low wage of China with low market shares in US markets. To this aim, as before, I aggregate the firm-level predictions of the model to sector-level organisational dynamics. I derive a structural model in two stages that identifies the mechanism of the *first and second channels of the competition effect on vertical disintegration*. The first stage estimates the effects of both channels, i.e. the sector offshoring activity and the China market share on the sector's intermediate inputs imports, on the respective price index.[17] As before, the second stage estimates the effect of price index changes predicted by both channels of the competition effect on the intra-firm intensity of the sector. In line with the theory, the results show that the increase in the sector offshoring share and the increase in China's market share in the imports of the sector's intermediate inputs reduce the sector price index. The reductions in the price index predicted by both channels lead to vertical disintegration of the offshore supply chains.

I conclude by introducing a theoretical extension to the multi-country model that studies the role of free-trade agreements (FTAs) and multilateral agreements (MAs) as institutional information shocks that trigger the exploration of new locations under institutional uncertainty.[18]

The FTAs incorporate a set of rules and regulations that define the institutional framework in the agreement, such as intellectual property and property rights protection, foreign investment, dispute resolution mechanisms, environmental regulation, labour market regulation and mobility.[19] The ratification

[17]After controlling for the total offshoring activity of the sector, China's market share in the final good sector's imports captures the relocation of offshore suppliers to China.

[18]As predicted by the theory, the exploration of new countries by northern final good producers may increase the offshoring activity and/or relocation processes of offshore suppliers across foreign countries. This extension focuses on the role of FTAs and MAs as triggers of the exploration sequences to new locations.

[19]See Maggi (1999), Dür et al. (2014), and Limão (2016). For examples of regulatory agreements involved in FTAs see

of a FTA reveals a commitment of the signing governments to provide an institutional environment that meets the set of rules specified in the agreement. If those rules are observable by the final good producers, a new FTA impacts on the institutional beliefs about a partner country, leading to an improvement of the previously pessimistic priors.[20]

Exploring further the institutional dimension of the FTAs, I also consider the role of FTAs among third countries as institutional information shocks. I define them as those FTAs where the country of the final good producers (North) is not involved. The model predicts that they may impact on priors and trigger the exploration of new locations in the FTA by northern firms. The intuition is the following: when a FTA is under negotiation, countries with good institutional fundamentals do not want to expose themselves to trade with partners under poor institutional conditions, while countries with bad institutional fundamentals may want to avoid committing to strict rules that they cannot enforce. Thus, the institutional framework of the FTA emerges from bargaining on a set of rules among the members. The final good producers from a non-member country may associate this FTA to a common institutional ground among the members. Therefore, the countries with relatively worse priors may benefit from the partners with better institutional reputation. The FTA may positively impact on the priors of the first countries and thus incentivise the offshoring exploration of that location by northern firms.

Finally, I analyse also the role of multilateral agreements (MAs) as institutional information shocks. In particular, I focus on the accession to WTO memberships. The WTO membership reveals the country's commitment to a common set of rules that define a general institutional framework in areas such as trade policy, intellectual property, and dispute settlement.[21] Thus, the commitment to these rules revealed by WTO membership may impact on the prior beliefs about that country.

Using UN Comtrade import data for the US at HS 6 digits for the period 1996-2016, I find supportive evidence for the extension's predictions: when a country signs a FTA with third countries that count with good institutional reputation, it increases the probability of offshoring exploration of that country by US firms in differentiated goods. Regarding MAs, the empirical evidence shows that access to WTO membership increases the probability of exploring a new location by US firms, with a stronger effect

NAFTA: www.naftanow.org, EU: europa.eu, Pacific Alliance: alianzapacifico.net/en, MERCOSUR: www.mercosur.int, China-Australia (ChAFTA): www.dfat.gov.au/trade/agreements/in-force/chafta/Pages/australia-china-fta.

[20] I also analyse the effects of preferential tariffs on the exploration decisions to new locations. If prior beliefs about institutions in the partner country are pessimistic, no final good producer may find it attractive to explore the offshoring potential in the foreign location previous to the agreement. When the reduction in tariffs for intermediate inputs is sufficiently large, it may trigger a sequential offshoring exploration. Therefore, tariff changes may lead to stronger relocation of suppliers compared to an approach that ignores the presence of institutional uncertainty.

[21] The WTO provides an institutional framework for the General Agreement on Tariffs and Trade (GATT), the General Agreement on Trade in Services (GATS), and the Treaty on Trade Related Aspects on Intellectual Property Rights (TRIPS) (Felbermayr et al., 2020). The WTO agreements cover goods, services and intellectual property, and among others, they set procedures for settling disputes and monitoring trade policies (WTO's official website).

for differentiated goods. Finally, the results also show that signing a FTA with the US also increases the probability of exploring the partner in new differentiated inputs. In all the cases, the effects of these institutional information shocks are relevant or significantly stronger for differentiated goods, i.e. for the case of institutional or contract dependent goods.

The paper is organised as follows. I follow with a review of the literature. Section 2 defines the North-South model setup and the perfect information equilibrium. Section 3 introduces uncertainty in the organisational fixed costs, defines the learning mechanism and sourcing decisions, and characterises the dynamic equilibrium paths. Section 4 introduces the empirical model for the North-South setup. Section 5 extends the model to multiple countries and introduces the respective empirical models. Section 6 analyses the role of FTAs from a theoretical and an empirical perspective. Section 7 concludes.

Literature review. My theoretical approach has its roots in two branches of the literature: global sourcing and firm theory. Regarding the first branch, the main theoretical reference for a perfect information benchmark is Antràs and Helpman (2004).[22] I contribute to this literature by introducing a dynamic model that analyses the effects of institutional uncertainty on firms' organisational dynamics.

Grossman and Helpman (2002) analyse how the organisational structure is affected by competition in the final good market. In particular, they show that an exogenous increase in the elasticity of substitution, which produces stronger competition in the final goods market, induces more outsourcing (i.e. less integration). Instead, I identify an endogenous mechanism that increases competition intensity in the final good market and produces a progressive vertical disintegration of the supply chains.

Antràs (2005) characterises a dynamic organisational equilibrium path of a differentiated sector in a context of a Vernon's product cycle.[23] Both models can be taken as complementary mechanisms for sectoral dynamics characterised by an initial offshoring phase of foreign integration followed by a progressive vertical disintegration. While Antràs (2005) centers the attention on the progressive standardisation of the technology, I focus on how the progressive increase in competition intensity in the final goods market affects the dynamic organisational structure of the supply chains.

My paper also relates to the growing literature on uncertainty in global sourcing decisions (Carballo, 2016; Kohler and Kukharskyy, 2019; Larch and Navarro, 2021; Handley et al., 2020).[24] The closest

[22] It is also related to Antràs (2003, 2005); Grossman and Helpman (2002, 2005) and Antràs and Helpman (2008).

[23] As the technology becomes more standardised, the final good producers start offshoring production in low-wage countries. At first under foreign integration, and at a later stage of standardisation through arm's length trade.

[24] There is a more extensive literature on uncertainty in trade, in particular in export decisions (see Rob and Vettas (2003); Segura-Cayuela and Vilarrubia (2008); Albornoz et al. (2012); Nguyen (2012); Ramondo et al. (2013); Aeberhardt et al. (2014); Araujo et al. (2016)). In terms of the characterisation of a learning process and a sequential dynamic, close references are Segura-Cayuela and Vilarrubia (2008); Albornoz et al. (2012) and Araujo et al. (2016).

reference is Larch and Navarro (2021). By assuming complete contracts, the authors concentrate on the location dimension of the sourcing decisions under institutional uncertainty, the characterisation of the multiple equilibria and the respective consequences on the countries' sectoral specialisation patterns. I incorporate the organisational dimension of the sourcing decision by introducing incomplete contracts, but instead, I simplify the location dimension. In this sense, both approaches are complements.

Handley et al. (2020) studies the effects of trade policy uncertainty on firms' import decisions and input choices. From two different and complementary perspectives, we analyse the role of institutional shocks as triggers of the exploration process. However, the models differ in the type of the underlying uncertainty and the focus of the analysis. First, Handley et al. (2020) focus on the uncertainty defined by exposure to a potential tariff shock. Instead, I analyse the situation where firms lack precise information about the institutional fundamentals in foreign locations, but they can progressively reduce it by learning from others.[25] Second, they analyse the effects on input choices and abstract from the organisational dimension of the sourcing decisions. Instead, I focus on the latter aspects of the sourcing choices.[26]

Regarding the literature on global sourcing and trade liberalisation (Ornelas and Turner, 2008, 2012; Ornelas et al., 2020), I contribute to it by identifying an additional role that tariff reductions in intermediate inputs may play on the global sourcing decisions, when firms face uncertainty about institutional conditions in the partner countries. I also identify the role of the institutional dimension of FTAs and MAs in the exploration of new sourcing locations under institutional uncertainty.

The second branch of the literature from which I draw is firm theory, particularly the property rights approach. The characterisation of the firm is based on the Grossman and Hart (1986)'s version developed by Antràs and Helpman (2004). I generalise the space of the organisational choice defined in the latter by allowing for a more flexible allocation of property rights. Following Grossman and Hart (1986) and Hart and Moore (1990), the final good producers can choose integration in either of the two possible directions, i.e. final-good producer's control (*backward integration*) and supplier's control (*forward integration*), in addition to outsourcing with an independent supplier. The generalisation allows me to overcome the lack of distinction in the data between the two types of integration, and thus derive theory-consistent empirical models to test for the main theoretical dynamic predictions. Nevertheless, I show that the model results are also robust to the specification in Antràs and Helpman (2004), where only outsourcing and backward integration types are considered.[27]

[25] The model could also incorporate stochastic institutional fundamentals in a relatively straightforward manner.

[26] Carballo (2016) and Kohler and Kukharskyy (2019) focus on how the exposure of firms to exogenous shocks (in the demand or the supply side) affect the sourcing decisions, but assuming perfect knowledge of the stochastic nature of the world. Instead, I analyse a situation in which firms can reduce the uncertainty progressively by exploiting informational externalities.

[27] In Appendix E.2, I show empirical evidence for the generalised approach. I build on Yeaple (2006); Nunn (2007); Nunn and

2 The two-country model: North-South

The model consists of a world economy with two countries, North (N) and South (S), and one factor of production, labour (ℓ). The representative consumer preferences are represented by equation (1), where $q_{0,t}$ denotes the consumption in period t of a perfectly competitive and tradable homogeneous good, and $Q_{j,t}$ is the aggregate consumption index in the differentiated sector j in period t.

$$U_t = \gamma_0 \ln q_{0,t} + \sum_{j=1}^{J} \gamma_j \ln Q_{j,t} \quad , \quad \gamma_j > 0 \quad \forall j = 0, ..., J \quad , \quad \sum_{j=0}^{J} \gamma_j = 1. \tag{1}$$

For the moment, I assume that all the goods are tradable in the world market, there are no transport costs nor trade barriers, and consumers have identical preferences across countries.

The per-period aggregate consumption in the differentiated sector j is defined as:

$$Q_{j,t} = \left[\int_{i \in I_{j,t}} q_{j,t}(i)^{\alpha_j} di \right]^{1/\alpha_j} \quad , \quad 0 < \alpha_j < 1, \tag{2}$$

which consists of the aggregation of the consumed varieties $q_{j,t}(i)$ on the range of varieties i of sector j in period t . The elasticity of substitution between any two varieties in sector j is $\sigma_j = 1/(1 - \alpha_j)$.

The inverse demand function for variety i of sector j in period t is given by:

$$p_{j,t}(i) = \gamma_j E Q_{j,t}^{-\alpha_j} q_{j,t}(i)^{\alpha_j - 1}, \tag{3}$$

where E is the per period total (world) expenditure,[28] and the sector's price index in t is defined as:

$$P_{j,t} \equiv \left[\int_{i \in I_{j,t}} p_{j,t}(i)^{1-\sigma_j} di \right]^{\frac{1}{1-\sigma_j}}. \tag{4}$$

Each of the differentiated sectors has a continuum of heterogeneous final good producers. The final good varieties in sectors $j = 1, ..., J$ are produced with a Cobb-Douglas technology:

$$q_j(i) = \theta \left(\frac{x_{h,j}(i)}{\eta_j} \right)^{\eta_j} \left(\frac{x_{m,j}(i)}{1 - \eta_j} \right)^{1-\eta_j}, \tag{5}$$

where $\eta_j \in (0, 1)$ is a technology parameter, which measures the final good producer intensity (i.e. H-

Trefler (2013) and Antràs (2015). Additionally, I trace elements that relate to the evolutionary theory of the firm (Nelson and Winter, 1982, 2002; Nelson, 1995; Dosi et al., 2000; Teece, 2009). I identify the presence of tacit knowledge and idiosyncratic routines as determinants of the efficiency losses when a party seizes the control of the other after investments in relationship-specific assets are realised. I develop a novel measure to identify it.

[28] See Appendix A.1 for the derivation of the demand functions.

intensity) of the sector j, and the parameter θ represents the productivity level of the final good producer.

The quantity of services produced by the final good producer H is denoted by $x_{h,j}$, while $x_{m,j}$ indicates the quantity of intermediate input provided by the supplier M. The first refers to services provided by the final good producer, such as design, marketing, and assembly of the final good.[29] The second indicates the intermediate inputs supplied by a manufacturer. They are both produced after investing in relationship-specific assets $h_j(i), m_j(i)$, respectively, that fully depreciate in one period. The investment in one unit of relationship-specific assets requires the use of one unit of labour. The production technology of the inputs have constant returns and are given by $x_{h,j}(i) = h_j(i)$ and $x_{m,j}(i) = m_j(i)$.

As in Antràs and Helpman (2004), the final good producers are located only in the North, and thus the services $x_{h,j}$ can be produced only by northern producers. The final good producers can decide to contract with northern or southern manufacturers M for the supply of the intermediate inputs. The final good producers face ex-ante a perfectly elastic supply of manufacturers in all the locations.[30] When the final good producer decides to contract with a southern supplier, the final good producer must pay the offshoring sunk cost s_j^r in northern labour units. The sunk cost refers to feasibility studies related to the organisation of the offshore supply chain and the optimal organisational structure.

Each organisational type has a per-period organisational fixed cost denoted by $f_{k,j}^l$, with $l = N, S$ indicating the location of the intermediate input supplier and $k = O, V_H, V_M$ referring to the type of allocation of property rights.[31] The per-period organisational costs are defined in northern units of labour.

The homogeneous sector has a constant returns to scale technology given by $q_0 = A_{0,l}\ell_0$, where $A_{0,l} > 0$ refers to the productivity parameter in country l and $A_{0,S} < A_{0,N}$. Therefore, $w^N > w^S$. Furthermore, I assume that γ_0 is large enough such that every country produces it.

Entry cost and productivity draw. Final good producers enter the market according to a Melitz (2003)'s type mechanism. After the payment of a market entry sunk cost $w^N s_j^e$, the final good producer discovers her productivity level θ. The productivity is drawn from a c.d.f. distribution $G_j(\theta)$.

2.1 Organisational choice under perfect information.

If after entry, the final good producer decides to remain active, she must choose among six organisational types: domestic outsourcing O^N; domestic integration, which can be backward V_H^N or forward V_M^N;

[29] The assembly could be provided instead by the supplier, while the final good producer focuses on the services of design and marketing. See Feenstra (1998) for the cases of Mattel and Nike, and Gereffi et al. (2005) for apparel industry.

[30] Ex-post, however, the parties are locked into a bilateral exchange. Due to incomplete contracts, they are subject to opportunistic behaviour and hold up in their respective investment (Williamson, 1971, 1979).

[31] O, V_H, V_M refer to outsourcing, backward integration, and forward integration, respectively. I define them in section 2.1.

foreign outsourcing O^S; and foreign integration, which can also be backward V_H^S or forward V_M^S.[32]

After the organisational decision, she offers a contract to potential suppliers. The contract defines the location of the supplier, the organisational structure, and an upfront payment. Suppliers apply to the contract and the final good producer chooses one among the candidates. Both parties simultaneously decide their respective investment levels in the specific assets. The output is produced and sold. The revenues are distributed according to a Nash bargaining. Figure 1 shows a simplified sequence of the timing of events.

Until otherwise stated, I focus the analysis on one differentiated sector. To simplify notation, I drop the subscript j.

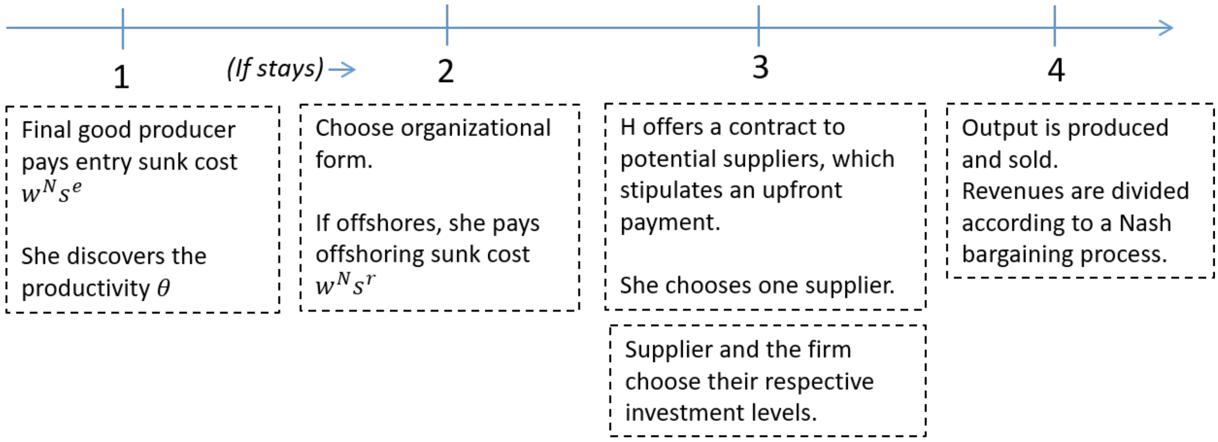


Figure 1: Timing of events

The final good producer's organisational choice must be solved by backward induction, starting from the Nash bargaining stage. To simplify notation, I drop the time index in the remaining of section 2.[33]

Nash bargaining. I define β as the bargaining power of the final good producer in the asymmetric Nash bargaining. The location of the intermediate input supplier is denoted as $l = N, S$. The solution to the Nash bargaining shows that the revenue shares received by the final good producer under each

[32]Backward integration refers to property rights allocated on the final good producer, while forward integration corresponds to property rights allocated on the intermediate input supplier.

[33]See Appendix A.2 for a detailed characterisation of the organisational choice and the respective proofs.

organisational type are given by: [34]

$$\begin{aligned}
\beta_O^l &= \beta && \text{if outsourcing } O \text{ in country } l,\\
\beta_{V_H}^l &= (\delta_{V_H}^l)^{\alpha(1-\eta)} + \beta[1-(\delta_{V_H}^l)^{\alpha(1-\eta)}] && \text{if backward integration } V_H \text{ in country } l,\\
\beta_{V_M}^l &= \beta[1-(\delta_{V_M}^l)^{\alpha\eta}] && \text{if forward integration } V_M \text{ in country } l.
\end{aligned}$$

Under backward integration (V_H^l), the final good producer H faces an efficiency loss in the production of the intermediate inputs if she fires the manager of the integrated supplier M in country l after the investments in relationship-specific assets. The efficiency losses in the production of the intermediate input are represented by $(1-\delta_{V_H}^l)$ with $\delta_{V_H}^l \in (0,1)$. Under forward integration (V_M^l), supplier M in country l faces an efficiency loss in producing the final good producer services if he fires the manager of the integrated final good production facilities H after the investments in the relationship-specific assets. The efficiency losses in the production of the final good producer services are represented by $(1-\delta_{V_M}^l)$, with $\delta_{V_M}^l \in (0,1)$.[35]

Assumption A. 1. $\delta_{V_H}^N \geq \delta_{V_H}^S > 0$ *and* $\delta_{V_M}^N \geq \delta_{V_M}^S > 0$.

Assumption A.1 states that the efficiency losses are larger in the case of multinational operations, as a result of higher technological and/or cultural frictions related to the management and monitoring of overseas operations relative to fully domestic supply chains. Therefore, the ranking of the revenue shares of the final good producer under each organisational type are:

$$\beta_{V_H}^N \geq \beta_{V_H}^S > \beta_O^N = \beta_O^S = \beta > \beta_{V_M}^S \geq \beta_{V_M}^N. \tag{6}$$

Investment decisions and input provision. Both parties internalise the revenue shares β_k^l in their investment decisions. The parties simultaneously decide their investment levels by maximising their respective profits. The ex-post production levels of the respective inputs for the variety i, which are a

[34] Under asymmetric Nash bargaining equilibrium, each party receives its outside option plus a share of the residual revenues. For example, under backward integration, the outside option of M is zero and for H is $(\delta_{V_H}^l)^{\alpha(1-\eta)}r(i)$, where $r(i)$ denote the total revenues. Thus, the total revenue share of H, i.e. $\beta_{V_H}^l$, is the sum of the outside option revenue share, $(\delta_{V_H}^l)^{\alpha(1-\eta)}$, plus β share of the residual revenues, $\beta[1-(\delta_{V_H}^l)^{\alpha(1-\eta)}]$. See Appendix A.2.1 for further discussion.

[35] A similar characterisation of the efficiency losses can be found in Antràs and Helpman (2004). However, while the latter defines it as a general efficiency loss in the production of both inputs, I define it as an efficiency loss in the production of the respective input. For a complete characterisation of the Nash bargaining, the efficiency losses and the respective proofs, see Appendix A.2.1.

function of the ex-ante investment decisions in the relationship-specific assets, are given by:[36]

$$\begin{aligned} x_{h,k}^{l,*}(\theta) &= \frac{\alpha\beta_k^l\eta}{w^N} r_k^{l,*}(\theta), \\ x_{m,k}^{l,*}(\theta) &= \frac{\alpha(1-\beta_k^l)(1-\eta)}{w^l} r_k^{l,*}(\theta), \end{aligned} \tag{7}$$

with $k = O, V_H, V_M$, and the total revenues given by:

$$r_k^{l,*}(\theta) \equiv \alpha^{\sigma-1}\theta^{\sigma-1}(\gamma E)^\sigma Q^{1-\sigma} \left[\left(\frac{\beta_k^l}{w^N}\right)^\eta \left(\frac{1-\beta_k^l}{w^l}\right)^{1-\eta} \right]^{\sigma-1}. \tag{8}$$

Organisational choice. The final good producer faces a discrete set of possible organisational types. Given the upfront payment, the final good producer chooses the organisational structure $\{k, l\}$ that maximises the overall profits:

$$\max_{\beta_k^l} \pi_k^l(\theta, Q, \eta) = \theta^{\sigma-1}(\gamma E)^\sigma Q^{1-\sigma}\psi_k^l(\eta) - w^N f_k^l, \tag{9}$$

with $k = O, V_H, V_M$, location $l = N, S$, and

$$\psi_k^l(\eta) = \left[\frac{1-\alpha[\beta_k^l\eta + (1-\beta_k^l)(1-\eta)]}{\alpha^{1-\sigma}}\right] \left[\left(\frac{\beta_k^l}{w^N}\right)^\eta \left(\frac{1-\beta_k^l}{w^l}\right)^{1-\eta} \right]^{\sigma-1}.$$

Assumption A. 2 (Ranking in organisational fixed costs)**.**

$$\begin{cases} f_O^N < f_{V_H}^N < f_O^S + (1-\lambda)s^r < f_{V_H}^S + (1-\lambda)s^r, \\ f_O^N < f_{V_M}^N < f_O^S + (1-\lambda)s^r < f_{V_M}^S + (1-\lambda)s^r, \end{cases}$$

where $\lambda \in (0,1)$ *denotes the per-period survival rate to an exogenous "death" shock.*

I assume that the higher organisational complexity involved under integration, relative to the management of two independent specialised firms, imposes additional managerial or governance costs (Coase, 1937; Williamson, 1979, 1985; Grossman and Helpman, 2002). Thus, the organisational fixed costs of any type of integration in l cannot be smaller than the fixed costs of outsourcing in that same location, i.e. $f_O^l < f_{V_H}^l$ and $f_O^l < f_{V_M}^l$. Additionally, I assume that overseas operations require a larger management structure relative to fully domestic supply chains. Both conditions together result in assumption A.2.

The optimisation program defined by (9) balances the two trade-off situations that the final good producers face when they decide on the organisational structure of the supply chain from the discrete set

[36]For a complete characterisation of the respective maximisation programs and proofs, see Appendix A.2.2.

of feasible types. From a property rights dimension, they can realise gains from integration by allocating the property rights to the party that has the highest contribution to the relationship, but at the cost of facing higher organisational fixed costs of integration due to the more complex structure of the organisation. At the same time, from a location dimension, they can exploit the gains from offshoring that result from the lower marginal costs of southern suppliers, but at the cost of higher fixed costs of offshore operations.

Sector classification and organisational types. In the case of H-intensive sectors, i.e. when $\eta \geq \bar{\eta}_c$,[37] backward integration minimises the hold up by transferring the property rights on all the assets to the final good producer. However, I show in section 2.2 that for some final good producers, those gains are surpassed by the higher fixed costs of integration.

In the case of M-intensive or component-intensive sectors, i.e. when $\eta \leq \underline{\eta}_c$, forward integration minimises the hold-up by transferring the property rights on all the assets to the manufacturer M. However, those gains cannot compensate for the higher organisational fixed costs for some final good producers.

In the case of the sectors with a balanced intensity between the two parties, i.e. when $\underline{\eta}_c < \eta < \bar{\eta}_c$, outsourcing dominates any type of integration. Therefore, the only active dimension in the sourcing decision is the location of the intermediate input supplier.

2.2 Perfect information steady-state.

The characterisation of the perfect information equilibrium is close to Antràs and Helpman (2004). The main departure comes from the possibility of forward integration as an additional organisational type. This generalisation leads to the emergence of a third type of sector (*balanced intensity*) and a different organisational structure of the component-intensive sectors compared to Antràs and Helpman (2004).

H- and M-intensive sectors. In H-intensive sectors, forward integration is strictly dominated by the other two organisational types. In M-intensive sectors, instead, backward integration is strictly dominated by the other two organisational types. In both sectors, the equilibrium shows a sectoral structure with four organisational types. The organisational structure in equilibrium for H- and M-intensive sectors are similar, and they only differ in the type of integration that emerges. Thus, I characterise it in general for both sectors, where V indicates V_H for H-intensive sectors and V_M for M-intensive sectors.[38]

[37] For definition of the critical values $\bar{\eta}_c$ and $\underline{\eta}_c$, see Appendix A.2.3.

[38] See Appendix A.4 for proofs and explicit expressions for the productivity cutoffs.

The most productive final good producers in the market choose V^S, i.e. foreign integration. The respective productivity cutoff, θ_V^S, is defined by the indifferent firm between this organisational type and arm's length trade, O^S: [39]

$$\pi^{prem}_{V^S/O^S}(\theta) \equiv \pi_V^S(\theta) - \pi_O^S(\theta) \quad \Rightarrow \quad \pi^{prem}_{V^S/O^S}(\theta_V^S) = 0.$$

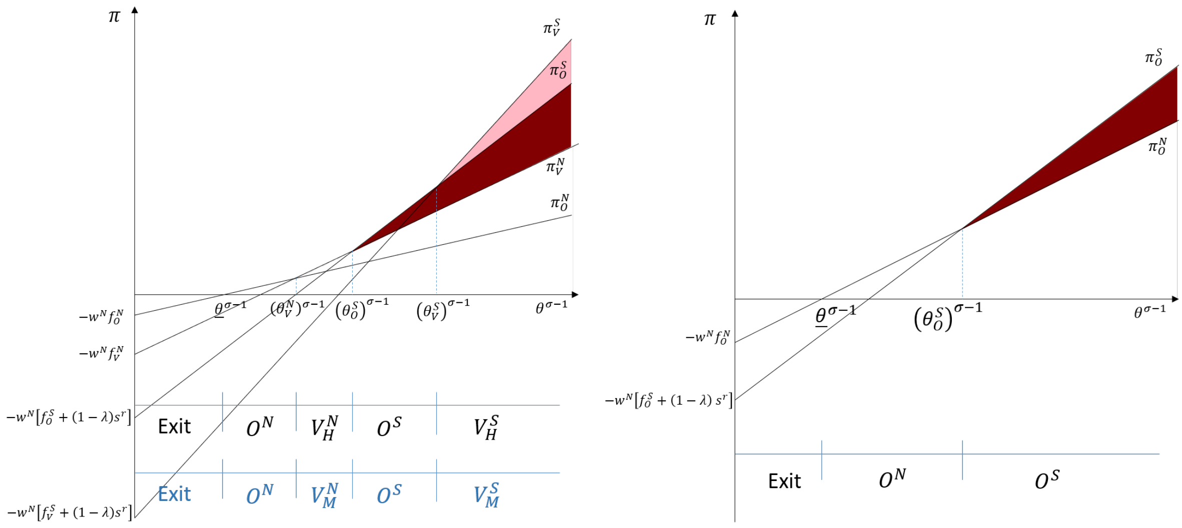
Figure 2a illustrates with the light shaded area the profit premium of V^S relative to O^S.

The final good producers with relative lower productivity find it more difficult to afford the higher fixed costs of foreign integration, but they are productive enough to afford the fixed costs of foreign outsourcing. Thus, the most productive among them opt, instead, for an independent southern supplier, O^S.[40] The arm's length trade productivity cutoff θ_O^S, which also represents the offshoring productivity cutoff, is defined by the final good producer that obtains a discounted offshoring profit premium high enough to recover the offshoring sunk cost $w^N s^r$.

$$\pi^{prem}_{O^S/V^N}(\theta) \equiv \pi_O^S(\theta) - \pi_V^N(\theta) \quad \Rightarrow \quad \pi^{prem}_{O^S/V^N}(\theta_O^S) = (1-\lambda)w^N s^r,$$

with $\pi^{prem}_{O^S/V^N}(\theta)$ as the profit premium of arm's length trade relative to domestic integration.

Finally, the domestic integration productivity cutoff, θ_V^N, is defined by $\pi^{prem}_{V^N/O^N}(\theta_V^N) = 0$, and the market productivity cutoff, $\underline{\theta}$, is given by the condition $\pi_O^N(\underline{\theta}) = 0$.



(a) H-intensive [M-intensive]

(b) Balanced-intensity

Figure 2: Perfect information steady states by sectors type

[39]The offshoring profit premium of those producers under V is the sum of both coloured areas in Figure 2a, for $\theta \geq \theta_V^S$. The offshoring profit premium of those producers under O^S is the dark coloured area for $\theta \in [\theta_O^S, \theta_V^S)$. The cutoff θ_V^S is defined by the indifferent producers between V^S and O^S. See Appendix A.3 for formal derivation of profit premiums.

[40]When the gains from offshoring, $w^S < w^N$, overcompensate the losses from a "misallocation" of property rights.

Balanced-intensity sectors. Outsourcing strictly dominates any type of integration when the contribution of each party to the total output is relatively balanced. Therefore, only two organisational forms are observed in these industries: *domestic outsourcing* and *arm's length trade*.[41] The sectoral organisational structure under equilibrium is illustrated by Figure 2b.

The shaded area represents the offshoring profit premium for the final good producer with $\theta \geq \theta_O^S$. The offshoring productivity cutoff, θ_O^S, is defined by the final good producer that realises a discounted offshoring profit premium high enough to recover the offshoring sunk cost.

$$\pi^{prem}_{O^S/O^N}(\theta) \equiv \pi_O^S(\theta) - \pi_O^N(\theta) \quad \Rightarrow \quad \pi^{prem}_{O^S/O^N}(\theta_O^S) = (1-\lambda) w^N s^r.$$

Finally, the market productivity cutoff, $\underline{\theta}$, is defined by the condition $\pi_O^N(\underline{\theta}) = 0$.

The related-party trade database does not identify the type of integration (forward or backward). However, the generalisation of the organisation-space allows me to overcome this data limitation and derive predictions on organisational dynamics under institutional uncertainty that contemplates both types of integration. Moreover, the analysis below remains robust to the situation where only one type of integration is available (i.e. backward integration), as in Antràs and Helpman (2004).[42]

3 Uncertainty in organisational fixed costs in South: model setup

A close reference to the characterisation of the Bayesian learning mechanism and the offshoring exploration decisions as a Markov decision process is Larch and Navarro (2021). The main difference is that, by assuming incomplete contracts, my focus is on the organisational dynamics, i.e. in the dynamic allocation of property rights across the value chain, while by assuming complete contracts, Larch and Navarro (2021) center the attention in the location dimension of the sourcing decisions.[43]

3.1 Model setup and initial conditions.

The initial conditions are defined as the steady-state economy with non-tradable intermediate inputs (*n.t.i.*). Offshoring strategies are initially not feasible for the northern final good producers due to weak institutional fundamentals in South. The higher marginal costs in the North imply a higher price index,

[41] See Appendix A.5 for proofs and explicit expressions for the productivity cutoffs in balanced-intensity sectors.

[42] In Appendix E.2, I use data for US manufacturing sectors to analyse empirical evidence for the generalisation of the organisational choice introduced in this section.

[43] To avoid the emergence of multiple equilibria, I simplify the location dimension of the offshoring decision under institutional uncertainty. For a complete characterisation of the location dimension in offshoring decisions under institutional uncertainty and its consequences in terms of specialisation of countries and welfare, see Larch and Navarro (2021).

$P^{n.t.i.}$, which translates into a lower competition intensity in the final good market.

Under *n.t.i* conditions, the most productive final good producers in the H-intensive [M-intensive] sectors choose domestic backward [forward] integration, while the least productive producers opt instead for domestic outsourcing. In the balanced-intensity sectors, they all choose domestic outsourcing.

I denote with $*$ the perfect information equilibrium variables. Comparing both steady states:[44]

- $H[M]$-intensive sectors: $\underline{\theta}^{n.t.i.} < \underline{\theta}^*$; $\theta^{N,n.t.i}_{V_{H[M]}} < \theta^{N,*}_{V_{H[M]}}$; $P^{n.t.i.} > P^*$; $Q^{n.t.i.} < Q^*$,
- Balanced-intensity sectors: $\underline{\theta}^{n.t.i.} < \underline{\theta}^*$; $P^{n.t.i.} > P^*$; $Q^{n.t.i.} < Q^*$.

Institutional reform in South ($t = 0$). An institutional information shock (e.g. institutional reform) takes place in the South in $t = 0$, but the weak credibility of the southern government produces that northern final good producers do not fully believe in the fundamentals of the new institutional regime. Thus, based on how credible the announcement of the southern government is, uncertainty emerges about the per-period fixed costs for each organisational type that involves a southern supplier, i.e. $f^S_O, f^S_{V_H}, f^S_{V_M}$. The final good producers' prior beliefs at $t = 0$ about institutions in South post-reform are:

$$f^S_k \sim Y(f^S_k) \quad \text{with} \quad f^S_k \in [\underline{f}^S_k, \bar{f}^S_k] \text{ and } k = O, V_H, V_M, \tag{10}$$

where $Y(.)$ denotes the c.d.f. of the prior uncertainty.[45]

The organisational choice is modelled as a recursive Markov decision process where firms update their beliefs through a Bayesian learning mechanism. Based on the priors, each final good producer must decide whether to explore the offshoring potential or wait. If the final good producer chooses to explore, she must pay a sunk cost for feasibility studies to set up a supply chain abroad, which consists in the analysis of the possible offshoring strategies from the South. Thus, after paying the offshoring sunk cost $w^N s^r$, she discovers the organisational fixed costs in the South for all the alternative types, i.e. $f^S_O, f^S_{V_H}, f^S_{V_M}$. After she receives this information, she must choose the optimal organisational form.[46]

If, instead, she decides to wait, she does it by sourcing for one more period with a domestic supplier under the previous organisational type k'^N. At the beginning of the next period, she updates the prior beliefs by observing the chosen organisational type of the final good producers that explored their off-

[44] Appendix B characterises the *n.t.i* steady state for each type of sector. Appendix A.8 defines the price and aggregate consumption indices under perfect information equilibrium for H- and M-intensive sectors, while Appendix A.7 defines them for balanced-intensity sectors.

[45] For the moment, the only condition on the prior distribution is that it has a finite expected value. To avoid a taxonomy of cases, I also assume that the true value is within the range of the distribution, i.e. $f^S_k \in [\underline{f}^S_k, \bar{f}^S_k]$.

[46] An important feature of the exploration activity is that it sets the final good producer in an absorbing state of the Markov process. After exploration, there is no remaining uncertainty to the final good producer.

shoring potential in the previous period. With this new information, she decides first whether to leave the market or remain active. If she stays active, she decides whether to explore the offshoring potential or wait one more additional period.

In the following sections, I introduce the information externalities and the learning mechanism. Then, I characterise the exploration decisions of the initial explorers ($t = 0$) and the followers ($t > 0$). Figure 3 illustrates the timing of events of the recursive Markov decision process.

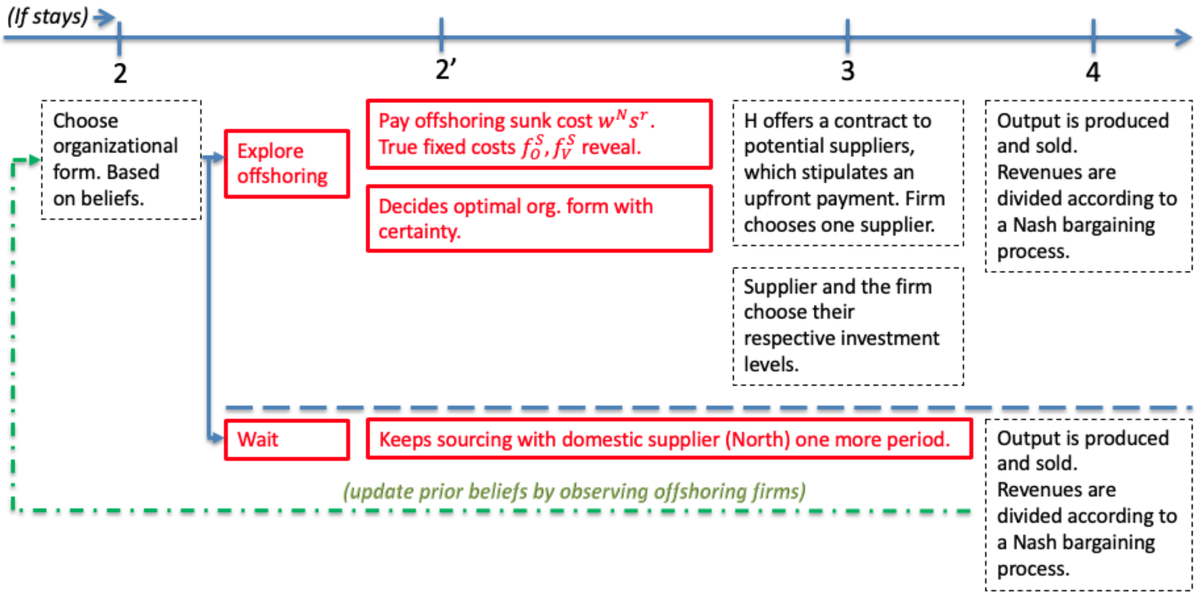


Figure 3: Timing of events - Uncertainty

3.1.1 Informational externalities and learning.

The learning mechanism involves the interaction of two states: the *beliefs* state and the *physical* state (Larch and Navarro, 2021). The latter refers to the information externalities generated by the actions of producers under offshoring. The first state defines how producers under domestic sourcing can update their beliefs.

Physical state: information externalities. I define the maximum affordable fixed cost for a final good producer under organisational type $k^S = O^S, V_H^S, V_M^S$ in period t as:

$$\pi^{\text{prem}}_{k^S/k'^N,t}(\theta) = 0 \quad \Rightarrow \quad f_k^S(\theta) = \frac{r_k^N(\theta, Q_t)}{\sigma w^N} \left[\left(\frac{w^N}{w^S} \right)^{(1-\eta)(\sigma-1)} - 1 \right] + f_{k'}^N, \tag{11}$$

where k'^N indicates V_H^N in the case of H-intensive sectors, V_M^N for M-intensive, and O^N for the industries with balanced intensity. It is easy to see that if $f_k^S > f_k^S(\theta)\ \forall k^S$, the final good producer θ does not find it profitable to offshore under any type. Thus, after discovering her offshoring potential in the South, she decides to remain sourcing domestically under the previous organisational type k'^N.

I define $\theta^S_{k,t}$ as the least productive final good producers doing offshoring under type k in t, and $\tilde{\theta}^S_t$ as the least productive producers that has explored the offshoring potential in $t-1$. Thus, $f^S_{k,t} \equiv f^S_k(\theta^S_{k,t})$ denotes the maximum affordable fixed cost under type k for the final good producers $\theta^S_{k,t}$ in t, and $\tilde{f}^S_{k,t} \equiv f^S_k(\tilde{\theta}^S_{k,t})$ indicates the maximum affordable fixed cost under type k for $\tilde{\theta}^S_{k,t}$ in t.

Beliefs state: learning. The initial state of the beliefs is defined by the initial prior distributions in equation (10), and they evolve according to the learning mechanism defined in (12). Intuitively, the final good producers that have not explored their offshoring potential can learn by observing the other producers' behaviour (*physical state*). In particular, I assume that the final good producers can observe the productivity θ of their competitors and the organisational type chosen by each of them.[47]

The posterior beliefs at the beginning of any period $t > 0$ for each $k = O, V_H, V_M$ are given by:

$$f^S_k \sim \begin{cases} Y(f^S_k) & \text{if } f^S_{k,t} = f^S_{k,t-1} = \bar{f}^S_k, \\ Y(f^S_k | f^S_k \leq f^S_{k,t}) = \frac{Y(f^S_k | f^S_k \leq f^S_{k,t-1})}{Y(f^S_{k,t} | f^S_k \leq f^S_{k,t-1})} & \text{if } \tilde{f}^S_{k,t} = f^S_{k,t} < f^S_{k,t-1}, \\ f^S_{k,t} & \text{if } \tilde{f}^S_{k,t} < f^S_{k,t}. \end{cases} \tag{12}$$

The first line indicates that the posterior beliefs for type k remain equal to the prior, when no final good producer has yet offshored under that type. The second line indicates a truncation of the prior uncertainty, exploiting the information that emerged from the new offshoring final good producers under type k. As a result of applying Bayes rule, the distribution progressively truncates from the right, while the lower bound of the prior remains constant.[48] To simplify the notation, I removed the lower bound in the condition of the distribution.

Finally, the third line indicates the moment in which the true value is revealed, and thus the uncertainty distribution collapses to the maximum affordable fixed cost by the least productive producer that offshores under type k. This takes place if, after exploring the offshoring potential in type k, at least one final good producer returns to domestic sourcing. I discuss this further below.

[47] Alternatively, if they can observe the total size of the final good market and the respective market shares of the competitors, together with the chosen organisational type, they can infer the productivity level. In Appendix C.6, I define the learning process for the situation in which the ownership structure is unobservable when offshoring, but they can still observe the location from where the other final good producers are sourcing.

[48] For proofs of the derivation of the Bayesian updating process, see Appendix C.1. For a similar Bayesian learning process see Rob (1991); Segura-Cayuela and Vilarrubia (2008); Larch and Navarro (2021)

3.1.2 Exploration decision of the offshoring potential.

The final good producer must decide whether to explore her offshoring potential under type k or wait by sourcing domestically under its current organisational type.

$$\mathcal{V}_{k,t}(\theta;\theta_t^S) = \max\{V_{k,t}^o(\theta;\theta_t^S); V_{k,t}^w(\theta;\theta_t^S)\};\ \text{for } k = O, V_H, V_M,$$

where $\theta_t^S = \{\theta_{O,t}^S, \theta_{V_H,t}^S, \theta_{V_M,t}^S\}$ indicates the state of the sector in period t.

The value of exploring the offshoring potential for a final good producer θ under type $k^S = O^S, V_H^S, V_M^S$ is given by the expected discounted profit premium of that type k^S relative to the current domestic sourcing organisational type k'^N, net of the offshoring sunk cost $w^N s^r$:

$$V_{k,t}^o(\theta;\theta_t^S) = \mathbb{E}_t\left[\max\left\{0; \sum_{\tau=t}^{\infty}\lambda^{\tau-t}\pi_{k^S/k'^N,\tau}^{\text{prem}}(\theta)\right\}\middle| f_k^S \leq f_{k,t}^S\right] - w^N s^r.$$

The final good producers, based on their posterior beliefs at t, can compute this expected value of offshoring for each alternative type, $k^S = O^S, V_H^S, V_M^S$.

The value of waiting is defined as:

$$\mathcal{V}_{k,t}^w(\theta;\theta_t^S) = 0 + \lambda\mathbb{E}_t[\mathcal{V}_{k,t+1}(\theta;\theta_{t+1}^S),$$

which is computed by the producers for each type $k^S = O^S, V_H^S, V_M^S$, based on posterior beliefs at t.

The Bellman equation for each offshoring type takes the form:

$$\mathcal{V}_{k,t}(\theta;\theta_t^S) = \max\left\{V_{k,t}^o(\theta;\theta_t^S); \lambda\mathbb{E}_t[\mathcal{V}_{k,t+1}(\theta;\theta_{t+1}^S)]\right\}. \tag{13}$$

Assumption A. 3. *Information flow decreases in the upper bound:*

$$\frac{\partial[f_{k,t}^S - E(f_k^S | f_k^S \leq f_{k,t}^S)]}{\partial f_{k,t}^S} > 0.$$

Under assumption A.3, I show that the One-Step-Look-Ahead (OSLA) rule is the optimal policy rule. In other words, in expectation at t, waiting for one period and exploring the offshoring potential in the next period dominates waiting for any longer periods.[49]

Therefore, the Bellman equation becomes $\mathcal{V}_{k,t}(\theta;\theta_t^S) = \max\left\{V_{k,t}^o(\theta;\theta_t^S); V_{k,t}^{w,1}(\theta;\theta_t^S)\right\}$. From this

[49]This assumption implies that the information revealed is decreasing in time. See Appendix C.2 for proofs.

expression, I derive the trade-off function (14) for each offshoring type $k = O^S, V_H^S, V_M^S$:

$$\mathcal{D}_{k,t}(\theta; \theta_t^S, \tilde{\theta}_{t+1}^S) = V_{k,t}^o(\theta; \theta_t^S, \tilde{\theta}_{t+1}^S) - V_{k,t}^{w,1}(\theta; \theta_t, \tilde{\theta}_{t+1}), \tag{14}$$

where the first argument of the function refers to the final good producer θ taking the decision, the second argument indicates the state of the system at the moment of the decision θ_t^S, and the third argument denotes the expected state of the system one period after, $\tilde{\theta}_{t+1}^S$.

When the value of offshoring is higher than the value of waiting, the final good producer finds it profitable to explore the offshoring potential under type k in t. When it is negative, she finds it optimal to wait for one period. When the trade-off function is zero, the final good producer is indifferent between exploring and waiting. In the last case, I assume that she chooses to explore.

$$\mathcal{D}_{k,t}(\theta; \theta_t^S, \tilde{\theta}_{t+1}^S) \begin{cases} \geq 0 & \text{Explores offshoring potential in South under type } k \text{ in } t. \\ < 0 & \text{Waits one period sourcing under } k'^N. \end{cases}$$

After paying the offshoring sunk cost $w^N s^r$, the final good producer discovers the value of the fixed costs in the South for all the offshoring organisational types. Therefore, she decides to explore her offshoring potential whenever the trade-off function is non-negative for at least one type $k = O^S, V_H^S, V_M^S$.[50]

Substituting the value of offshoring and the value of waiting into equation (14), I obtain:[51]

$$\mathcal{D}_{k,t}(\theta; \theta_t^S, \tilde{\theta}_{t+1}^S) = \max\left\{0; \mathbb{E}_t\left[\pi_{k^S/k^N,t}^{\text{prem}}(\theta) \middle| f_k^S \leq f_{k,t}^S\right]\right\} - w^N s^r \left[1 - \lambda \frac{Y(f_{k,t+1}^S)}{Y(f_{k,t}^S)}\right]. \tag{15}$$

From this expression, I derive a first property of the equilibrium path. Consistently with Larch and Navarro (2021), Lemma 1 shows that the exploration of the offshoring potential in the South is led by the most productive final good producers in the market.

Lemma 1 (Sequential offshoring)**.** *The final good producers with higher productivity have an incentive to explore the offshoring potential in earlier periods.*

$$\frac{\partial \mathcal{D}_{k,t}(\theta; \theta_t^S, \tilde{\theta}_{t+1}^S)}{\partial \theta} \geq 0.$$

Proof. See Appendix C.5.1. □

[50] After she receives that information, she may opt for a different organisational offshore structure than the type that triggered the exploration decision. In section 3.2, I characterise the decisions for each sector.

[51] See Appendix C.3 for derivation of equation (15).

Moreover, the trade-off function is strictly increasing in θ for those final good producers facing a real trade-off, i.e. those with a positive value of offshoring.

Assumption A. 4. *$\mathcal{D}_{k,t=0}(\bar{\bar{\theta}};\bar{\bar{\theta}},\bar{\bar{\theta}}) > 0$ for at least one $k = O, V_H, V_M$, where $\bar{\bar{\theta}}$ refers to the most productive final good producer in the market.*

Assumption A.4 establishes that at least the most productive final good producer in the market, denoted by $\bar{\bar{\theta}}$, finds it profitable at $t = 0$ to explore the offshoring potential for at least one organisational type $k = O, V_H, V_M$. This is a necessary condition to trigger the sequential exploration of the offshoring potential in South.[52]

3.2 Sectoral equilibrium paths.

I focus the analysis on the sectoral organisational dynamics, particularly on the vertical disintegration patterns that result from an endogenous increase in competition intensity. Thence, I concentrate on the characterisation of the equilibrium paths for the sectors where those patterns emerge, i.e. the M- and H-intensive sectors. Given that both types of integration are strictly dominated by outsourcing in balanced-intensity sectors, those dynamic patterns are absent in the sectoral equilibrium paths. Thus, I characterise the latter in Appendix C.4.

Both H- and M-intensive sectors face similar equilibrium paths. The main difference is that the integration type that emerges in the first case is backward, V_H, while in the second case, it is forward, V_M. I characterise the equilibrium paths for both sectors together, where V refers to V_H for a H-intensive sector and V_M for a M-intensive sector.

3.2.1 H- and M-intensive sectors: The trade-off function.

The final good producers may find it optimal to offshore by either arm's length trade or integration. When they must decide whether to explore their offshoring potential or wait, they compare the profits under domestic integration with the expected profit under each of the two alternative offshoring types.[53]

The trade-off function is thus given by:

$$\mathcal{D}_{k,t}(\theta;\theta_t^S,\tilde{\theta}_{t+1}^S) = \max\left\{0;\mathbb{E}_t\left[\pi^{prem}_{k^S/V^N,t}(\theta)\middle| f_k^S \leq f_{k,t}^S\right]\right\} - w^N s^r\left[1-\lambda\frac{Y(f_{k,t+1}^S)}{Y(f_{k,t}^S)}\right], \tag{16}$$

[52]If the distribution $G(\theta)$ is unbounded on the right, i.e. $\bar{\bar{\theta}} \to \infty$, then the assumption A.4 holds for any distribution $Y(f_k^S)$ with a finite expected value.

[53]In the case of H-intensive sectors V refers to V_H. The other organisational types strictly dominate forward integration. Therefore, it is not considered a potentially profitable alternative. Instead, in M-intensive sectors, V indicates V_M. The other types strictly dominate backward integration. Thus, it is not considered as a potentially profitable alternative.

with $k = O, V$. A final good producer with productivity θ explores the offshoring potential in period t when $\mathcal{D}_{k,t}(\theta; \theta_t^S, \tilde{\theta}_{t+1}^S) \geq 0$ for at least one $k = O^S, V^S$.

The offshoring exploration productivity cutoff, i.e. the least productive final good producer exploring the offshoring potential, at any period t, is defined in Lemma 2.

Lemma 2 (Per-period offshoring exploration productivity cutoff)**.** *The offshoring exploration productivity cutoff in any period t, denoted as $\tilde{\theta}_{t+1}^S$, is given by:*

$$\tilde{\theta}_{t+1}^S = \min\left\{\tilde{\theta}_{O,t+1}^S; \tilde{\theta}_{V,t+1}^S\right\},$$

with

$$\tilde{\theta}_{O,t+1}^S = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N \left[\mathbb{E}(f_O^S | f_O^S \leq f_{O,t}^S) - f_V^N + s^r \left(1 - \lambda \frac{Y(f_{O,t+1}^S)}{Y(f_{O,t}^S)}\right)\right]}{\psi_O^S(\eta) - \psi_V^N(\eta)}\right]^{\frac{1}{\sigma-1}},$$

$$\tilde{\theta}_{V,t+1}^S = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N \left[\mathbb{E}(f_V^S | f_V^S \leq f_{V,t}^S) - f_V^N + s^r \left(1 - \lambda \frac{Y(f_{V,t+1}^S)}{Y(f_{V,t}^S)}\right)\right]}{\psi_V^S(\eta) - \psi_V^N(\eta)}\right]^{\frac{1}{\sigma-1}}.$$

Proof. $\tilde{\theta}_{O,t+1}^S$ and $\tilde{\theta}_{V,t+1}^S$ are defined by the fixed points:

$$\mathcal{D}_{V,t}(\tilde{\theta}_{V,t+1}; \theta_t^S, \tilde{\theta}_{t+1}^S) = 0 \Rightarrow \quad \mathbb{E}_t \left[\pi_{V^S/V^N,t}^{prem}(\tilde{\theta}_{V,t+1}) \Big| f_V^S \leq f_{V,t}^S\right] = w^N s^r \left[1 - \lambda \frac{Y(f_{V,t+1}^S)}{Y(f_{V,t}^S)}\right],$$

$$\mathcal{D}_{O,t}(\tilde{\theta}_{O,t+1}; \theta_t^S, \tilde{\theta}_{t+1}^S) = 0 \Rightarrow \quad \mathbb{E}_t \left[\pi_{O^S/V^N,t}^{prem}(\tilde{\theta}_{O,t+1}) \Big| f_O^S \leq f_{O,t}^S\right] = w^N s^r \left[1 - \lambda \frac{Y(f_{O,t+1}^S)}{Y(f_{O,t}^S)}\right].$$

See Appendix C.5.2. □

Organisational choice after exploration. After paying the offshoring sunk cost $w^N s^r$, the producer receives information on the true values $f_O^S, f_{V_H}^S, f_{V_M}^S$. Therefore, she chooses the organisational type that maximises her profits, independently of the type k that triggered the exploring decision.

The organisational decision after exploration is as follows: After paying $w^N s^r$ in period t, the final good producer discovers the true values of f_O^S, $f_{V_H}^S$ and $f_{V_M}^S$, and she must choose an organisational type. The final good producer with productivity θ chooses foreign integration, V^S, when:

$$\pi_{V^S/O^S,t}^{prem}(\theta) = \pi_{V,t}^S(\theta) - \pi_{O,t}^S(\theta) \geq 0.$$

She chooses arm's length trade, O^S, when:

$$\pi^{prem}_{O^S/V^N,t}(\theta) = \pi^S_{O,t}(\theta) - \pi^N_{V,t}(\theta) \geq 0 \quad \text{and} \quad \pi^{prem}_{V^S/O^S,t}(\theta) < 0.$$

Otherwise, she remains under domestic integration.

Lemma 3 (Foreign integraton productivity cutoff)**.** *The foreign integration productivity cutoff at the end of period t, $\theta^S_{V,t+1}$, i.e. the least productive final good producer that has chosen V^S after paying the sunk cost in period t, is given by:*

$$\theta^S_{V,t+1} = \max\left\{\tilde{\theta}^S_{t+1}; \theta^{S,\bullet}_{V,t+1}\right\}, \tag{17}$$

with

$$\pi^{prem}_{V^S/O^S,t}(\theta^{S,\bullet}_{V,t+1}) = 0 \quad \Rightarrow \quad \theta^{S,\bullet}_{V,t+1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N \left[f^S_V - f^S_O\right]}{\psi^S_V(\eta) - \psi^S_O(\eta)} \right]^{\frac{1}{\sigma-1}}. \tag{18}$$

Proof. See Appendix C.5.3. □

3.2.2 H- and M-intensive sectors: Long-run properties of the trade-off function.

Lemma 4 (Convergence of offshoring productivity cutoff)**.** *The sector converges asymptotically to the perfect information equilibrium, $\theta^S_t \xrightarrow{t\to\infty} \theta^{S,*} = \theta^{S,*}_O$, when:*

$$\text{Case I: } f^S_O = \underline{f}^S_O \Rightarrow f^S_{O,\infty} = \underline{f}^S_O,$$
$$\text{Case II: } \underline{f}^S_O + (1-\lambda)s^r < f^S_O.$$

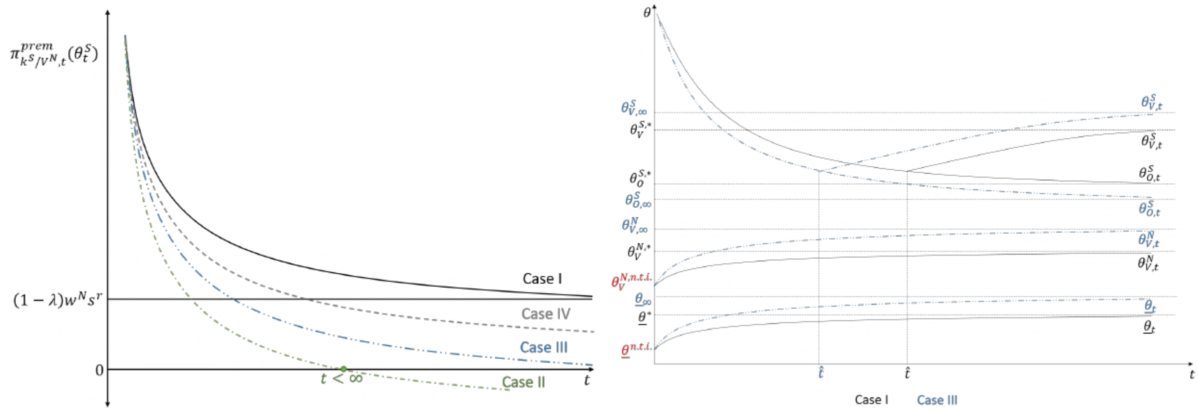
Hysteresis takes places, i.e. convergence leads to some "excess" of offshoring , when:

$$\text{Case III: } \underline{f}^S_O + (1-\lambda)s^r = f^S_O \Rightarrow \theta^S_t \xrightarrow{t\to\infty} \theta^{S,\neg r}_O,$$
$$\text{Case IV: } \underline{f}^S_O + (1-\lambda)s^r > f^S_O > \underline{f}^S_O \Rightarrow \theta^S_t \xrightarrow{t\to\infty} \theta^S_{O,\infty},$$

with $\theta^{S,*}_O > \theta^S_{O,\infty} > \theta^{S,\neg r}_O$, and $\theta^{S,\neg r}_O$ denoting the case where the marginal firms obtain zero per period offshoring profit premium by doing arm's length trade, i.e. firms who cannot recover $w^N s^r$.

Proof. See Appendix C.5.4. □

I define $\hat{t}$ as the earliest period in which: $\tilde{\theta}^S_{\hat{t}+1} \leq \theta^{S,\bullet}_{V,t+1}$, i.e. for $t > \hat{t}$, the new producers exploring the offshoring potential in South choose foreign outsourcing after the exploration decision. Figure 4a illustrates the cases characterised in Lemma 4. Depending on the optimistic level of the priors, $\hat{t}$ may take place right in the first period, i.e. $\hat{t} = 0$, or in any finite period after the initial one. Under Case II, $\hat{t}$ necessarily takes place before the period in which the convergence stops. This is a natural consequence of the sequential offshoring process.



(a) Offshoring productivity cutoff

(b) Productivity cutoffs

Figure 4: H- and M-intensive sectors. Equilibrium paths

3.2.3 H- and M-intensive sectors: Competition effect and the disintegration dynamics.

As more firms explore their offshoring potential, the offshoring productivity cutoff converges to the long-run steady states defined by Cases I to IV in Lemma 4. The lower prices charged by the final good producers under offshoring reduce the price index and increases the aggregate consumption index in the final good markets. The price index and the aggregate consumption index converge to their respective long-run steady states defined by Cases I to IV, as shown by Lemma 5.

Lemma 5 (Price index effect of sequential offshoring)**.** *As the offshoring productivity cutoff converges to the steady state (Lemma 4), the price index in the final good market reduces:*

$$\begin{cases} \textit{Cases I and II: } P_t \searrow P^* & \textit{if } \theta^S_t \searrow \theta^{S,*}, \\ \textit{Case III: } P_t \searrow P^{\neg r} & \textit{if } \theta^S_t \searrow \theta^{S,\neg r}, \\ \textit{Case IV: } P_t \searrow P_\infty \in (P^*; P^{\neg r}) & \textit{if } \theta^S_t \searrow \theta^S_\infty \in (\theta^{S,\neg r}; \theta^{S,*}). \end{cases}$$

Proof. See Appendix C.5.5. □

Lemma 6 (Convergence of market productivity cutoff)**.** *As the offshoring productivity cutoff converges to the steady state (Lemma 4), the price index in the final good market reduces (Lemma 5), and the* *market productivity cutoff increases:*

$$\begin{cases} \textit{Cases I and II: } \underline{\theta}_t \nearrow \underline{\theta}^* & \textit{if } \theta_t^S \searrow \theta^{S,*}, \\ \textit{Case III: } \underline{\theta}_t \nearrow \underline{\theta}^{\neg r} & \textit{if } \theta_t^S \searrow \theta^{S,\neg r}, \\ \textit{Case IV: } \underline{\theta}_t \nearrow \underline{\theta}_\infty \in (\underline{\theta}^*; \underline{\theta}^{\neg r}) & \textit{if } \theta_t^S \searrow \theta_\infty^S \in (\theta^{S,\neg r}; \theta^{S,*}). \end{cases}$$

Proof. See Appendix C.5.6. □

From Lemma 6, it is possible to see that the decreasing price index intensifies the competition in final good market, and sequentially pushes the least productive final good producers out of the market. As $P_t \searrow P^*$, the market productivity cutoff $\underline{\theta}_t \nearrow \underline{\theta}^*$.

Proposition 1 (First channel of competition effect on vertical disintegration)**.** *As the offshoring productivity cutoff converges to the steady state (Lemma 4), the price index in the final good market reduces (Lemma 5), and:*

(a) the least productive final good producers under domestic integration sequentially disintegrate the supply chains to domestic outsourcing:

$$\begin{cases} \textit{Cases I and II: } \theta_{V,t}^N \nearrow \theta_V^{N,*} & \textit{if } \theta_t^S \searrow \theta^{S,*}, \\ \textit{Case III: } \theta_{V,t}^N \nearrow \theta_V^{N,\neg r} & \textit{if } \theta_t^S \searrow \theta^{S,\neg r}, \\ \textit{Case IV: } \theta_{V,t}^N \nearrow \theta_{V,\infty}^N \in (\theta_V^{N,*}; \theta_V^{N,\neg r}) & \textit{if } \theta_t^S \searrow \theta_\infty^S \in (\theta^{S,\neg r}; \theta^{S,*}). \end{cases}$$

(b) starting from $\hat{t}$, the least productive final good producers under foreign integration sequentially disintegrate the supply chains to foreign outsourcing:

$$\begin{cases} \textit{Cases I and II: } \theta_{V,t}^S \nearrow \theta_V^{S,*} & \textit{if } \theta_t^S \searrow \theta^{S,*}, \\ \textit{Case III: } \theta_{V,t}^S \nearrow \theta_V^{S,\neg r} & \textit{if } \theta_t^S \searrow \theta^{S,\neg r}, \\ \textit{Case IV: } \theta_{V,t}^S \nearrow \theta_{V,\infty}^S \in (\theta_V^{S,*}; \theta_V^{S,\neg r}) & \textit{if } \theta_t^S \searrow \theta_\infty^S \in (\theta^{S,\neg r}; \theta^{S,*}). \end{cases}$$

Proof. See Appendix C.5.7. □

Figure 4b illustrates the equilibrium paths of the productivity cutoffs for Case I (*solid line*) and Case III (*dashed line*). Any path between I and III represents Case IV. For simplicity, I will refer from now on to either of the long-run steady states as the perfect information steady-state.[54]

[54]As shown in Lemma 4, some steady states differ from the perfect information equilibrium (hysteresis). Nevertheless, for

Effects on offshoring firms: regime change and sequential disintegration. Proposition 1 (b) shows that the least final good productive producers under foreign integration sequentially shift to foreign outsourcing, as the competition in the final goods market intensifies. For $t \geq \hat{t}$, as $P_t \searrow P^*$, the foreign integration productivity cutoff converges from below to the perfect information steady state: $\theta^S_{V,t} \nearrow \theta^{S,*}_V$.

The least productive of the early offshoring final good producers have chosen V^S as a temporal organisational type. As the competition intensifies, they find it optimal to vertically disintegrate and switch to arm's length trade.[55] This represents a non-monotonic behaviour of the foreign integration productivity cutoff over time. It manifests itself as a regime change or a reorganisation of the supply chains of the least productive final good producers that have initially chosen foreign integration.[56]

Effects on middle size firms: sequential disintegration of domestic supply chains. Proposition 1 (a) shows that the least productive producers under domestic integration sequentially disintegrate the supply chain to domestic outsourcing. As before, due to the effect of the increasing competition on the revenues, some domestically integrated final good producers discover that the gains from integration can no longer compensate for the higher managerial or governance costs. Thus, they sequentially shift towards independent northern suppliers (domestic outsourcing).

4 Empirical model: Competition effect in North-South model

I test the theoretical prediction characterised by Proposition 1: *the first channel of competition effect on vertical disintegration*. In particular, I focus on the organisational dynamics of the offshoring final good producers.[57] To that aim, I use US manufacturing sector-level data for the period 2002-2016. I describe the data in section 4.1, and I follow with stylised facts in section 4.2. In sections 4.3.1 to 4.3.5, I introduce a set of reduced-form empirical models that capture different features of the sectoral organisational dynamics. Finally, in section 4.3.6, I aggregate the firm-level predictions of the theoretical model to sector-level consistent organisational dynamics, and I derive a structural two-stage empirical

simplicity, I refer as "convergence to perfect information equilibrium" to any of those cases. For further discussions on the welfare consequences of each steady-state, see Larch and Navarro (2021).

[55] For simplicity, I assume that there is zero cost of reorganisation of the supply chain when they switch from foreign integration to foreign outsourcing. The introduction of a cost of disintegration would simply shift upwards the productivity level in the conditions that define the period $\hat{t}$.

[56] The increase in competition intensity in the final good market shrinks the total revenues for all the active final good producers. It diminishes the outside options at the bargaining stage of the final good producers under integration. Thus, it affects proportionally more to those final good producers under integration. Therefore, a subset of the final good producers under V^S observes that the gains from integration cannot compensate for the higher managerial costs of that organisational type. Thus, they sequentially shift the regime from V^S towards O^S.

[57] In other words, I test for the effects characterised in part (b) of Proposition 1. The available data does not allow to test for the vertical disintegration dynamics on domestic supply chains.

model that identifies the mechanism of the competition effect characterised Proposition 1.

4.1 Data.

The main datasets are the Related-Trade Party dataset and the manufacturing survey, both from the US Census Bureau, and the supplementary import table before redefinitions of the input-output matrix from the Bureau of Economic Analysis (BEA).

I use imports data for the period 2002-2016 from the Related-Trade Party dataset, provided by the US Census Bureau.[58] The data covers US manufacturing sectors reported at NAICS 6 digits, classified according to the supplier's (i.e. exporter's) activity. The data allows for the distinction between imports of US firms from a related party (*intra-firm trade*) and a non-related party (*independent suppliers*). The sector-level aggregation constitutes the main drawback of the data for a complete structural estimation of the model's predictions. For that reason, I aggregate the firm-level model's predictions and derive the respective sectoral organisational equilibrium dynamics.

A second limitation of the data refers to the lack of distinction between forward and backward integration in imports flows. Instead, it identifies whether the parties are related (in either way) or independent. Nevertheless, the generalisation of the organisational space in the theoretical model to both types of integration allows me to overcome this limitation in the data. Thus, the model's prediction test does not require the distinction between forward and backward integration.

A third limitation comes from the classification of imports at the supplier sector, while the model's predictions are defined at the final good producer sector. Thus, to reclassify the data from supplier to final good producer sectors, I use *import matrix before redefinitions 2012* of the input-output matrix provided by the BEA. I identify the final good producer sectors by the user manufacturing industries in the matrix, while the supplier sector is linked to the manufacturing industries of the imported commodity in the matrix. Both are classified by BEA code. After reclassification of the manufacturing survey and the related-trade party datasets to BEA code, I merge both datasets to the matrix. Thus, I obtain a sample that consists of 139 final good sectors, 160 supplier sectors, and 173 foreign countries.

Considering that the main predictions of the theoretical model are related to the organisational dynamics of the final good producer sectors, I aggregate the m (i.e. supplier) dimension in the data and identify the mean supplier sector features at the final good producer level.

Regarding the imports data, I transform it to obtain the imports at final good producer sector j level. To that aim, I build a measure based on the BEA matrix that captures the share of each final good sector

[58] For the period 2005-2016, the data comes directly from the Census Bureau. For the years 2002-2004, I use the data of the Census Bureau provided in Antràs (2015).

j in the imports of each input m sector. It is denoted as $HshrM_{m,j}$. Using these shares, I distribute the imports of each input m through each final good sector j and aggregate them at the j level. Thus, I compute the total imports and the intra-firm imports of each sector j from each sourcing location. The manufacturing survey provides data on total sales of the final good producer sector j.[59] Combining this data with the imports data at sector j level, I compute the *offshoring share* and the *intra-firm intensity* of each final good sector j.[60] In section 4.3, I discuss the construction of the main variables.

I use the "liberal" criteria of Rauch (1999)'s classification of commodities. I define a measure that takes the value 0 if Rauch's category is "*w*", 0.5 if "*r*", and 1 if "*d*".[61] After reclassification to BEA codes, I obtain a continuous differentiation index in $[0, 1]$, which increases in the differentiation of the sector. I merge this data with the input-output matrix and obtain a differentiation index for j and m sides of the relationship. Thus, I obtain a weighted mean supplier differentiation index at the sector j level.

The elasticity of substitution of the final good markets comes from Broda and Weinstein (2006), and the data on bilateral tariffs comes from the World Integrated Trade Solutions (WITS). I reclassify these datasets to BEA codes and compute the respective mean values for each sector j.

Finally, using a factor analysis approach (FA), I build a measure for H-intensity of the final good sector, η_j, which is defined by the first factor from a factor analysis of the determinants of the H-intensity. To that aim, I build on the works of Yeaple (2006); Nunn (2007); Nunn and Trefler (2013) and Antràs (2015).[62] The data used for that purpose comes from the manufacturing survey of the Census Bureau and the Business R&D and Innovation Survey (BRDIS) survey of the National Center for Science and Engineering Statistics (NCSES) of the National Science Foundation.

4.2 Stylised facts.

Figure 5a shows a positive trend in US total imports for differentiated and non-differentiated supplier's sectors.[63] The positive trend in total imports and the negative trend in the share of intra-firm imports of the differentiated sectors shown by Figure 5 are consistent with the sectoral equilibrium path characterised in Section 3.2. The model's prediction states that the sequential offshoring equilibrium path increases the competition intensity in the final good markets, and thus it eventually leads to a sequential

[59]Additionally, the manufacturing survey data is used to compute the measures of the determinants of the component-intensity of the sector j in the static empirical model. For further discussion on the data and identification of the static empirical models, see appendices E.1 and E.2.

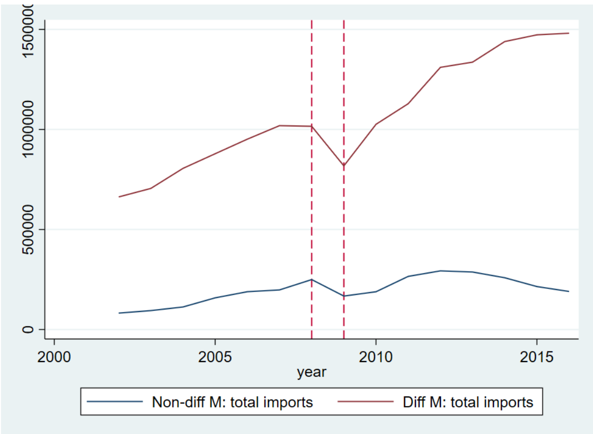
[60]The *offshoring share* is the total imports of sector j over the total sales of the sector. Instead, the *intra-firm intensity* is defined as the total intra-firm imports of sector j over the total sales of the sector. Additionally, I compute for the reduced-form model the *intra-firm share*, which refers to the intra-firm imports over the total imports of the sector j.

[61]The catergories are: i) good traded on an organised exchange (*w*), ii) reference priced (*r*), and iii) differentiated (*d*).

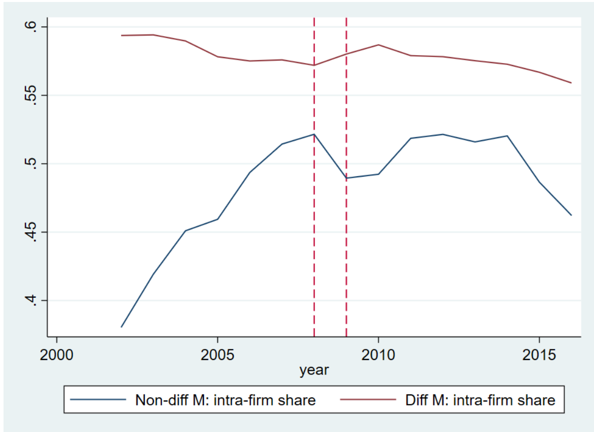
[62]Main measures are: Capital intensity, Machinery intensity, R&D intensity, Advertising intensity. See Appendix E.2.

[63]The vertical lines indicate the global financial crisis.

vertical disintegration of the offshoring firms. Additionally, Figure 5b shows an increasing participation of independent suppliers in US imports, in particular in the differentiated supplier's industries. [64]



(a) Total imports, millions USD.



(b) Intra-firm import share.

Figure 5: US imports by type of input m sector (*differentiated* and *non-differentiated*).

Figure 6 illustrates the predicted sectoral dynamic path and highlights the main features of the first channel of the competition effect on vertical disintegration. The sequential reduction in the offshoring productivity cutoff (*red solid line*) translates to a progressive increase in the competition intensity in the final goods market (i.e. reduction of the sector's price index). Among offshoring firms, it leads to a sequential vertical disintegration of the least productive final good producers under foreign integration (*blue dashed line*), which begins in period $\hat{t}$.[65]

4.3 Identification of the empirical models and estimation results.

I test for the predictions of Proposition 1, i.e. *the first channel of competition effect on vertical disintegration*, in particular those related to the organisational dynamics of offshoring firms. In sections 4.3.1 to 4.3.5, I introduce a set of reduced-form models that show evidence consistent with different features of the organisational dynamics characterised by Proposition 1. Sections 4.3.1 and 4.3.2 present the models in a two-country setup, where I aggregate the foreign sourcing locations. Sections 4.3.3 and 4.3.4 exploit the variation that comes from the country dimension. Section 4.3.5 disentangles the bilateral and global effects of the offshoring activity on the vertical disintegration of supply chains.

Finally, in section 4.3.6, I introduce main specification. It refers to a two-stage structural empirical model that identifies the mechanism of the first channel of the competition effect on vertical disintegra-

[64]This pattern is also consistent with the increasing offshoring activity of US firms shown in Feenstra (1998) for an earlier period. There is a more stable behaviour pattern in the sense that the trend shows a consistently negative trend all over the period, except during the financial crisis. During the crisis, it showed a small increase, but it returned quickly to the decreasing trend. It is consistent with a progressive vertical disintegration of the offshoring firms (Feenstra, 1998).

[65]The *green dotted lines* illustrate the effect of the increasing competition intensity in the domestic supply chains.

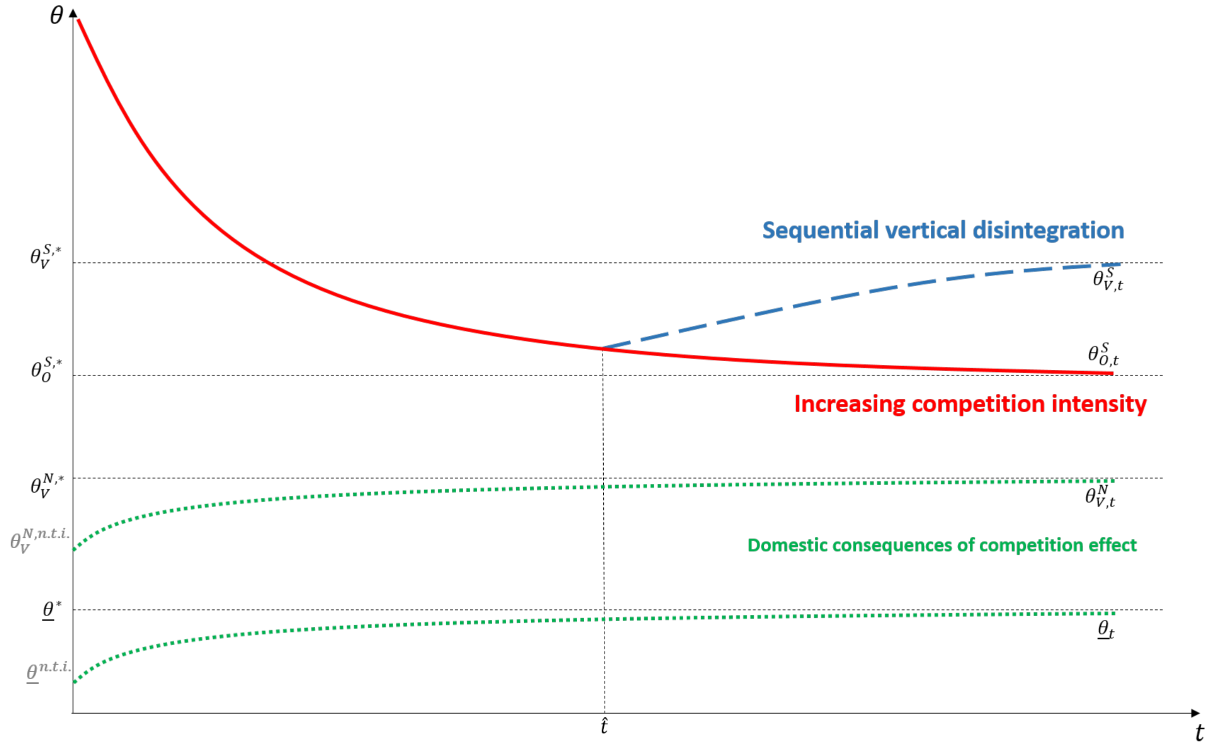


Figure 6: First channel of competition effect: increase in offshoring activity

tion, as characterised by Proposition 1.

4.3.1 Reduced form model: First channel of competition effect in a two-countries setup.

Following the North-South setup, I aggregate the country dimension to one offshoring location. Given the non-linear nature of the model, I define a fractional logit model given by:

$$\mathbb{E}\Big[IFshr_{j,t}\Big|\boldsymbol{x}\Big] = \frac{\exp(\boldsymbol{x}'_{j,t}\boldsymbol{\rho})}{1+\exp(\boldsymbol{x}'_{j,t}\boldsymbol{\rho})} \quad \text{with} \quad \boldsymbol{x}'_{j,t}\boldsymbol{\rho} = \rho_1 \ln(\mathit{offshr\ shr}_{j,t}) + \mathit{other\ controls} + \rho_t, \tag{19}$$

where $IFshr_{j,t}$ indicates the global intra-firm import share of sector j in year t, and $\mathit{offshr\ shr}_{j,t}$ measures the offshoring share of sector j in period t. Among the other controls, I include a set of sector-level variables that account for the relevant dimensions identified by the theoretical model.[66] The control variables are: the elasticity of substitution of the final good sectors, from Broda and Weinstein (2006) ($sigma_j$), the degree of differentiation of the mean supplier sector relative to sector j ($M\ diff_j$),[67] and the differentiation degree of the final good producer sector ($H\ diff_j$). The model also includes year fixed effects (ρ_t). Finally, the observations are weighted by the relevance of final good sector j in imports of

[66] These control variables also account for the sector-level determinants of the organisational choices identified by the previous empirical literature. See Yeaple (2006); Nunn (2007); Nunn and Trefler (2013); Antràs (2015).

[67] This measure is similar to the contract dependence index from Nunn (2007). I describe below the construction of the weighted mean measure of the differentiation index.

supplier sector m, i.e. $\mathit{HshrM}_{m,j}$.

Definition of the main variables. From the manufacturing survey, I obtain the final good sector total sales in year t, $\mathit{total\ sales}_{j,t}$, while the data on total imports and intra-firm imports at the input sector level in year t, $\mathit{total\ imp}_{m,t}$ and $\mathit{IF\ imp}_{m,t}$, comes from the related-party trade dataset.[68]

The variable $\mathit{IFshr}_{j,t}$ is defined as:

$$\mathit{IFshr}_{j,t} = \sum_m \mathit{IFshr}_{m,t} \times \mathit{MshrH}_{m,j} \quad \text{with} \quad \mathit{IFshr}_{m,t} = \frac{\mathit{IF\ imp}_{m,t}}{\mathit{total\ imp}_{m,t}}, \tag{20}$$

and the offshoring share, $\mathit{offshr\ shr}_{j,t}$, is:

$$\mathit{offshr\ shr}_{j,t} = \frac{\mathit{total\ imp}_{j,t}}{\mathit{total\ sales}_{j,t}} \quad \text{with} \quad \mathit{total\ imp}_{j,t} = \sum_m \mathit{total\ imp}_{m,t} \times \mathit{HshrM}_{m,j}. \tag{21}$$

The variable $\mathit{offshr\ shr}_{j,t}$ captures the intensity of offshoring activity in sector j, which is related to the *red solid line* in Figure 6. The model predicts a negative coefficient ρ_1: higher offshoring activity in sector j (*decreasing red solid line*) leads to lower intra-firm import share (*increasing blue dashed line*).

The differentiation index for the mean supplier of sector j is $\mathit{M\ diff}_j = \sum_m \mathit{M\ diff}_m \times \mathit{MshrH}_{m,j}$.

Results. Column (1) of Table 1 reports the estimated coefficients and average marginal effects of the model in equation (19). Column (2), instead, introduces the offshoring share in levels.[69] The empirical evidence is consistent with the theoretical predictions of Proposition 1: as the offshoring activity in the sector increases, the intra-firm import share decreases. The latter is consistent with a vertical disintegration of the offshore supply chains.

However, the results may also capture a situation where the intra-firm import share increases but offshoring final good producers do not vertically disintegrate their supply chains. In Figure 6, it would be represented by a decreasing red solid line, while the blue dashed line remains horizontal from $\hat{t}$ on. To account for the latter concern, I introduce a complementary reduced-form model in section 4.3.2, which is able to account for this potential situation.

[68]Total imports is defined as the sum of related-party imports plus non-related party imports. The non-classified imports are removed from the sample.

[69]See Table 10 in Appendix E.3.2 for complete table. Table 11 in Appendix E.3.2 reports the results of models that control for sector j fixed effects. The supportive evidence vanishes in the latter case.

Table 1: Competition effect: coefficients and average marginal effects.

	(1) $IFshr_{j,t}$		(2) $IFshr_{j,t}$		(3) $IFint_{j,t}$	
	+	++	+	++	+	++
$\ln(\mathit{offshr\ shr}_{j,t})$	-0.180**	-0.0381***				
	(0.0768)	(0.0139)				
$\mathit{offshr\ shr}_{j,t}$			-2.356*	-0.506*	11.69***	0.279***
			(1.427)	(0.289)	(1.319)	(0.0389)
$\mathit{offshr\ shr}^2_{j,t}$					-6.006***	-0.143***
					(1.268)	(0.0331)
FEs	t	t	t	t	t	t
Observations	2039	2039	2039	2039	2039	2039

Other controls: $H\ diff_j$, $M\ diff_j$, $\ln(sigma_j)$, $\eta(\bar{FA}_j)$. Coefficients (+) and average marginal effects (++). Standard errors in parentheses. Cluster s.e. at sector j. $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

4.3.2 Reduced form model: Intra-firm intensity.

I define $IFint_{j,t}$ as the intra-firm intensity in the sector j in period t, which is given by:

$$IFint_{j,t} = \frac{IF\ imp_{j,t}}{tot\ sales_{j,t}} \quad \text{with} \quad IF\ imp_{j,t} = \sum_m imp\ rel_{m,t} \times HshrM_{m,j} \tag{22}$$

The dynamics illustrated in Figure 6 show that the intra-firm intensity exhibits a non-monotonic behaviour over time. Until period $\hat{t}$, the intra-firm intensity increases as the offshoring activity in the sector progressively increases (*sequential offshoring*). From that moment on, a further increase in offshoring activity leads to a progressive reduction in the intra-firm intensity. Thus, considering the U-shaped relationship predicted by the theory, the empirical model specifies a quadratic relation between the offshoring share and the intra-firm intensity. I define it as a fractional logit model, which is given by:

$$\begin{aligned}\mathbb{E}\left[IFint_{j,t}\middle|\boldsymbol{x}\right] =& \frac{\exp(\boldsymbol{x}'_{j,t}\boldsymbol{\rho})}{1+\exp(\boldsymbol{x}'_{j,t}\boldsymbol{\rho})} \\ & \text{with } \boldsymbol{x}'_{j,t}\boldsymbol{\rho} = \rho_1 \mathit{offshr\ shr}_{j,t} + \rho_2 \mathit{offshr\ shr}^2_{j,t} + \mathit{other\ controls} + \rho_t,\end{aligned} \tag{23}$$

Results. Column (3) of Table 1 reports the results of model in (23).[70] The inverted U-shape of the effect of the offshoring share on the intra-firm intensity provides evidence consistent with the predictions of the model: once the sector has reached a sufficiently extensive offshoring activity, characterised by $\hat{t}$, further increase in the offshoring share induces a vertical disintegration of the offshore supply chains.

[70] See 10 in Appendix E.3.2 for report of full table. Table 11 in Appendix E.3.2 reports the results of models that control for sector j fixed effects. The results remain robust.

4.3.3 Reduced form model: Competition effect at bilateral levels.

I exploit now the variation in the country dimension. I estimate the effects of the global offshoring activity of sector j in the bilateral intra-firm import shares.

The empirical model is given by:

$$\mathbb{E}\Big[\mathit{IFshr}_{l,j,t}\Big|\boldsymbol{x}\Big] = \frac{\exp(\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho})}{1+\exp(\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho})} \quad \text{with} \quad \boldsymbol{x}'_{l,j,t}\boldsymbol{\rho} = \rho_1 \ln(\mathit{offshr\ shr}_{j,t}) + \mathit{other\ controls} + \rho_l + \rho_t, \tag{24}$$

where $\mathit{IFshr}_{l,j,t}$ indicates the bilateral intra-firm import share of sector j from country l in year t, and $\mathit{offshr\ shr}_{j,t}$ refers to the offshoring share of sector j in period t from all sourcing locations. From the theory, the increase in the offshoring activity in any country l affects the organisation of supply chains in all sourcing locations, through its impact on the price index in the final good market. Therefore, the bilateral intra-firm import share of sector j is affected by the global offshoring activity of sector j.

As before, the other controls include: the elasticity of substitution from Broda and Weinstein (2006); the degree of differentiation of the mean supplier industry, *M diff*, which is defined by equation (19); the H differentiation level (*H diff*); and $\ln(1+\mathit{tariffs}_{l,j,t})$, where $\mathit{tariffs}_{l,j,t}$ denotes the weighted mean of tariffs in inputs imported by sector j in year t from country l. For the definition of the variables, see Appendix E.3.2. The model includes country (ρ_l) and year (ρ_t) fixed effects. The observations are weighted by the relevance of the final good sector j in supplier sector m's imports, i.e. $\mathit{HshrM}_{m,j}$.

Table 2: Competition effect: average marginal effects.

	(1)	(2)	(3)	(4)	(5)	(6)
	$\mathit{IFshr}_{l,j,t}$	$\mathit{IFshr}_{l,j,t}$	$\mathit{IFshr}_{l,j,t}$	$\mathit{IFshr}_{l,j,t}$	$\mathit{IFint}_{l,j,t}$	$\mathit{IFint}_{l,j,t}$
$\ln(\mathit{offshr\ shr}_{j,t})$	-0.00598**	-0.00756***				
	(0.00264)	(0.00244)				
$\mathit{offshr\ shr}_{j,t}$			-0.0280	-0.0417	0.0109***	0.0104***
			(0.0333)	(0.0304)	(0.00117)	(0.00107)
$\mathit{offshr\ shr}^2_{j,t}$					-0.00494***	-0.00473***
					(0.00116)	(0.00111)
FEs	l , t	lt	l , t	lt	l , t	lt
Observations	60979	60979	60979	60979	60979	60979

Other controls: $\ln(1+\mathit{tariff}_{l,j,t})$, $\mathit{H\ diff}_j$, $\mathit{M\ diff}_j$, $\ln(\mathit{sigma}_j)$, $\eta(\bar{FA}_j)$. Average marginal effects.
Standard errors in parentheses. Cluster s.e. at sector j. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results. Columns (1) and (2) of Table 2 show the estimation results of the model in equation (24). The empirical models provide supportive evidence for the competition effect predicted by Proposition 1: as the global offshoring activity in sector j increases, the bilateral intra-firm import share decreases. The latter is consistent with a progressive vertical disintegration of the supply chains. The effect vanishes when the offshoring share is introduced in levels (see columns (3) and (4)).[71]

4.3.4 Reduced form model: Intra-firm intensity.

I analyse the effect of the global offshoring activity in the bilateral intra-firm intensity. The empirical model is given by:[72]

$$\begin{aligned}\mathbb{E}\Big[\mathit{IFint}_{l,j,t}\Big|\boldsymbol{x}\Big] &= \frac{\exp(\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho})}{1+\exp(\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho})} \\ &\text{with } \boldsymbol{x}'_{l,j,t}\boldsymbol{\rho} = \rho_1 \mathit{offshr\ shr}_{j,t} + \rho_2 \mathit{offshr\ shr}^2_{j,t} + \mathit{other\ controls} + \rho_l + \rho_t,\end{aligned} \tag{25}$$

Results. The results of model in equation (25) are reported in columns (5) and (6) of Table 2. They provide evidence in favour of the quadratic relationship between the global offshoring share and the bilateral intra-firm intensity, consistent with the sectoral dynamics illustrated in Figure 6.[73]

4.3.5 Reduced form models: Bilateral and global effects.

From theory, the characterisation of the mechanism of the competition effect through the price index implies that the global offshoring activity of the sector affects the bilateral intra-firm import share (and the bilateral intra-firm intensity). The alternative would be an effect limited to the bilateral relationships, without global effects. Thus, the latter would provide evidence that the impact of the offshoring activity is not channelled through the sector's price index in the final good market.

To that aim, I disentangle the bilateral offshoring share and the global offshoring share of the sector j, and test for their impact on the bilateral intra-firm import share (and the bilateral intra-firm intensity). The empirical models are given by:

$$\mathbb{E}\Big[\mathit{IFshr}_{l,j,t}\Big|\boldsymbol{x}\Big] = \frac{\exp(\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho})}{1+\exp(\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho})} \quad ; \quad \mathbb{E}\Big[\mathit{IFint}_{l,j,t}\Big|\boldsymbol{x}\Big] = \frac{\exp(\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho})}{1+\exp(\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho})}, \tag{26}$$

with

$$\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho} = \rho_1 \ln(\mathit{offshr\ shr}_{l,j,t}) + \rho_2 \ln(\mathit{offshr\ shr}_{\neg l,j,t}) + \mathit{other\ controls} + \rho_l + \rho_t,$$

where $\neg l$ indicates the aggregation of all the countries excluding l.

[71] See Table 12 in Appendix E.3.2 for report of the full table. Table 13 in Appendix E.3.2 reports the results for the models with sector j fixed effects. As before, the evidence is not consistent with the theoretical predictions in the latter case.

[72] For the definition of the variables, see Appendix E.3.2.

[73] Appendix E.3.2: Table 12 in reports full table, and Table 13 reports models with sector fixed effects. Results remain robust.

Table 3: Competition effect: bilateral and global effects.

	(1)		(2)		(3)		(4)	
	$IFshr_{l,j,t}$		$IFint_{l,j,t}$		$IFshr_{l,j,t}$		$IFint_{l,j,t}$	
	+	++	+	++	+	++	+	++
$\ln(\mathit{offshr\ shr}_{l,j,t})$	0.144***	0.0111***	1.151***	0.00142***	0.158***	0.0117***	1.105***	0.00135***
	(0.0276)	(0.00237)	(0.0327)	(0.0000622)	(0.0208)	(0.00184)	(0.0211)	(0.0000464)
$\ln(\mathit{offshr\ shr}_{\neg l,j,t})$	-0.123***	-0.00951***	-0.0636***	-0.0000787***	-0.155***	-0.0115***	-0.0916***	-0.000112***
	(0.0278)	(0.00201)	(0.0206)	(0.0000259)	(0.0282)	(0.00191)	(0.0185)	(0.0000210)
FEs	l , t	l , t	lt	lt	l , t	l , t	lt	lt
Observations	60978	60978	60978	60978	60978	60978	60978	60978

Other controls: $H\ diff_j$, $M\ diff_j$, $\ln(1+tariff_{l,j,t})$, $\ln(sigma_j)$, $\eta(\bar{FA})_j$. Coefficients (+) and average marginal effects (++).
Standard errors in parentheses. Cluster s.e. at sector j. $^{*}\ p<0.10$, $^{**}\ p<0.05$, $^{***}\ p<0.01$

Results. Table 3 shows that the effect of the offshoring activity on the vertical disintegration of the supply chains is driven by the global offshoring activity. This result is consistent with an effect channelled through the changes in sector's price index.

4.3.6 Empirical model: Identification of the competition effect mechanism.

I introduce a two-stage model that identifies the mechanism of the first channel of the competition effect on vertical disintegration through the price index in the final good markets, as characterised by Proposition 1. For the derivation of the respective regressions, see Appendix E.3.3.

In a first-stage regression, I estimate the effect of the offshoring share in the sector's price index. To that aim, I derive the following log-linear model:

$$\ln(P_{j,t}) = b_0 + b_1 \ln(\mathit{offshr\ shr}_{j,t}) + \mathit{other\ controls} + b_l + b_t + u_{j,t}. \tag{27}$$

In a second-stage regression, I use the predicted value of $\ln(P_{j,t})$ from the first stage and estimate the effect on the intra-firm intensity. In other words, I use the predicted changes in the sector j's price index produced by changes in the sector's offshoring share. Thus, the second-stage regression is defined as a fractional logit model given by:

$$\mathbb{E}\Big[IFint_{l,j,t}\Big|\boldsymbol{x}\Big] = \frac{\exp(\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho})}{1+\exp(\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho})} \quad \text{with} \quad \boldsymbol{x}'_{l,j,t}\boldsymbol{\rho} = \rho_1 \widehat{\ln(P_{j,t})} + \mathit{other\ controls} + \rho_l + \rho_t. \tag{28}$$

Results. The results are reported in Table 4.[74] Regarding the first regression, the table shows that an increase in the sectoral offshoring activity reduces the sector's price index in the final good market. The result is consistent with the intensification of the competition in the final good market due to a progressive increase in the share of offshoring final good producers.

[74] See full table of first stage regression in Table 14 in Appendix E.3.3.

The results of the second-stage regression provide supportive evidence for the vertical disintegration consequences of the competition effect predicted by the theory. Reductions in the sector's price index, predicted by an increase in the sector offshoring activity, result in a lower intra-firm intensity in the sector.

Table 4: Competition effect: Estimation in two stages.

	Second stage: Coefficients reported		
	Agg. countries	*No aggregation of countries*	
	(1)	(2)	(3)
	$IFint_{j,t}$	$IFint_{l,j,t}$	$IFint_{l,j,t}$
$\ln(\widehat{P_{j,t}})$	-35.43***	-25.63***	-25.74***
	(1.814)	(1.598)	(1.545)
$\ln(1 + tariff_{l,j,t})$		51.88**	61.78***
		(22.253)	(17.724)
$H\ diff_j$	2.486***	2.905***	2.982***
	(0.573)	(0.533)	(0.514)
$M\ diff_j$	-0.164	2.855***	2.755***
	(0.363)	(0.524)	(0.482)
$\ln(sigma_j)$	2.583***	2.046***	2.063***
	(0.195)	(0.16)	(0.158)
$\eta(\bar{FA})_j$	0.191*	-0.362**	-0.345**
	(0.101)	(0.159)	(0.146)
FEs	t	l , t	lt
	First stage: Main coefficients		
	(1)	(2)	(3)
	$\ln(P_{j,t})$	$\ln(P_{j,t})$	$\ln(P_{j,t})$
$\ln(offshr\ shr_{j,t})$	-0.0312***	-0.0350***	-0.0352***
	(0.00869)	(0.00959)	(0.00979)
FEs	t	l , t	lt
R^2	0.292	0.297	0.309
Adjusted R^2	0.285	0.294	0.282

Second stage: Bootstrapped s.e. (1000 rep). Coefficients reported.

All stages: Cluster s.e. at sector j. Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To sum up, the model shows that an increase in the offshoring activity impacts on a reduction of the sector's price index, which translates into a more intensive competition in the final good markets. The theory predicts that the latter leads to a progressive vertical disintegration of the offshore supply chains, supported by the findings above.

5 Multiple countries

In a world with multiple countries, the effect of the offshoring decisions on the price index, and thence on the sector's organisational structure, may not be independent of the location of the suppliers. Thus, it may also come from the relocation of offshore suppliers across foreign countries. Therefore, I extend the model to multiple countries. The main goal is to characterise the relocation dynamics of offshore suppliers after an institutional reform in one low-wage foreign country (the East) takes place. Under such conditions, I study the consequences of the competition effect on the organisational dynamics.[75]

I define a world economy with three countries: East (E), North (N) and South (S). The production of the services x_h and the final good varieties are still produced only in the North, but the intermediate inputs x_m can be supplied by manufacturers in any location.

Assumption A. 5. *Wages are higher in the South than in the East, but institutional fundamentals are better in South for each organisational type.*

$$w^E < w^S < w^N \quad ; \quad f_O^S < f_V^S < f_O^E < f_V^E \quad \textit{with } V = V_H, V_M.$$

I assume that East have lower marginal costs than South, but the institutional fundamentals are better in South.[76] In addition to Assumption A.2, the Assumption A.5 defines the marginal costs differences and the institutional fundamental conditions in foreign countries. However, the ranking on institutional fundamentals is unknown to the final good producers when I introduce uncertainty in section 5.2.[77]

Given assumptions A.2 and A.5, together with the assumption that $\psi_O^E(\eta) > \psi_V^S(\eta)$[78], the sector organisational equilibrium under perfect information is represented by:

$$\underline{\theta}^* < \theta_V^{N,*} < \theta_O^{S,*} < \theta_V^{S,*} < \theta_O^{E,*} < \theta_V^{E,*}. \tag{29}$$

5.1 Perfect information equilibrium.

The wage advantage in the East allows the most productive final good producers in the market to realise higher gains from offshoring. Thus, a comparison of the perfect information equilibrium to an initial

[75] For a more general analysis of the consequences of institutional uncertainty in the location dimension and the consequences in terms of specialisation of countries and consumer's welfare, see Larch and Navarro (2021).

[76] If $f_k^E \leq f_k^S$, no final good producer finds it optimal to offshore from South under any organisational type. Therefore, only offshoring types O^E, V^E are observable in perfect information equilibrium.

[77] An additional simplifying assumption is that the offshoring sunk cost $w^N s^r$ is homogeneous across countries.

[78] The assumption $\psi_O^E(\eta) > \psi_V^S(\eta)$ implies that the gains from the lower marginal costs in the East with respect to South compensate the loss from a less efficient allocation of property rights of vertical integration in South with respect to East. If the gains from the lower marginal costs are not large enough, the ranking of organisational types is still as depicted in equation (29), but without observing any producer under O^E.

condition situation where only offshoring from the South is possible shows:[79]

$$P^{(S)} > P^* \quad ; \quad Q^{(S)} < Q^* \quad , \quad \underline{\theta}^{(S)} < \underline{\theta}^* \quad ; \quad \theta_V^{N,(S)} < \theta_V^{N,*} \quad ; \quad \theta_O^{S,(S)} < \theta_O^{S,*} \quad ; \quad \theta_V^{S,(S)} < \theta_V^{S,*}; \quad (30)$$

where (S) denotes the equilibrium variables when offshoring is possible only from South and there is no remaining uncertainty about southern institutions, and $*$ denotes now the perfect information equilibrium conditions for the multi-country model.

5.2 Institutional reform in East: Model setup and initial conditions.

I assume initial conditions are defined by the steady-state where offshoring is only possible from the South, and there is no uncertainty about the institutional conditions in this country.

There is an institutional information shock (e.g. institutional reform) in the East in $t = 0$, but the northern final good producers have uncertainty about the scope of those reforms. As a result, they build prior beliefs based on the credibility of the announcement of the eastern government. As before, the prior uncertainty is given by:

$$f_k^E \sim Y(f_k^E) \quad \text{with} \quad f_k^E \in [\underline{f}_k^E, \bar{f}_k^E], \quad (31)$$

with $k = O, V_H, V_M$. The learning mechanism is defined as in section 3.1.1, but instead relative to the organisational fixed costs in East.

5.3 Exploration decision of offshoring potential in East: Relocation and competition.

Each final good producer, who have not explored the offshoring potential in the East, must decide at each period t whether to explore offshoring in East or wait one more period under the current organisational form k'. Notice that k' may denote a domestic sourcing type (O^N, V^N) or an offshoring type from South (O^S, V^S). The decision of a final good producer with productivity θ relative to type k in t is defined by:

$$\mathcal{V}_{k,t}(\theta; \theta_t^E) = \max\{V_{k,t}^o(\theta; \theta_t^E); V_{k,t}^w(\theta; \theta_t^E)\}; \text{ for } k = O^E, V_H^E, V_M^E,$$

with $\theta_t^E = \{\theta_{O,t}^E, \theta_{V_H,t}^E, \theta_{V_M,t}^E\}$ denoting the state of the sector in period t.

The value of exploring the offshoring potential for a final good producer with productivity θ in t under type k is given by the expected discounted profit premium of type k relative to its current organisational type k', net of the offshoring sunk cost $w^N s^r$:

[79] In the case of (S) equilibrium conditions, there is no offshoring from East under any organisational type, i.e. $\theta_k^{E,(S)} \to \infty$ for $k = O, V_H, V_M$. Therefore, $\theta_O^{E,(S)} > \theta_O^{E,*}$ and $\theta_V^{E,(S)} > \theta_V^{E,*}$.

$$V^{o;E}_{k,t}(\theta;\theta^E_t) = \mathbb{E}_t\left[\max\left\{0; \sum_{\tau=t}^{\infty}\lambda^{\tau-t}\pi^{\text{prem}}_{k/k',\tau}(\theta)\right\}\middle| f^E_k \leq f^E_{k,t}\right] - w^N s^r.$$

The respective value of waiting is defined as:

$$\mathcal{V}^w_{k,t}(\theta;\theta^E_t) = 0 + \lambda\mathbb{E}_t[\mathcal{V}_{k,t+1}(\theta;\theta^E_{t+1}).$$

Thus, the Bellman equation for each offshoring type k from East for a producer θ in t takes the form:

$$\mathcal{V}_{k,t}(\theta;\theta^E_t) = \max\left\{V^o_{k,t}(\theta;\theta^E_t); \lambda\mathbb{E}_t[\mathcal{V}_{k,t+1}(\theta;\theta^E_{t+1})]\right\}. \tag{32}$$

By an equivalent assumption to A.3, I derive the following trade-off function:

$$\mathcal{D}_{k/k',t}(\theta;\theta^E_t,\tilde{\theta}^E_{t+1}) = \max\left\{0; \mathbb{E}_t\left[\pi^{\text{prem}}_{k/k',t}(\theta)\middle| f^E_k \leq f^E_{k,t}\right]\right\} - w^N s^r\left[1-\lambda\frac{Y(f^E_{k,t+1})}{Y(f^E_{k,t})}\right]. \tag{33}$$

The trade-off function characterises a sequential exploration led by the most productive final good producers in the market.[80] Therefore, the sequential exploration of the East starts as a relocation process of offshore suppliers. The final good producers, originally offshoring from South, sequentially start to relocate their supply chain to the East.[81]

Proposition 2 (Second channel of competition effect on vertical disintegration)**.** *As the offshoring productivity cutoff in East converges to the steady state (Lemma MC-4), the price index in the final good market reduces (Lemma MC-5), and:*

(a) the least productive final good producers under domestic integration sequentially disintegrate the supply chains to domestic outsourcing:

$$\begin{cases} \textit{Cases I and II: } \theta^N_{V,t} \nearrow \theta^{N,*}_V & \textit{if } \theta^E_t \searrow \theta^{E,*}, \\ \textit{Case III: } \theta^N_{V,t} \nearrow \theta^{N,\neg r}_V & \textit{if } \theta^E_t \searrow \theta^{E,\neg r}, \\ \textit{Case IV: } \theta^N_{V,t} \nearrow \theta^N_{V,\infty} \in (\theta^{N,*}_V;\theta^{N,\neg r}_V) & \textit{if } \theta^E_t \searrow \theta^E_\infty \in (\theta^{E,\neg r};\theta^{E,*}). \end{cases}$$

(b) the least productive final good producers under foreign integration in South sequentially disinte-

[80] In Appendix D.2, I derive the Lemmas for the multi-country (MC) model: Lemma MC-1 (sequential exploration), Lemma MC-2 (exploration productivity cutoff of East), and Lemma MC-3 (foreign integration productivity cutoff in East).

[81] As before, I assume that at least the most productive final good producer in the market finds profitable to explore the offshoring potential in the East under at least one type k, i.e. $\mathcal{D}_{k/k',t=0}(\bar{\bar{\theta}};\bar{\bar{\theta}},\bar{\bar{\theta}}) > 0$

grate the supply chains to foreign outsourcing in South:

$$\begin{cases} \textit{Cases I and II: } \theta^{S}_{V,t} \nearrow \theta^{S,*}_{V} & \textit{if } \theta^{E}_{t} \searrow \theta^{E,*}, \\ \textit{Case III: } \theta^{S}_{V,t} \nearrow \theta^{S,\neg r}_{V} & \textit{if } \theta^{E}_{t} \searrow \theta^{E,\neg r}, \\ \textit{Case IV: } \theta^{S}_{V,t} \nearrow \theta^{S}_{V,\infty} \in (\theta^{S,*}_{V}; \theta^{S,\neg r}_{V}) & \textit{if } \theta^{E}_{t} \searrow \theta^{E}_{\infty} \in (\theta^{E,\neg r}; \theta^{E,*}). \end{cases}$$

(c) starting from $\hat{t}$, the least productive final good producers under foreign integration in East sequentially disintegrate the supply chains to foreign outsourcing in East:

$$\begin{cases} \textit{Cases I and II: } \theta^{E}_{V,t} \nearrow \theta^{E,*}_{V} & \textit{if } \theta^{E}_{t} \searrow \theta^{E,*}, \\ \textit{Case III: } \theta^{E}_{V,t} \nearrow \theta^{E,\neg r}_{V} & \textit{if } \theta^{E}_{t} \searrow \theta^{E,\neg r}, \\ \textit{Case IV: } \theta^{E}_{V,t} \nearrow \theta^{E}_{V,\infty} \in (\theta^{E,*}_{V}; \theta^{E,\neg r}_{V}) & \textit{if } \theta^{E}_{t} \searrow \theta^{E}_{\infty} \in (\theta^{E,\neg r}; \theta^{E,*}). \end{cases}$$

Proof. See Appendix D.2.7.[82] □

Relocation and competition effect. As more final good producers explore their offshoring potential in the East, they sequentially relocate their supply chain to this country. This allows the final good producers to exploit the lower marginal costs offered by contracting eastern suppliers, driving the price index further down as the sequential relocation flow to East continues.

As shown by Proposition 2, the increase in competition induces a sequential disintegration of domestic and southern offshore supply chains, and from period $\hat{t}$ on, a vertical disintegration of the least productive producers under foreign integration in East.

The increase in the competition intensity also generates the exit of the least productive producers from the market (Lemma MC-6 (a)). An additional effect is a potential reshoring decision of the least productive producers offshoring from the South (Lemma MC-6 (b)). However, I describe below the cases when reshoring decisions may not be observed.

Additional considerations on equilibrium paths: Sequential institutional shocks. If the institutional reform in the East takes place before the sector reaches the steady-state defined in section 3.2, denoted here as (S), it may be possible that the reshore characterised above is not observed.[83] The main

[82]For Lemma MC-4 (convergence of offshoring productivity cutoff in East), see Appendix D.2.4. For Lemma MC-5 (price index effect of relocation of offshore suppliers), see Appendix D.2.5. For Lemma MC-6 (convergence of market and offshoring productivity cutoffs), see Appendix D.2.6.

[83]I describe here one case. For a complete analysis of the multiple equilibria with simultaneous institutional reforms, see Larch and Navarro (2021).

condition is that the institutional reform in the East takes place at a period t where $\theta_t^S > \theta_O^{S,*}$, i.e. when the offshoring exploration cutoff in South is still above its new steady-state level. A second condition is that the prior beliefs about eastern institutions must be optimistic enough such that the offshoring exploration of the East is faster than the exploration flow to the South. Thus, the convergence of the relocation from South to East takes place before the offshoring exploration to South finishes.

5.4 Empirical model: Competition effect in multi-country model.

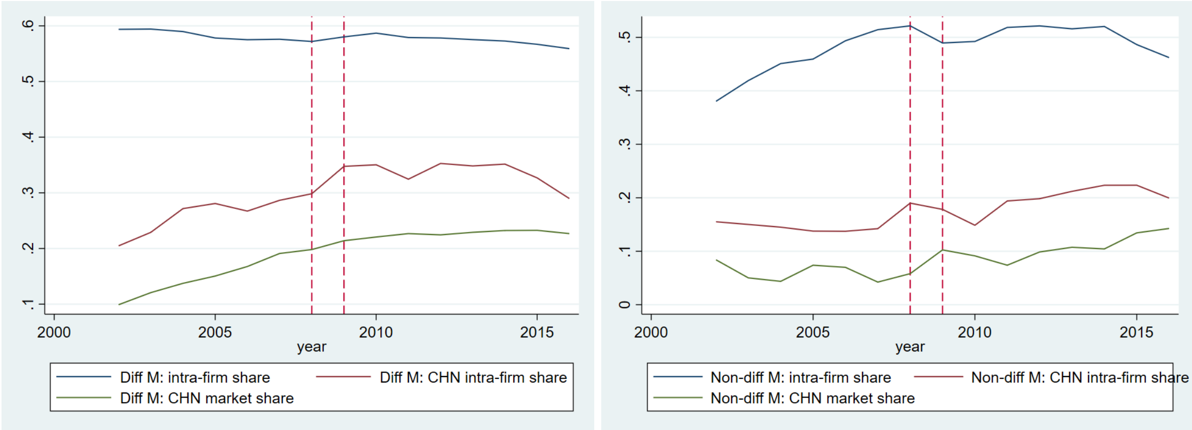
I introduce an empirical model to test for both channels of the competition effect: i) the progressive vertical disintegration that results from the increase in the competition intensity due to the increasing offshoring activity (Proposition 1); ii) the progressive vertical disintegration that results from the relocation of the offshore suppliers towards foreign locations with lower marginal costs (Proposition 2). With that aim, I consider a particular institutional shock in a low wage foreign country with initial low market share in US markets: the accession of China to the WTO.

5.4.1 China access to WTO: stylized facts.

The access of China to the WTO in December 2001 has had a deep impact on the global organisation of supply chains. Handley and Limão (2017) analyses the effect of the membership of China to the WTO on the reduction of the tariff's uncertainty for Chinese goods in the US. They show that, after controlling for tariffs changes, a significant share of the export growth from China to the US is explained by the reduction in the uncertainty about future tariffs shocks.

However, the slow increase in the imports from China relative to other foreign sourcing locations, shown by Figure 7, may reflect effects of a residual uncertainty beyond the tariffs dimension addressed by Handley and Limão (2017). The low market share of China in 2002 and its progressive increase in the years following the WTO membership is in line with sectoral dynamics characterised by the theoretical model above. Figure 7 shows that the market share of China in the US imports is growing up to 14 years after the reform, which is consistent with a sequential exploration and relocation of suppliers to that country. In this sense, the model complements the findings in Handley and Limão (2017).

The period covered by the data on imports imposes limitations for a direct control of the Chinese institutional shock. Nevertheless, it may still shed light on the sectoral dynamics predicted by the theoretical model. Figure 7a provides a first glimpse to a possible theory-consistent relation between the penetration of China in the US market (i.e. relocation of offshore suppliers to China) and the intra-firm import share. The negative trend in the intra-firm import share of differentiated goods may respond



(a) Differentiated sectors

(b) Non-differentiated sectors

Figure 7: Intra-firm shares and China market-share, by M sector type

to an increasing competition intensity in the final-good markets, which may come from the sequential relocation of suppliers to a low wage country (China).

From the model's perspective, the Chinese access to the WTO may have created incentives for US firms to begin a sequential exploration of the offshoring potential in that country. I test for both channels of the competition effect on vertical disintegration: i) the exploration of domestic sourcing firms, captured by an increase in the sectoral offshoring share (Proposition 1), and ii) the relocation of offshore suppliers, identified by the market share of China in intermediate inputs imports (Proposition 2).

5.4.2 Competition effect: China institutional shock and relocation channel.

The first channel of the competition effect is identified in the same manner as before, i.e. by $\textit{offshr shr}_{j,t}$. The effect of the relocation of offshore suppliers to China is captured by China's market share in US imports of intermediate inputs of sector j in year t. The intuition is the following. Assuming that the relocation to China is driven by the marginal costs advantages that this country offers relative to the previous offshore locations, an increase in the market share of China in the imports of intermediate inputs of a sector j should have an impact on a reduction in the sector's price index, and thus an increase in the competition intensity in the final goods market.[84]

I estimate the effects of the increase of the offshoring activity (predicted by Proposition 1) and the relocation of suppliers to China (predicted by Proposition 2), through their impact on the price index, on the sector's organisational structure (i.e. sector's intra-firm intensity). With that aim, I follow a two-stage regression approach similar to the empirical model in section 4.3.6.[85]

[84] After controlling for the offshoring intensity in the sector, the increase in the market share of China captures a relocation of offshore supply chains towards this country.

[85] For derivation of the two stages, see Appendix E.3.4.

Identification of the empirical model. In the first stage, I estimate the effect of the offshoring share (Proposition 1) and China's market share (Proposition 2) on the sector's price index. I derive the following log-linear model:

$$\ln(P_{j,t}) = b_0 + b_1 \ln(\textit{offshr shr}_{j,t}) + b_2 \ln(\textit{CHN mkt shr}_{j,t}) + \textit{other controls} + b_l + b_t + u_{j,t} \quad (34)$$

In the second stage, I use the predicted value of $\ln(P_{j,t})$ from the first regression and estimate its effect on the intra-firm intensity. In other words, I use the predicted changes in the sector price index induced by changes in the sector global offshoring activity and relocation of offshore suppliers to China. The second stage is defined as a fractional logit model:

$$\mathbb{E}\Big[\textit{IFint}_{l,j,t}\Big|\boldsymbol{x}\Big] = \frac{\exp(\boldsymbol{x'_{l,j,t}\rho})}{1+\exp(\boldsymbol{x'_{l,j,t}\rho})} \quad \text{with} \quad \boldsymbol{x'_{l,j,t}\rho} = \rho_1 \widehat{\ln(P_{j,t})} + \textit{other controls} + \rho_l + \rho_t. \quad (35)$$

Table 5: Competition effect: Estimation in two stages.

	Second stage: Main coefficient reported		
	Agg. countries	*No aggregation of countries*	
	(1)	(2)	(3)
	$\textit{IFint}_{j,t}$	$\textit{IFint}_{l,j,t}$	$\textit{IFint}_{l,j,t}$
$\widehat{\ln(P_{j,t})}$	-33.52***	-23.42***	-23.38***
	(1.981)	(1.751)	(1.697)
FEs	t	t , l	lt
	First stage: Main coefficients		
	(1)	(2)	(3)
	$\ln(P_{j,t})$	$\ln(P_{j,t})$	$\ln(P_{j,t})$
$\ln(\textit{offshr shr}_{j,t})$	-0.0307***	-0.0340***	-0.0340***
	(0.00841)	(0.00961)	(0.00981)
$\ln(\textit{CHN mrkt shr}_{j,t})$	-0.00531	-0.00784**	-0.00826**
	(0.00332)	(0.00323)	(0.00343)
FEs	t	t , l	lt
R^2	0.299	0.301	0.314
Adjusted R^2	0.291	0.298	0.285

Second stage: Bootstrapped s.e. (1000 rep). Coefficients reported.
All stages: Cluster s.e. at sector j. Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results. The regression results are reported in Table 5.[86] The results of the first stage show, as before, that an increase in the offshoring share reduces the sector's price index. Additionally, the results show that an increase in China's market share in the imports of intermediate inputs of sector j leads to a further

[86] Full table is reported in Table 15 in Appendix E.3.4.

reduction in the price index. Therefore, as more final good producer relocate their offshore suppliers to China, the competition in the final good market intensifies. The empirical evidence is consistent with the theoretical predictions on the two channels that intensify the competition in the final goods market.

The results of the second stage show supportive evidence for the vertical disintegration consequences of the competition effect characterised by the theoretical model above. It shows that the sector's price index reductions predicted by both channels in the first stage regression result in lower intra-firm intensity in the sector. To sum up, the regression results are consistent with the predictions of the model and provide supportive evidence for Propositions 1 and 2.

6 The role of FTAs and MAs on exploration decisions

I develop a simple theoretical extension of the model to characterise the role that free trade agreements (FTAs) and multilateral agreements (MAs) may play as exploration triggers of new sourcing locations. I highlight specific features of FTAs and MAs that may lead to novel effects on exploration decisions when firms face institutional uncertainty.

6.1 Role of FTAs.

I consider the role of the FTAs from two dimensions: the preferential tariffs and the institutional arrangements. The first refers to the reduction in bilateral tariffs among the members of the FTAs. The second comprehends the institutional commitments and regulations agreed by the members that constitute the institutional framework of the FTAs (Maggi, 1999; Dür et al., 2014; Limão, 2016). It includes areas such as: intellectual property and property rights protection, foreign investment, dispute resolution mechanisms, environmental regulation, labour market regulations and mobility.[87]

I begin with the role of preferential tariffs on the exploration decisions of new locations. I follow with the role of the institutional dimension of the FTAs as information shocks on the prior beliefs that may lead to exploration of new locations and thus sequential offshoring and relocation processes.

6.1.1 Role of FTAs: tariff dimension.

I define the marginal cost for a northern producer of an intermediate input sourced from l as $c_t^l = \tau_{m,t}^l w^l$, where $\tau_{m,t}^l$ captures the associated trade costs relative to the location $l = N, E, S$. I define it as $\tau_{m,t}^l = 1$

[87] For examples of this type of regulations involved in FTAs see NAFTA: www.naftanow.org, EU: europa.eu, Pacific Alliance: alianzapacifico.net/en, MERCOSUR: www.mercosur.int, China-Australia (ChAFTA): www.dfat.gov.au/trade/agreements/in-force/chafta/Pages/australia-china-fta.

when the tariffs are zero with respect to the country l. Therefore, $\tau^N_{m,t} = 1 \,\forall\, t$.

Two-country model: North-South FTA. The initial conditions are defined by free trade in the final goods and positive tariffs in the intermediate inputs, i.e. $\tau^S_{m,t} > 1$ for any $t < 0$. In $t = 0$, a FTA between North and South is signed and all tariffs are removed, i.e. $\tau^S_{m,t} = 1 \,\forall\, t \geq 0$. I consider that the FTA is limited to a tariff reduction and has no implications in terms of institutional reforms. Therefore, the priors about the southern institutions are not directly affected by the agreement.

If tariffs in intermediate inputs previous to the FTA are large enough, such that $c^S_t > c^N_t$, no final good producer finds it profitable to offshore from the South independently of the uncertainty about southern institutions. In other words, $\theta^S_O > \bar{\bar{\theta}}$ and $\theta^S_V > \bar{\bar{\theta}}$. Instead, when initial tariffs are small enough such that $c^S_t < c^N_t$, it may be possible that under perfect information, some final good producers would have found it profitable to offshore from the South. However, when the prior beliefs about southern institutions are pessimistic, it may discourage all the northern final good producers from exploring their offshoring potential in South. This situation takes place when the following condition holds for any $t < 0$:[88]

$$\mathcal{D}_{k,t}(\bar{\bar{\theta}}; \bar{\bar{\theta}}, \bar{\bar{\theta}}, \tau^S_{m,t}) < 0 \quad \text{for all} \quad k = O, V_H, V_M.$$

If the tariff reduction introduced by the FTA is large enough, it may induce the offshoring exploration at the given prior beliefs for at least the most productive producers in the market:

$$\mathcal{D}_{k,t=0}(\bar{\bar{\theta}}; \bar{\bar{\theta}}, \bar{\bar{\theta}}, \tau^S_{m,t}) \geq 0 \quad \text{for at least one} \quad k = O, V_H, V_M.$$

Once the exploration begins, the information spillovers drive the sector to the perfect information steady-state, as characterised in Section 3.2.

Multicountry-model: North-East FTA. I extend the previous case to a multi-country setup. As before, initially, offshoring is only profitable in the South. There is free trade in the final goods but the northern country sets positive tariffs on intermediate inputs, i.e. $\tau^S_{m,t} = \tau^E_{m,t} > 1$. To avoid a taxonomy of cases, I assume that at the current tariffs, the marginal costs of the intermediate inputs for the final good producers from each location are: $c^E_t < c^S_t < c^N_t$. Under perfect information, some final good producers would find it profitable to offshore in the East.

When the prior beliefs about eastern institutions are too pessimistic, no final good producer finds it attractive to explore the offshoring potential from the East at the given tariffs. Thus, for any $t < 0$:

$$\mathcal{D}_{k/k',t}(\bar{\bar{\theta}}; \bar{\bar{\theta}}^E, \bar{\bar{\theta}}^E, \tau^E_{m,t}, \tau^S_{m,t}) < 0 \quad \text{for all} \quad k = O, V_H, V_M.$$

[88] $\bar{\bar{\theta}}$ indicates the most productive final good producer in the differentiated sector. A necessary condition is that the support of the distribution $G(\theta)$ is bounded to the right, i.e. $\bar{\bar{\theta}} < \infty$.

In $t = 0$ the FTA between North and East takes place, and the tariffs on intermediate inputs are removed for eastern suppliers, i.e. $\tau^E_{m,t} = 1$. As before, the FTA is limited to an agreement on tariffs. Thus, the prior beliefs about eastern institutions are not directly affected by the FTA.

If the change in tariffs induces a large enough reduction in the marginal cost c^E_t relative to c^S_t, the most productive final good producers currently offshoring in South may find it profitable to explore East for a potential relocation of suppliers. The FTA triggers the sequential exploration of East if:

$$\mathcal{D}_{k/k',t=0}(\bar{\bar{\theta}}; \bar{\bar{\theta}}^E, \bar{\bar{\theta}}^E, \tau^E_{m,t}, \tau^S_{m,t}) \geq 0 \quad \text{for at least one} \quad k = O, V_H, V_M.$$

The sequential exploration drives the sector to the perfect information steady-state, as in section 5.

Summing up, preferential tariffs may have a stronger effect compared to an approach that neglects the presence of institutional uncertainty. When institutional uncertainty is present, small reductions in intermediate input tariffs may create enough incentives for the most productive final good producers in the market to explore the offshoring potential in those locations, and thus trigger the sequential offshoring equilibrium paths characterised above.

6.1.2 Role of FTAs: institutional dimension.

I analyse the role of the institutional dimension for two types of FTAs: i) the signature of a FTA with North, ii) the signature of a FTA among third countries where the North is not a member of the agreement. Additionally, I study the role of MAs, in particular, the access to a WTO membership. I show that these shocks may impact the prior beliefs that northern producers possess about foreign locations and thus create incentives to explore the offshoring potential in those countries.

FTAs with North. The implementation of a FTA usually goes beyond reductions in tariffs and incorporates institutional aspects (Dür et al., 2014). Therefore, the signature of a FTA reveals a commitment of the governments to provide an institutional environment that meets the set of specified rules.

When a FTA between the North (*US in the empirical model*) and a foreign location is signed, the institutional framework is observable by the northern producers. Thus, if the institutional priors about the partner country were relatively pessimistic, the FTA may positively affect the beliefs.

FTAs among third countries. The FTAs signed among third countries, where the North (*US*) is not involved, may also reveal information to the northern producers about the institutional conditions in the countries involved in the agreement. When a FTA is under negotiation, countries with good institutional fundamentals may not want to expose themselves to trade with partners under poor institutional conditions, while countries with bad institutional fundamentals may want to avoid strict rules that they cannot enforce. Thus, the institutional framework of the FTA emerges as the result of a bargaining on a set of rules that regulate the relationships among the members.

The northern final good producers may associate the FTA among third countries to the revelation of a common institutional ground among the members. Therefore, the countries with relatively worse priors may benefit from those with a better institutional reputation. The priors related to the first countries, i.e. those with worse priors, may experience a positive shock, and thus the FTA may promote the offshoring exploration in those locations.

MAs: WTO membership. The access of a country to a WTO membership reveals information regarding regulations that members of the organisation must follow. It may affect the prior beliefs that northern producers possess about the institutional conditions in that location.

Modelling of the prior's shock. I assume that initially, the prior beliefs of northern producers in sector j about country l institutions before any shock takes place are given by:

$$f^l_{k,j} \sim Y_j(f^l_{k,j}) \quad \text{with} \quad f^l_{k,j} \in \left[\underline{f}^l_{k,j}, \bar{f}^l_{k,j}\right] \text{ and } k = O, V_H, V_M.$$

As already mentioned, FTAs and MAs are institutional shocks that reveal information about rules to which the government of country l has committed to enforce. In other words, it reveals the minimal institutional conditions in the country l. In the model, it is captured by a reduction in the upper bound defined by the initial prior, only when prior to the shock the institutional beliefs were relatively pessimistic. Formally, the prior institutional uncertainty at any period t is given by:

$$f^l_{k,j} \sim Y_j(f^l_{k,j}) \quad \text{with} \quad f^l_{k,j} \in \left[\underline{f}^l_{k,j}, \bar{f}^l_{k,j} - \mathbf{I}^l_{k,j,t}\right],$$

where $\bar{f}^l_{k,j}$ refers to the initial upper bound of the prior distribution, and $\mathbf{I}^l_{k,j,t}$ refers to the institutional information revealed by FTAs and MAs shocks experienced by a non-explored location l up to period t. $\mathbf{I}^l_{k,j,t}$ is defined as:

$$\mathbf{I}^l_{k,j,t} \equiv \max\left\{\mathbb{1}\left[d^{US}_{l,t} = 1\right] FTA^{US}_{k,l}; \mathbb{1}\left[d^{WTO}_{l,t} = 1\right] WTO_{k,l}; \mathbb{1}\left[d^{FTA:3rd}_{l,t} = 1\right] FTA^{3rd}_{k,l}\right\}$$

where $d^{US}_{l,t}$ is a dummy that refers to the existence of a FTA between the North (*US*) and country l in period t, $d_{l,t}^{WTO}$ is a dummy that indicates the WTO membership of country l in period t, and $d_{l,t}^{FTA:3rd}$ is a dummy that indicates that country l has a FTA with third countries in period t.

The variable $FTA_{k,l}^{US}$ refers to the institutional information revealed by a FTA between the North and country l, i.e. by the institutional commitment revealed by the agreement. The variable $FTA_{k,l}^{3rd}$ represents the institutional information revealed by a FTA that country l signs with third countries. Finally, $WTO_{k,l}$ denotes the upper bound defined by the WTO institutional framework. All these variables are defined in $[0, \infty]$ and they are increasing in the information revealed by the respective FTA or MA.

6.2 Empirical model: The role FTAs on exploration decisions.

6.2.1 Data.

I use data on US imports classified at HS codes (6 digits) from UN Comtrade. The main advantage of this dataset is the longer sample period (1996-2016), which allows me to cover a higher number of WTO accessions and the formation of new FTAs and new memberships of countries to pre-existing FTAs. A second advantage comes from the higher disaggregation of the data, which provides a higher variation of foreign countries' first-time exploration decisions for each product code.

The Rule of Law index comes from the World Governance Indicators of the World Bank database, the data on GDP per capita and GDP from the World Development Indicator of the World Bank. I use the data on distance and common official language from CEPII. Finally, the data on FTA comes from an updated version of "Mario Larch's Regional Trade Agreements Database from Egger and Larch (2008)".

6.2.2 Identification: definition of main variables.

I identify the tariff dimension of the FTAs by controlling for bilateral tariffs. Regarding the institutional dimension of the FTAs, I identify the three types of shocks characterised in section 6.1.2: i) the signature of a FTA with the US, ii) the access to WTO membership, iii) the signature of a FTA with third countries.

The prior beliefs about the institutional conditions in country l in year t are captured by the respective Rule of Law index. This index is built based on surveys. Therefore, instead of being a direct measure of the institutional fundamentals, it is closer to capturing the perceptions about the institutional conditions in each country. In the latter sense, it is a suitable proxy for the prior beliefs about the institutional conditions in each location.[89] I define the Rule of Law index by the exponential function of the original

[89] *"Rule of Law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence"*. World Bank http://info.worldbank.org/governance/wgi/Home/Documents. For methodological information see Kaufmann et al. (2011). See Larch and Navarro (2021) for further discussions.

value reported in WGI, such that it is defined in $(0, \infty)$.

I identify the first type of shock as $FTA^{US}_{l,t}$, which captures the institutional differential between the US and the prior beliefs of country l at the moment t' when it signs a FTA with US. When prior beliefs about institutions in country l are better than in US, $FTA^{US}_{l,t}$ takes value zero, i.e. the agreement provides no additional information about the institutional conditions in l. Thus, $FTA^{US}_{l,t}$ is given by:[90]

$$FTA^{US}_{l,t} = \begin{cases} \max\left\{RL^{US}_{t'} - RL_{l,t'}, 0\right\} & \text{if } l \text{ access the FTA in } t' \leq t \\ 0 & \text{otherwise} \end{cases}$$

The effect of the access to WTO membership is captured by the variable $WTO_{l,t}$. It takes the value one from the period when country l becomes a member of WTO, and zero otherwise.[91]

I identify the FTAs among third countries by the variable $FTA^{3rd}_{l,t}$ defined in $[0, \infty)$. When country l becomes a member of a FTA with third countries, the variable measures the additional information revealed by the agreement about institutions in the country l. To capture this, the variable takes the maximum value between the mean institutional quality of the members of the agreement at the year that the country l becomes part of it, and the Rule of Law index of country l in that same year. In other words, it captures the additional information revealed by the agreement over the direct perception of institutional conditions. Thus, $FTA^{3rd}_{l,t}$ is given by:[92]

$$FTA^{3rd}_{l,t} = \begin{cases} \max\left\{RL^{FTA3rd}_{l,t'}, RL_{l,t'}\right\} & \text{if } l \text{ access the FTA in } t' \leq t \\ 0 & \text{otherwise} \end{cases}$$

where $RL^{FTA3rd}_{l,t'}$ denotes the mean value of the Rule of Law indices of all the countries that are part of the agreement in the accession year t'.

If the country signs multiple FTAs during the sample period, the variable takes the value of new FTAs only when new information is revealed. For instance, consider the situation where country l signs a FTA "A" in year t' and a FTA "B" in year t'' with $t' < t''$. The variable $FTA^{3rd}_{l,t}$ is:

$$FTA^{3rd}_{l,t} = \begin{cases} \max\left\{RL^{FTA3rd:"A"}_{l,t'}, RL_{l,t'}\right\} & \text{if } t' \leq t \\ \max\left\{RL^{FTA3rd:"A"}_{l,t'}, RL^{FTA3rd:"B"}_{l,t''}, RL_{l,t'}\right\} & \text{if } t'' \leq t \\ 0 & \text{otherwise} \end{cases}$$

[90] It considers only those FTAs signed during the sample period. Previous FTAs are captured by country fixed effects.
[91] It considers only new memberships during the sample period. Previous memberships are captured by country fixed effects.
[92] It considers only those FTAs signed during the sample period. Previous FTAs are captured by country fixed effects.

Table 6 shows the correlation between the FTA variables defined above and the cumulative changes in the future beliefs about institutional conditions in country l. The positive correlation between the FTAs among third countries and the changes in the Rule of Law years after the agreement is consistent with an impact of the FTAs among third countries on the institutional priors.

Table 6: Correlation table: FTA shocks and cumulative change in future institutional beliefs

	$FTA^{US}_{l,t}$	$FTA^{3rd}_{l,t}$
$\Delta RL_{l,t}$	-0.0228	0.0503***
$RL_{l,t+1} - RL_{l,t-1}$	-0.0185	0.0533***
$RL_{l,t+2} - RL_{l,t-1}$	-0.0127	0.0908***
$RL_{l,t+3} - RL_{l,t-1}$	-0.0104	0.0804***

* p <0.10, ** p <0.05 , *** p <0.01

6.2.3 Empirical model.

I define a conditional probability model that captures the probability of exploring the offshoring potential from country l in input m in period t for inputs that have not been imported from that country l by US firms up to period $t-1$. Thus, the empirical model is given by:

$$\Pr\Big(\textit{offshr stat}_{m,l,t} = 1 \Big| \textit{offshr stat cum}_{m,l,t-1} = 0\Big) = \Phi\Big(\ln(1 + \textit{tariff}_{m,l,t})\gamma_1, RL_{l,t}\gamma_2, FTA^{US}_{l,t}\gamma_3, FTA^{3rd}_{l,t}\gamma_4, WTO_{l,t}\gamma_5, ..., \gamma_m, \gamma_t\Big), \tag{36}$$

The variable $\textit{offshr stat}_{m,l,t}$ is a dummy that indicates the offshoring status in input m of US firms in year t. The variable $\textit{offshr stat cum}_{m,l,t-1}$ is a cumulative offshoring status up to $t-1$, which is defined as a dummy that takes the value zero when US firms have not imported the input m from country l up to year $t-1$ and one when it has been imported from l in any period before t. I also consider specifications that capture differential effects for differentiated goods, $\textit{M diff}_m$.

Regression results. Table 7 shows that reductions in bilateral tariffs increase the probability of exploration of country l in m, in particular for differentiated goods. As expected from the theory, the results show that better institutional priors (Rule of law) implies a higher probability of exploration of country l in good m, and that the effect is stronger for goods that are more dependent on institutional conditions.[93]

Regarding the role of FTAs with the US, the results show that it increases the probability of exploration for differentiated goods, while it has no impact on non-differentiated goods.

About the FTAs among third countries, Column (1) shows that it has no effect on the probability of the exploration. When country fixed effects are included in Column (2), the coefficient becomes sig-

[93] The coefficient related to the effect of Rule of Law on exploration remains significant and positive for differentiated goods, when country fixed effects are included. However, the respective effect for non-differentiated goods vanishes.

Table 7: Conditional probability model: Institutional shocks and exploration decisions

	Exp. sign	(1) *offshr stat*$_{m,l,t}$	(2) *offshr stat*$_{m,l,t}$	(3) *offshr stat*$_{m,l,t}$	(4) *offshr stat*$_{m,l,t}$
$\ln(1+tariff_{m,l,t})$	-	-0.483***	-0.508***	-0.0173	0.0106
		(0.0660)	(0.0671)	(0.117)	(0.120)
$RL_{l,t}$	+	0.0661***	0.0104	0.0315***	-0.0142
		(0.00319)	(0.00787)	(0.00698)	(0.0103)
$FTA^{US}_{l,t}$	+	0.0289***	-0.000269	0.00812	-0.0158*
		(0.00303)	(0.00374)	(0.00832)	(0.00856)
$WTO_{l,t}$	+	0.230***	0.160***	0.142***	0.117***
		(0.00782)	(0.0144)	(0.0230)	(0.0266)
$FTA^{3rd}_{l,t}$		0.00188	-0.0286***	-0.0245***	-0.0587***
		(0.00264)	(0.00360)	(0.00631)	(0.00673)
$\ln(1+tariff_{m,l,t}) \times M\ diff_m$	-			-0.891***	-1.018***
				(0.187)	(0.194)
$RL_{l,t} \times M\ diff_m$	+			0.0480***	0.0335***
				(0.00787)	(0.00807)
$FTA^{US}_{l,t} \times M\ diff_m$	+			0.0238**	0.0178*
				(0.00961)	(0.00965)
$WTO_{l,t} \times M\ diff_m$	+			0.103***	0.0461*
				(0.0258)	(0.0267)
$FTA^{3rd}_{l,t} \times M\ diff_m$	+			0.0352***	0.0394***
				(0.00728)	(0.00730)
FEs		t , *HS4dig*	t , *HS4dig* , l	t , *HS4dig*	t , *HS4dig* , l

Other controls in columns (1) and (3): $\ln(dist_l)$, $\ln(\bar{GDPpc}_l)$, $\ln(\bar{GDP}_l)$, *common official lang*$_l$.

Robust standard errors in parentheses. $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

nificant and negative. This effect is consistent with a trade diversion effect, while it does not provide evidence in favour of the mechanism predicted by the model. Columns (3) and (4), instead, show that it positively affects the exploration decisions for differentiated goods relative to non-differentiated goods. The negative effect for non-differentiated goods is still in line with an expected trade diversion effect. Instead, the positive and significant coefficient related to the interaction term provides supportive evidence for their role as institutional information shocks on priors. The information revealed by FTA^{3rd} positively affects the exploration decisions in goods that rely more on the institutional environment.

Finally, the empirical evidence shows that access to WTO membership promotes offshoring exploration.[94] This is in line with the model's predictions considering that the accession to the WTO reveals

[94] The results are consistent with the theoretical predictions and the literature that have already analysed entry decisions after WTO accessions (Handley and Limão, 2017; Handley et al., 2020).

a commitment of country l to a general set of rules in a multilateral agreement. As expected from the theory, the effect is stronger for differentiated goods.

7 Conclusions

I develop a dynamic model on global sourcing where the final good producers face uncertainty about institutional conditions in foreign countries when deciding the organisation of their supply chain. The model centers the attention on the dynamic allocation of property rights. I introduce first a model in a two-country setup (North-South), where northern final good producers face uncertainty about the southern institutional conditions. Later, I extend it to multiple countries.

I characterise the underlying learning mechanism and the trade-off decisions that the final good producers face when they decide whether to explore their offshoring potential in a foreign location or wait, and the resulting sectoral equilibrium organisational dynamics. The main result is that the sequential increase in the offshoring activity progressively reduces the price index in the final good markets, which translates into a higher intensity in the competition in the final goods market. This leads to a progressive vertical disintegration of the supply chains (Proposition 1: *first channel of the competition effect on vertical disintegration*).

In the multi-country extension, I show that when final good producers under offshoring decide to explore new locations with lower marginal costs, they may trigger a sequential relocation of offshore suppliers towards those countries. The lower marginal costs offered by the new sourcing locations push the sector's price index further down, reinforcing the vertical disintegration trend (Proposition 2: *second channel of the competition effect on vertical disintegration*).

Using US manufacturing sector-level data for 2002-2016, I find evidence on sectoral dynamics that supports both channels of the competition effect. Regarding the first channel, I find that as the offshoring activity in a sector increases, the price index reduces, which leads to a progressive reduction in the intra-firm intensity of the sector. Regarding the second channel, I focus on the analysis of one specific institutional shock: the access of China to the WTO. Considering the low wage of China and its initial low market share in US markets, I identify the effect of a relocation towards a country with lower marginal costs. The empirical results show that as the relocation of offshore suppliers to China advances, the price index reduces, pushing for a reduction in the intra-firm intensity sector.

Finally, I analyse the role of FTAs as triggers of the exploration decisions of new locations. The role of FTAs is analysed from two dimensions: preferential tariffs and institutional arrangements.[95] The

[95] Regarding the tariff dimension, the model shows that if the prior beliefs about institutions in the partner country previous to

main focus is on the institutional dimension of FTAs, and their role as information shocks on institutional priors. The signature of a FTA reveals a commitment of the signing governments to provide an institutional environment that meets the set of rules specified in the agreement. If those rules are observable by northern firms, a new FTA impacts on the prior beliefs about the partner-country and thus incentivise the offshoring exploration of the country.

From this perspective, the model also shows that FTAs among third countries may affect countries' priors beliefs and thus potentially create incentives to explore those locations by northern firms. In particular, when the final good producers associate the FTA to some common institutional ground among the members of the FTA, the countries with relatively worse priors may benefit from those with a better institutional reputation.

As an additional dimension, I also analyse the role of multilateral agreements (MAs) as information shocks on prior beliefs. In particular, I focus on the access to WTO memberships. This membership reveals the members' commitment to a general institutional framework, which may impact on the previous pessimistic priors about the new members and thus promote the offshoring exploration of those countries by northern firms.

Using import data at HS 6 digits for the period 1996-2016 from UN Comtrade, I test for the role of these types of institutional shocks as incentives to explore those locations where the US final good producers have not explored their offshoring potential. I identify three types of shocks: the signature of a FTA where the US is involved; the signature of a FTA where the US is not involved; and the accession to the WTO membership. The empirical results provide support for the predictions of the model.

the FTA are pessimistic, no final good producer find it attractive to explore the offshoring in that country. When the reductions in tariffs for intermediate inputs are sufficiently large, it may create enough incentives to trigger a sequential exploration of that country by at least the most productive final good producers. Thus, small changes in the tariffs may induce a sectoral reorganisation that extends beyond the expected changes that arise from an approach that ignores the presence of institutional uncertainty.

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A Perfect information model

Under perfect information, I eliminate the time index to simplify the notation.

A.1 Consumer's problem

The budget constraint is given by:

$$p_0 q_0 + \sum_{j=1}^{J} \int_{i \in I_j} p_j(i) q_j(i) di \leq E.$$

Given the utility function defined by equation (1), $\gamma_j E$ refers to the expenditure in varieties of the differentiated sector j. Thus, the demand function for a variety i in differentiated sector j is:

$$q_j(i) = \left[\gamma_j E Q_j^{-\alpha_j} p_j(i)^{-1} \right]^{\sigma_j}.$$

The demand for homogeneous good is given by: $q_0 = \frac{\gamma_0 E}{p_0}$.

A.2 Appendix to organisational choice: backward induction solution.

A.2.1 Nash Bargaining

Plugging the equation (3) into the expression for revenues: $r(i) = \gamma E Q^{-\alpha} q(i)^{\alpha-1} q(i)$. Replacing with the production level of variety with the production technology (5), I get:

$$r(i) = \gamma E Q^{-\alpha} \theta^{\alpha} \left[\left(\frac{x_h(i)}{\eta} \right)^{\eta} \left(\frac{x_m(i)}{1-\eta} \right)^{1-\eta} \right]^{\alpha}.$$

The Nash bargaining equilibrium comes from the solution to the following problem:

$$\arg\max_{z} \Omega = [z r(i) - \omega_h]^{\beta} [(1-z) r(i) - \omega_m]^{1-\beta}.$$

From solving the FOC, I get:

$$z = \beta + \frac{(1-\beta)\omega_h - \beta \omega_m}{r(i)}.$$

Outsourcing (O). Both parties remain as independent specialised firms. Therefore, they keep control over their respective assets and the inputs produced from their use. If they do not reach an agreement, they receive their respective outside options, $\omega_h = \omega_m = 0$. Instead, if they agree, the final good variety is produced and the revenues are divided according to the Nash bargaining and the equilibrium shares are defined by $z = \beta$. Thus, the final good producer H receives the share $\beta_O^l = \beta$ and the supplier receives $1 - \beta_O^l = 1 - \beta$, where l denotes the location of the supplier M.

Backward integration (V_H). The final good producer H owns both types of assets. If she and the manager of M fail to reach an agreement, they both receive their respective outside options. The final good producer can fire the manager and seize the manufacturing facilities. Thus, H can use the assets at the supplier's location to produce the intermediate inputs without the latter's cooperation.

Under the non-cooperative outcome, H faces an efficiency loss in the production of the intermediate inputs, which is represented by $1 - \delta^l_{V_H}$ with $\delta^l_{V_H} \in (0, 1)$. When H fires the manager of M, she may involuntarily induce a disruption on routines and tacit knowledge at the supplier's facilities (Nelson and Winter, 1982; Dosi et al., 2000).[96] As a consequence, H faces an efficiency loss in the manufacturing process of the intermediate input for a given level of investment $m(i)$ in relationship-specific assets. Moreover, given the firm-specific nature of the routines and tacit knowledge, the outside option of the manager of M is still zero. The outside option of the final good producer is $\omega_h = (\delta^l_{V_H})^{\alpha(1-\eta)} r(i)$, where $r(i)$ denote the revenues if the parties reach an agreement (cooperate).[97]

If the parties cooperate, the Nash bargaining equilibrium leads to revenue shares given by:

$$\text{Final good producer: } \beta^l_{V_H} = (\delta^l_{V_H})^{\alpha(1-\eta)} + \beta[1 - (\delta^l_{V_H})^{\alpha(1-\eta)}],$$
$$\text{Supplier: } (1 - \beta^l_{V_H}) = (1 - \beta)[1 - (\delta^l_{V_H})^{\alpha(1-\eta)}],$$

where $\beta^l_{V_H}$ is the revenue share of H under backward integration with a supplier M located in country l.[98] Figure 8 shows $\beta^l_{V_H}$ as a function of η and $\delta^l_{V_H}$.

Forward integration (V_M). The manufacturer M owns both types of assets. Thus, M can fire the manager of H after the investment in relationship-specific assets and seized the northern facilities. M can thus take control of the production of the H-services and the final good variety.

Under the non-cooperative outcome, due to the destruction of tacit knowledge and disruption of routines at the final good production facilities, M faces an efficiency loss in the production of the final good producer services x_h represented by $1 - \delta^l_{V_M}$ with $\delta^l_{V_M} \in (0, 1)$. Thus, the revenue realised by M is $(\delta^l_{V_M})^{\alpha\eta} r(i)$, which defines his ω_m under forward integration. Given the firm-specific nature of the routines and tacit knowledge, the manager of H has an outside option equal to zero.

[96] They identify non-codifiable knowledge and routines as key determinants of a firm's (supplier's) productivity.

[97] The efficiency loss can easily include a general loss in the production of both inputs as in Antràs and Helpman (2004), together with a specific additional loss in the seized input. The first loss may be related to the higher complexity involved in the management of both facilities by H, while the second loss relates to the destruction of tacit knowledge and routines in the supplier's facilities. In such a case, the production of the variety would be given by $(\delta^l + (\delta^l_{m,V_H})^{1-\eta})q(i)$, where $(1 - \delta^l)$ refers to the general loss and $(1 - \delta_{m,V_H})$ refers to the input m specific dimension. Therefore, in terms of revenues: $(\delta^l + (\delta^l_{m,V_H})^{1-\eta})^{\alpha} r(i)$.

[98] By the upfront payment that the final good producer establishes in the contract, no rents are left to the supplier and M's participation constraint binds.

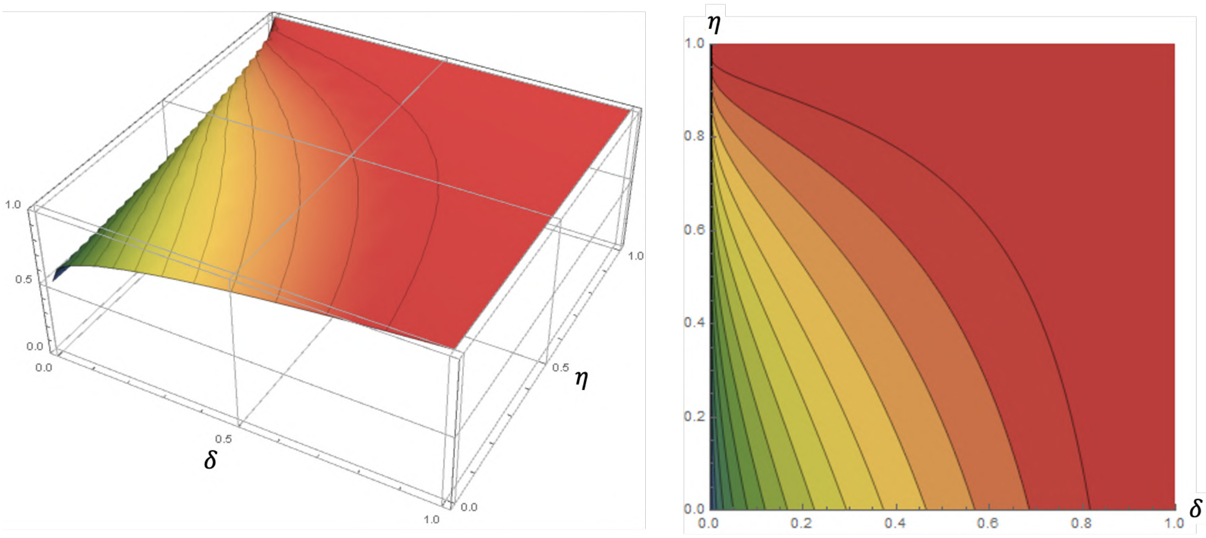


Figure 8: H's revenues share - backward integration, $\beta^l_{V_H}(\eta, \delta^l_{V_H})$. $[\beta = 0.5, \alpha = 0.4]$

If the parties agree, the Nash bargaining equilibrium results in revenue shares:

$$\text{Final good producer: } \beta^l_{V_M} = \beta[1 - (\delta^l_{V_M})^{\alpha\eta}],$$

$$\text{Supplier: } (1 - \beta^l_{V_M}) = (\delta^l_{V_M})^{\alpha\eta} r(i) + (1 - \beta)[1 - (\delta^l_{V_M})^{\alpha\eta}],$$

where $\beta^l_{V_M}$ denotes the revenue share of H under forward integration with a supplier located in l.[99] Figure 9 shows $\beta^l_{V_M}$ as a function of η and $\delta^l_{V_M}$.

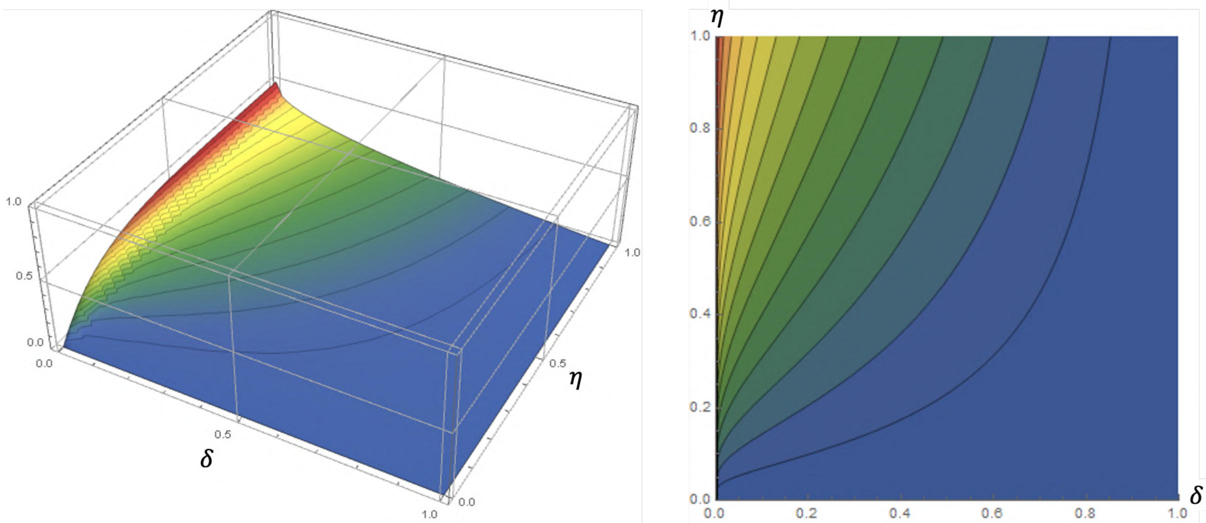


Figure 9: H's revenues share - forward integration, $\beta^l_{V_M}(\eta, \delta^l_{V_M})$. $[\beta = 0.5, \alpha = 0.4]$

[99]By the upfront payment that the final good producer establishes in the contract, no rents are left to the supplier and M's participation constraint binds.

A.2.2 Investment decisions and input provision.

Both parties internalise the respective revenue shares β_k^l in their investment decisions. The investments in the relationship-specific assets $h(i), m(i)$ require the use of labour according to the constant return technologies: $h_k^l(i) = \ell_{h,k}^l(i)$ and $m_k^l(i) = \ell_{m,k}^l$, where l denotes the location of M and $k = O, V_H, V_M$ indicates the type of ownership structure.[100]

The ex-post production levels of the respective inputs for the variety i are a function of the ex-ante investment decisions in the specific assets, and they are given by: $x_{h,k}^l(i) = h_k^l(i)$ and $x_{m,k}^l(i) = m_k^l(i)$. The parties decide their respective investment by solving their respective maximisation programs, which are given by:

$$\text{Final-good producer's program:} \qquad \max_{x_{h,k}^l(i)} \pi_{H,k}^l = \beta_k^l r_k^l(x_{h,k}^l(i)) - w^N x_{h,k}^l(i) - w^N f_k^l,$$

$$\text{Supplier's program:} \qquad \max_{x_{m,k}^l(i)} \pi_{M,k}^l = (1-\beta_k^l) r_k^l(x_{m,k}^l(i)) - w^l x_{m,k}^l(i).$$

From the FOCs, I derive the optimal investment levels for each party, the respective revenues, and the total output of variety i. The optimal investment levels and input production of each party are:

$$h_k^{l,*}(\theta) = x_{h,k}^{l,*}(\theta) = \frac{\alpha\beta_k^l\eta}{w^N} r_k^{l,*}(\theta),$$
$$m_k^{l,*}(\theta) = x_{m,k}^{l,*}(\theta) = \frac{\alpha(1-\beta_k^l)(1-\eta)}{w^l} r_k^{l,*}(\theta),$$

with $k = O, V_H, V_M$,

$$r_k^{l,*}(\theta) \equiv \alpha^{\sigma-1}\theta^{\sigma-1}(\gamma E)^\sigma Q^{1-\sigma}\left[\left(\frac{\beta_k^l}{w^N}\right)^\eta \left(\frac{1-\beta_k^l}{w^l}\right)^{1-\eta}\right]^{\sigma-1},$$

and the output level of the variety i for these investment levels is:

$$q_k^{l,*}(\theta) = \alpha^\sigma\theta^\sigma(\gamma E)^\sigma Q^{1-\sigma}\left[\left(\frac{\beta_k^l}{w^N}\right)^\eta \left(\frac{1-\beta_k^l}{w^l}\right)^{1-\eta}\right]^\sigma. \tag{37}$$

A.2.3 Organisational choice.

If instead of a discrete set of organisational choices, the final good producer is available to choose β from a continuum set, then the optimal choice is illustrated in Figure 10 as β^* as a function of η. However, given the discrete nature of the set, she chooses the organisational type that approximates the most to β^*.[101] I characterise this decision and the trade-off involved below.

In the case of H-intensive sectors, it is easy to see that the final good producer's revenue share is increasing in η, as predicted by Antràs and Helpman (2004), and in $\delta_{V_H}^l$. Thus, the critical level $\bar{\eta}_c$ is

[100] Although the investments in $h(i)$ always take place in the North by using northern labour, the magnitude depends on the location of the supplier and the chosen organisational type.

[101] For the derivation of the function $\beta^*(\alpha, \eta)$ see Antràs and Helpman (2004).

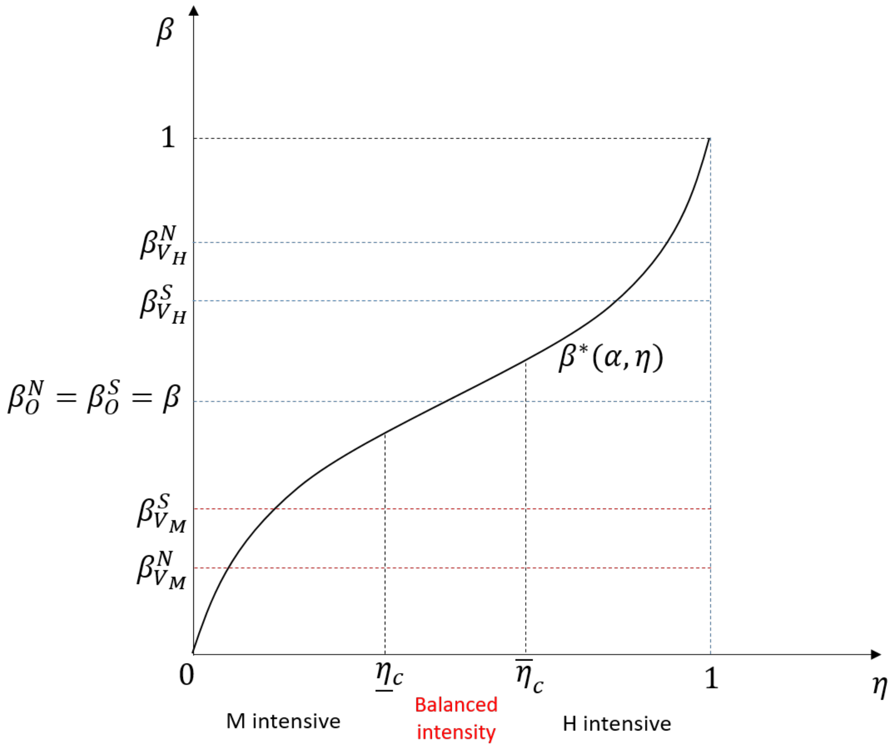


Figure 10: Optimal β and discrete organisational choices. Sectoral classification.

increasing in $\delta_{V_H}^l$. Intuitively, when the disruption on routines caused by the replacement of the manager of M is very low ($\delta_{V_H} \to 1$), or in other words, when the routines are easily assimilated by a new manager of M, the efficiency losses in the manufacturing of the intermediate input are lower. Therefore, the outside option of H improves pushing up the share β_{V_H} for a given η, and thus increases the critical level $\bar{\eta}_c$.

In the case of M-intensive or component-intensive sectors, the revenue share $\beta_{V_M}^l$ is still increasing in η but decreasing in $\delta_{V_M}^l$. Thus, the critical level $\underline{\eta}_c$ is decreasing in $\delta_{V_M}^l$. The intuition refers to a mirror situation from the case above. When the routines in the final good production facilities can be easily assimilated by a new manager ($\delta_{V_M} \to 1$), the efficiency losses from firing the manager of H are smaller. Therefore, the outside option of M increases, the share β_{V_M} for a given η diminishes, and thus the critical level $\underline{\eta}_c$ becomes smaller.

A.3 Offshoring profit premiums

The offshoring profit premium of a final good producer with productivity θ that chooses arm's length trade, relative to domestic outsourcing, is:

$$\begin{aligned}\pi_{O^S/O^N}^{\text{prem}}(\theta) &= \pi_O^S(\theta) - \pi_O^N(\theta) \\ &= r_O^S(\theta)\left[1 - \alpha[\beta_O^S\eta + (1-\beta_O^S)(1-\eta)]\right] - w^N f_O^S - r_O^N(\theta)\left[1 - \alpha[\beta_O^N\eta + (1-\beta_O^N)(1-\eta)]\right] + w^N f_O^N,\end{aligned}$$

using $\beta_O^S = \beta_O^N = \beta$, and $\frac{r_O^S(\theta)}{r_O^N(\theta)} = \left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)}$, the expression above becomes:

$$\pi^{\text{prem}}_{O^S/O^N}(\theta) = r_O^N(\theta)\left[\left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)} - 1\right][1-\alpha[\beta\eta + (1-\beta)(1-\eta)]] - w^N\left[f_O^S - f_O^N\right]. \tag{38}$$

The profit premium obtained by a producer θ under V^S relative to V^N, with $V = V_H, V_M$, is:

$$\begin{aligned}\pi^{\text{prem}}_{V^S/V^N}(\theta) &= \pi_V^S(\theta) - \pi_V^N(\theta),\\ &= r_V^S(\theta)\left[1-\alpha[\beta_V^S\eta + (1-\beta_V^S)(1-\eta)]\right] - w^N f_V^S - r_V^N(\theta)\left[1-\alpha[\beta_V^N\eta + (1-\beta_V^N)(1-\eta)]\right] + w^N f_V^N,\end{aligned}$$

using $\frac{r_V^S(\theta)}{r_V^N(\theta)} = \left[\left(\frac{\beta_V^S}{\beta_V^N}\right)^{\eta}\left(\frac{1-\beta_V^S}{1-\beta_V^N}\right)^{1-\eta}\left(\frac{w^N}{w^S}\right)^{1-\eta}\right]^{\sigma-1}$, the premium is thus given by:

$$\begin{aligned}\pi^{\text{prem}}_{V^S/V^N}(\theta) =& r_V^N(\theta)\Bigg[\left[\left(\frac{\beta_V^S}{\beta_V^N}\right)^{\eta}\left(\frac{1-\beta_V^S}{1-\beta_V^N}\right)^{1-\eta}\left(\frac{w^N}{w^S}\right)^{1-\eta}\right]^{\sigma-1}\\ &\times\left[1-\alpha[\beta_V^S\eta + (1-\beta_V^S)(1-\eta)]\right] - \left[1-\alpha[\beta_V^N\eta + (1-\beta_V^N)(1-\eta)]\right]\Bigg] - w^N\left[f_V^S - f_V^N\right].\end{aligned} \tag{39}$$

Finally, the profit premium of producer θ under arm's length trade relative to domestic integration:

$$\begin{aligned}\pi^{\text{prem}}_{O^S/V^N}(\theta) &= \pi_O^S(\theta) - \pi_V^N(\theta),\\ &= r_V^S(\theta)\left[1-\alpha[\beta\eta + (1-\beta)(1-\eta)]\right] - w^N f_O^S - r_V^N(\theta)\left[1-\alpha[\beta_V^N\eta + (1-\beta_V^N)(1-\eta)]\right] + w^N f_V^N,\end{aligned}$$

using $\frac{r_O^S(\theta)}{r_V^N(\theta)} = \left[\left(\frac{\beta}{\beta_V^N}\right)^{\eta}\left(\frac{1-\beta}{1-\beta_V^N}\right)^{1-\eta}\left(\frac{w^N}{w^S}\right)^{1-\eta}\right]^{\sigma-1}$, the premium is thus given by:

$$\begin{aligned}\pi^{\text{prem}}_{O^S/V^N}(\theta) =& r_V^N(\theta)\Bigg[\left[\left(\frac{\beta}{\beta_V^N}\right)^{\eta}\left(\frac{1-\beta}{1-\beta_V^N}\right)^{1-\eta}\left(\frac{w^N}{w^S}\right)^{1-\eta}\right]^{\sigma-1}\\ &\times[1-\alpha[\beta\eta + (1-\beta)(1-\eta)]] - \left[1-\alpha[\beta_V^N\eta + (1-\beta_V^N)(1-\eta)]\right]\Bigg] - w^N\left[f_O^S - f_V^N\right].\end{aligned} \tag{40}$$

A.4 H-intensive and M-intensive sectors: productivity cutoffs

Taking advantage of the similar organisation structure at equilibrium of the two type of sectors, I derive the respective productivity cutoff for both sectors together. The only difference comes from the type of integration observed in each case. The index V denotes integration, and it refers to V_H when a H-intensive sector is considered, and to V_M when it is the case of a M-intensive sector.

The market entry productivity cutoff, $\underline{\theta}^*$, is defined by the zero profit condition $\pi_O^N(\underline{\theta}^*) = 0$. Solving for the market productivity cutoff:

$$\underline{\theta}^* = (\gamma E)^{\frac{\sigma}{1-\sigma}} Q\left[\frac{w^N f_O^N}{\psi_O^N(\eta)}\right]^{\frac{1}{\sigma-1}}. \tag{41}$$

Final good producers doing domestic integration realise an additional per-period profit relative to domestic outsourcing, which is defined by the following condition:

$$\begin{aligned}\pi^{prem}_{V^N/O^N}(\theta) &= \pi_V^N(\theta) - \pi_O^N(\theta),\\ &= \theta^{\sigma-1}(\gamma E)^{\sigma} Q^{1-\sigma}\left[\psi_V^N(\eta) - \psi_O^N(\eta)\right] - w^N(f_V^N - f_O^N).\end{aligned}$$

Thus, the productivity cutoff for domestic integration is defined by the following condition: $\pi^{prem}_{V^N/O^N}(\theta) = 0$. The respective productivity cutoff is defined by:

$$\theta_V^{N,*} = (\gamma E)^{\frac{\sigma}{1-\sigma}} Q \left[\frac{w^N [f_V^N - f_O^N]}{\psi_V^N(\eta) - \psi_O^N(\eta)} \right]^{\frac{1}{\sigma-1}}. \tag{42}$$

The arm's length trade profit premium for final good producers with productivity θ, $\pi^{prem}_{O^S/V^N}(\theta)$, is defined as the difference between the profits that she obtains under arm's length trade (O^S) and the profits she would obtain under domestic integration (V^N). Formally,

$$\begin{aligned}\pi^{prem}_{O^S/V^N}(\theta) &= \pi_O^S(\theta) - \pi_V^N(\theta),\\ &= \theta^{\sigma-1}(\gamma E)^{\sigma} Q^{1-\sigma} \left[\psi_O^S(\eta) - \psi_V^N(\eta)\right] - w^N(f_O^S - f_V^N).\end{aligned}$$

The foreign outsourcing productivity cutoff is defined by the final good producer $\theta_O^{S,*}$ that is indifferent between domestic vertical backward integration and foreign outsourcing, i.e. $\pi^{prem}_{O^S/V^N}(\theta) = w^N(1-\lambda)s^r$. Thus, the respective productivity cutoff $\theta_O^{S,*}$ is given by:

$$\theta_O^{S,*} = (\gamma E)^{\frac{\sigma}{1-\sigma}} Q \left[\frac{w^N [f_O^S + (1-\lambda)s^r - f_V^N]}{\psi_O^S(\eta) - \psi_V^N(\eta)} \right]^{\frac{1}{\sigma-1}}. \tag{43}$$

The V^S profit premium obtained by the final good producers opting for this sourcing strategy relative to domestic integration is:

$$\begin{aligned}\pi^{prem}_{V^S/V^N}(\theta) &= \pi_V^S(\theta) - \pi_V^N(\theta),\\ &= \theta^{\sigma-1}(\gamma E)^{\sigma} Q^{1-\sigma} \left[\psi_V^S(\eta) - \psi_V^N(\eta)\right] - w^N(f_V^S - f_V^N).\end{aligned}$$

The profit premium obtained by the final good producers doing V^S compared to the premium they would realise under arm's length trade is defined as:

$$\begin{aligned}\pi^{prem}_{V^S/O^S}(\theta) &= \pi_V^S(\theta) - \pi_O^S(\theta),\\ &= \theta^{\sigma-1}(\gamma E)^{\sigma} Q^{1-\sigma} \left[\psi_V^S(\eta) - \psi_O^S(\eta)\right] - w^N(f_V^S - f_O^S).\end{aligned}$$

The productivity cutoff for foreign integration ($\theta_V^{S,*}$) is defined by the indifferent final good producer between arm's length trade and V^S, i.e. $\pi^{prem}_{V^S/O^S}(\theta_V^{S,*}) = 0$. Solving for $\theta_V^{S,*}$, the respective productivity cutoff is:

$$\theta_V^{S,*} = (\gamma E)^{\frac{\sigma}{1-\sigma}} Q \left[\frac{w^N [f_V^S - f_O^S]}{\psi_V^S(\eta) - \psi_O^S(\eta)} \right]^{\frac{1}{\sigma-1}}. \tag{44}$$

A.5 Balanced-intensity sectors: productivity cutoffs

The market entry productivity cutoff, $\underline{\theta}^*$, is defined by the zero profit condition $\pi_O^N(\underline{\theta}^*) = 0$, and it is given by:

$$\underline{\theta}^* = (\gamma E)^{\frac{\sigma}{1-\sigma}} Q \left[\frac{w^N f_O^N}{\psi_O^N(\eta)} \right]^{\frac{1}{\sigma-1}}. \tag{45}$$

The offshoring profit premium for a final good producer with productivity θ doing arm's length trade is defined as the difference in the profits she obtains under this sourcing type (O^S) relative to the profits she would earn under domestic outsourcing (O^N). Formally, it is defined by the following condition:

$$\begin{aligned}\pi^{prem}_{O^S/O^N}(\theta) &= \pi^S_O(\theta) - \pi^N_O(\theta),\\ &= \theta^{\sigma-1}(\gamma E)^{\sigma} Q^{1-\sigma}\left[\psi^S_O(\eta) - \psi^N_O(\eta)\right] - w^N(f^S_O - f^N_O).\end{aligned}$$

The arm's length trade productivity cutoff, $\theta^{S,*}_O$, which is also the offshoring productivity cutoff, is defined by the final good producer indifferent between domestic and foreign outsourcing, i.e. by the final good producer with a productivity such that the discounted value of the offshoring premiums $\pi^{prem}_{O^S/O^N}(\theta)$ is just enough to recover the offshoring market research sunk cost. Formally,

$$\pi^{prem}_{O^S/O^N}(\theta^{S,*}_O) = w^N(1-\lambda)s^r,$$

leading to the following expression for the productivity cutoff:

$$\theta^{S,*}_O = (\gamma E)^{\frac{\sigma}{1-\sigma}} Q \left[\frac{w^N[f^S_O + (1-\lambda)s^r - f^N_O]}{\psi^S_O(\eta) - \psi^N_O(\eta)}\right]^{\frac{1}{\sigma-1}}. \tag{46}$$

A.6 Price of variety by organisational type and final good producer's productivity

Taking equations (37) and (3), the price of a variety i produced by a final good producer with productivity θ under organisational type k^l is:

$$p^{l,*}_k(\theta) = \alpha^{-1}\theta^{-1}\left[\left(\frac{\beta^l_k}{w^N}\right)^{\eta}\left(\frac{1-\beta^l_k}{w^l}\right)^{1-\eta}\right]^{-1}$$

Using the expression above, I can derive the prices for each organisational type for any θ. The price of a variety i offered by a final good producer θ, who source the intermediate input from an independent domestic supplier, is:[102]

$$p^{N,*}_O(\theta) = \frac{w^N}{\alpha\theta\left[\beta^{\eta}(1-\beta)^{1-\eta}\right]}.$$

For a final good producer θ sourcing from an independent southern supplier, the price of variety i is:

$$p^{S,*}_O(\theta) = \frac{(w^N)^{\eta}(w^S)^{1-\eta}}{\alpha\theta\left[\beta^{\eta}(1-\beta)^{1-\eta}\right]}.$$

For integrated final good producers, the respective prices are:

$$p^{N,*}_V(\theta) = \frac{w^N}{\alpha\theta\left[(\beta^N_V)^{\eta}(1-\beta^N_V)^{1-\eta}\right]} \quad \text{for} \quad V = V_H, V_M \text{ and } l = N,$$

$$p^{S,*}_V(\theta) = \frac{(w^N)^{\eta}(w^S)^{1-\eta}}{\alpha\theta\left[(\beta^S_V)^{\eta}(1-\beta^S_V)^{1-\eta}\right]} \quad \text{for} \quad V = V_H, V_M \text{ and } l = S.$$

[102] Recall that $\beta^N_O = \beta^S_O = \beta$.

A.7 Balanced-intensity sectors: Price index and aggregate consumption

The ranking of prices of a variety produced by a final good producer with productivity θ for each organisational type, given that $w^S < w^N$, is:

$$\frac{p_O^{S,*}(\theta)}{p_O^{N,*}(\theta)} = \left(\frac{w^S}{w^N}\right)^{1-\eta} < 1 \quad \Rightarrow \quad p_O^{S,*}(\theta) < p_O^{N,*}(\theta). \tag{47}$$

A.7.1 Sectoral price index.

The price index in the sector is:

$$\begin{aligned}
P^{1-\sigma} =& \int_{\underline{\theta}}^{\theta_O^S} p_O^N(\theta)^{1-\sigma} H \frac{g(\theta)}{1-G(\underline{\theta})} d\theta + \int_{\theta_O^S}^{\infty} p_O^S(\theta)^{1-\sigma} H \frac{g(\theta)}{1-G(\underline{\theta})} d\theta, \\
=& \int_{\underline{\theta}}^{\infty} p_O^N(\theta)^{1-\sigma} H \frac{g(\theta)}{1-G(\underline{\theta})} d\theta + \frac{1-G(\theta_O^S)}{1-G(\underline{\theta})} \int_{\theta_O^S}^{\infty} p_O^S(\theta)^{1-\sigma} H \frac{g(\theta)}{1-G(\theta_O^S)} d\theta \\
&- \frac{1-G(\theta_O^S)}{1-G(\underline{\theta})} \int_{\theta_O^S}^{\infty} p_O^N(\theta)^{1-\sigma} H \frac{g(\theta)}{1-G(\theta_O^S)} d\theta, \\
P^{1-\sigma} =& H\left[\int_{\underline{\theta}}^{\infty} p_O^N(\theta)^{1-\sigma} \frac{g(\theta)}{1-G(\underline{\theta})} d\theta + \chi_O^S \int_{\theta_O^S}^{\infty} [p_O^S(\theta)^{1-\sigma} - p_O^N(\theta)^{1-\sigma}] \frac{g(\theta)}{1-G(\theta_O^S)} d\theta\right],
\end{aligned} \tag{48}$$

where H denotes the number of active final good producers in the market, and $\chi_O^S \equiv \frac{1-G(\theta_O^S)}{1-G(\underline{\theta})}$ indicates the share of final good producers under foreign outsourcing.

Plugging equation (47) and replacing with the expression for prices, I get:

$$P^{1-\sigma} = H\left(\frac{\alpha\left[\beta^\eta(1-\beta)^{1-\eta}\right]}{w^N}\right)^{\sigma-1} \left\{(\bar{\theta})^{\sigma-1} + \chi_O^S\left[\left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)} - 1\right](\bar{\theta}_O^S)^{\sigma-1}\right\}. \tag{49}$$

Alternatively, I can express the price index at each period t as a function of price indices of producers under each organisational type. Starting from equation (48), I get:

$$\begin{aligned}
P_t^{1-\sigma} =& H_t\left[\int_{\underline{\theta}_t}^{\infty} p_O^N(\theta)^{1-\sigma} \frac{g(\theta)}{1-G(\underline{\theta}_t)} d\theta + \chi_{O,t}^S \int_{\theta_{O,t}^S}^{\infty} [p_O^S(\theta)^{1-\sigma} - p_O^N(\theta)^{1-\sigma}] \frac{g(\theta)}{1-G(\theta_{O,t}^S)} d\theta\right], \\
P_t^{1-\sigma} =& \left(P_t^{O_t^N}\right)^{1-\sigma} + \chi_{O,t}^S\left[\left(P_t^{O_t^S}\right)^{1-\sigma} - \left(P_t^{O_t^S|O_t^N}\right)^{1-\sigma}\right],
\end{aligned} \tag{50}$$

with:

$$P_t^{O_t^N} = \left[\int_{\underline{\theta}_t}^{\infty} \left(p_O^N(\theta)\right)^{1-\sigma} \frac{g(\theta)}{1-G(\underline{\theta}_t)} d\theta\right]^{\frac{1}{1-\sigma}}, \tag{51}$$

$$P_t^{O_t^S} = \left[\int_{\theta_{O,t}^S}^{\infty} \left(p_O^S(\theta)\right)^{1-\sigma} \frac{g(\theta)}{1-G(\theta_{O,t}^S)} d\theta\right]^{\frac{1}{1-\sigma}}, \tag{52}$$

$$P_t^{O_t^S|O_t^N} = \left[\int_{\theta_{O,t}^S}^{\infty} \left(p_O^N(\theta)\right)^{1-\sigma} \frac{g(\theta)}{1-G(\theta_{O,t}^S)} d\theta\right]^{\frac{1}{1-\sigma}}. \tag{53}$$

$P_t^{O_t^S}$ indicates the price index of producers under foreign outsourcing. $P_t^{O_t^N}$ refers to the price index of all the active producers at t, as if they were all under domestic outsourcing. Finally, $P_t^{O_t^S|O_t^N}$ indicates the price index of all the producers under foreign outsourcing as if they were under domestic outsourcing.

A.7.2 Sectoral aggregate consumption index.

The aggregate consumption index is thence:

$$Q = \gamma E H^{\frac{1}{\sigma-1}} \left[\int_{\underline{\theta}}^{\infty} p_O^N(\theta)^{1-\sigma} \frac{g(\theta)}{1-G(\underline{\theta})} d\theta + \chi_O^S \int_{\theta_O^S}^{\infty} [p_O^S(\theta)^{1-\sigma} - p_O^N(\theta)^{1-\sigma}] \frac{g(\theta)}{1-G(\theta_O^S)} d\theta \right]^{\frac{1}{\sigma-1}},$$

or, by the equivalent expression:

$$Q = \frac{\gamma E H^{\frac{1}{\sigma-1}} \alpha \left[\beta^\eta (1-\beta)^{1-\eta}\right]}{w^N} \left\{ (\bar{\theta})^{\sigma-1} + \chi_O^S \left[\left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)} - 1 \right] (\bar{\theta}_O^S)^{\sigma-1} \right\}^{\frac{1}{\sigma-1}}.$$

A.7.3 Zero Cutoff Profit Condition (ZCPC) and Free Entry Condition (FEC)

ZCPC. By the ZCPC, the market productivity cutoff, denoted as $\underline{\theta}^*$, is implicitly defined by:

$$\frac{\pi_O^N(\underline{\theta}^*)}{1-\lambda} = 0 \quad \Rightarrow \quad \underline{\theta}^* = (\gamma E)^{\frac{\sigma}{1-\sigma}} Q^* \left[\frac{w^N f_O^N}{\psi_O^N(\eta)}\right]^{\frac{1}{\sigma-1}}. \tag{54}$$

Using the ZCPC, the revenues of the market productivity cutoff final good producers are:

$$\pi_O^N(\underline{\theta}^*) = 0 \quad \Rightarrow \quad r_O^N(\underline{\theta}^*) = \frac{w^N f_O^N}{1-\alpha[\beta\eta + (1-\beta)(1-\eta)]}. \tag{55}$$

The average revenue is:

$$\begin{aligned}\bar{r} &= \int_{\underline{\theta}^*}^{\theta_O^{S,*}} r_O^N(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^*)} d\theta + \int_{\theta_O^{S,*}}^{\infty} r_O^S(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^*)} d\theta,\\ &= r_O^N(\bar{\theta}^*) + \chi_O^{S,*} \left[\left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)} - 1 \right] r_O^N(\bar{\theta}_O^{S,*}).\end{aligned}$$

Dividing by $r_O^N(\underline{\theta}^*)$ and replacing with equation (55):

$$\bar{r} = \left[\left(\frac{\bar{\theta}^*}{\underline{\theta}^*}\right)^{\sigma-1} + \chi_O^{S,*} \left[\left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)} - 1 \right] \left(\frac{\bar{\theta}_O^{S,*}}{\underline{\theta}^*}\right)^{\sigma-1} \right] \frac{w^N f_O^N}{1-\alpha[\beta\eta + (1-\beta)(1-\eta)]}.$$

In terms of profits, $\bar{\pi} = \pi_O^N(\bar{\theta}^*) + \chi_O^{S,*} \left[\pi_{O^S/O^N}^{prem}(\bar{\theta}_O^{S,*}) - (1-\lambda)s^r\right]$. Expressing $r_O^S(\bar{\theta}_O^{S,*})$ in terms of $r_O^N(\bar{\theta}_O^{S,*})$, substituting the revenues $r_O^N(\bar{\theta}^*)$ and $r_O^N(\bar{\theta}_O^{S,*})$ as functions of $r_O^N(\underline{\theta}^*)$, and using (55), the ZCPC leads to:

$$\bar{\pi} = w^N f_O^N \left[\left(\frac{\bar{\theta}^*}{\underline{\theta}^*}\right)^{\sigma-1} - 1 + \chi_O^{S,*} \left[\left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)} - 1 \right] \left(\frac{\bar{\theta}_O^{S,*}}{\underline{\theta}^*}\right)^{\sigma-1} \right] - \chi_O^{S,*} w^N \left[f_O^S + (1-\lambda)s^r - f_O^N\right]$$

FEC. The present value of a final good producer, conditional on successful entry, is:

$$\bar{v} = \int_{\underline{\theta}^*}^{\infty} v(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^*)} d\theta = \frac{\bar{\pi}}{1-\lambda},$$

and the net value of entry is given by:

$$v^e = [1-G(\underline{\theta}^*)]\bar{v} - w^N s^e = \frac{[1-G(\underline{\theta}^*)]}{1-\lambda} \bar{\pi} - w^N s^e.$$

By FEC, $v^e = 0$, therefore:

$$\bar{\pi} = \frac{(1-\lambda) w^N s^e}{1-G(\underline{\theta}^*)}.$$

Number of active final good producers. The number (mass) of active final good producers is:

$$H^* = \frac{\gamma E}{\bar{r}} = \frac{\gamma E\left[1-\alpha[\beta\eta+(1-\beta)(1-\eta)]\right]}{\left[\left(\frac{\tilde{\theta}^*}{\underline{\theta}^*}\right)^{\sigma-1} + \chi_O^{S,*}\left[\left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)} - 1\right]\left(\frac{\tilde{\theta}_O^{S,*}}{\underline{\theta}^*}\right)^{\sigma-1}\right] w^N f_O^N},$$

A.8 H-intensive and M-intensive sectors: Price index and aggregate consumption

Price ranking for H-intensive sectors. The following ranking of prices of a variety produced by a final good producer with productivity θ for each organisational type is a direct result of the setup of the model. Given that $w^S < w^N$ and $\eta \to 1$:

$$\begin{aligned}
\frac{p_{V_H}^{N,*}(\theta)}{p_O^{N,*}(\theta)} &= \frac{\beta^\eta (1-\beta)^{1-\eta}}{\left(\beta_{V_H}^N\right)^\eta \left(1-\beta_{V_H}^N\right)^{1-\eta}} < 1 && \Rightarrow p_{V_H}^{N,*}(\theta) < p_O^{N,*}(\theta),\\
\frac{p_O^{S,*}(\theta)}{p_{V_H}^{N,*}(\theta)} &= \frac{\left(\beta_{V_H}^N\right)^\eta \left(1-\beta_{V_H}^N\right)^{1-\eta}}{\beta^\eta (1-\beta)^{1-\eta}}\left(\frac{w^S}{w^N}\right)^{1-\eta} < 1 \text{ (under A.6)} && \Rightarrow p_O^{S,*}(\theta) < p_{V_H}^{N,*}(\theta),\\
\frac{p_{V_H}^{S,*}(\theta)}{p_O^{S,*}(\theta)} &= \frac{\beta^\eta (1-\beta)^{1-\eta}}{\left(\beta_{V_H}^S\right)^\eta \left(1-\beta_{V_H}^S\right)^{1-\eta}} < 1 && \Rightarrow p_{V_H}^{S,*}(\theta) < p_O^{S,*}(\theta).
\end{aligned} \tag{56}$$

Assumption A. 6. *The gains from the lower marginal cost in the intermediate input overcome the losses from the hold-up.*

Assumption A.6 implies that four types of sourcing emerge. If assumption A.6 does not hold, foreign outsourcing is not profitable to any producer in the market at any period t. Therefore, vertical disintegration dynamics takes place only among domestic sourcing producers.

To sum up, the ranking of prices for each organisational type for a firm with productivity θ is:

$$p_{V_H}^{S,*}(\theta) < p_O^{S,*}(\theta) < p_{V_H}^{N,*}(\theta) < p_O^{N,*}(\theta).$$

The explicit expressions for the additional price ratios are:

$$\begin{aligned}
\frac{p_O^{S,*}(\theta)}{p_O^{N,*}(\theta)} &= \left(\frac{w^S}{w^N}\right)^{1-\eta} < 1 && \Rightarrow p_O^{S,*}(\theta) < p_O^{N,*}(\theta),\\
\frac{p_{V_H}^{S,*}(\theta)}{p_{V_H}^{N,*}(\theta)} &= \frac{\left(\beta_{V_H}^N\right)^\eta \left(1-\beta_{V_H}^N\right)^{1-\eta}}{\left(\beta_{V_H}^S\right)^\eta \left(1-\beta_{V_H}^S\right)^{1-\eta}}\left(\frac{w^S}{w^N}\right)^{1-\eta} < 1 \text{ (under A.6)} && \Rightarrow p_{V_H}^{S,*}(\theta) < p_{V_H}^{N,*}(\theta),\\
\frac{p_{V_H}^{S,*}(\theta)}{p_O^{N,*}(\theta)} &= \frac{\beta^\eta (1-\beta)^{1-\eta}}{\left(\beta_{V_H}^S\right)^\eta \left(1-\beta_{V_H}^S\right)^{1-\eta}}\left(\frac{w^S}{w^N}\right)^{1-\eta} < 1 && \Rightarrow p_{V_H}^{S,*}(\theta) < p_O^{N,*}(\theta).
\end{aligned} \tag{57}$$

Price ranking for M-intensive sectors. The following ranking of prices of a variety produced by a final good producer with productivity θ for each organisational type is a direct result of the setup of the model. Given that $w^S < w^N$ and $\eta \to 0$:

$$\begin{aligned}
\frac{p_{V_M}^{N,*}(\theta)}{p_O^{N,*}(\theta)} &= \frac{\beta^\eta (1-\beta)^{1-\eta}}{\left(\beta_{V_M}^N\right)^\eta \left(1-\beta_{V_M}^N\right)^{1-\eta}} < 1 && \Rightarrow p_{V_M}^{N,*}(\theta) < p_O^{N,*}(\theta), \\
\frac{p_O^{S,*}(\theta)}{p_{V_M}^{N,*}(\theta)} &= \frac{\left(\beta_{V_M}^N\right)^\eta \left(1-\beta_{V_M}^N\right)^{1-\eta}}{\beta^\eta (1-\beta)^{1-\eta}} \left(\frac{w^S}{w^N}\right)^{1-\eta} < 1 \text{ (under A.6)} && \Rightarrow p_O^{S,*}(\theta) < p_{V_M}^{N,*}(\theta), \\
\frac{p_{V_M}^{S,*}(\theta)}{p_O^{S,*}(\theta)} &= \frac{\beta^\eta (1-\beta)^{1-\eta}}{\left(\beta_{V_M}^S\right)^\eta \left(1-\beta_{V_M}^S\right)^{1-\eta}} < 1 && \Rightarrow p_{V_M}^{S,*}(\theta) < p_O^{S,*}(\theta).
\end{aligned} \tag{58}$$

To sum up, the ranking of prices for each organisational type for a firm with productivity θ is:

$$p_{V_M}^{S,*}(\theta) < p_O^{S,*}(\theta) < p_{V_M}^{N,*}(\theta) < p_O^{N,*}(\theta).$$

The explicit expressions for the additional price ratios are:

$$\begin{aligned}
\frac{p_O^{S,*}(\theta)}{p_O^{N,*}(\theta)} &= \left(\frac{w^S}{w^N}\right)^{1-\eta} < 1 && \Rightarrow p_O^{S,*}(\theta) < p_O^{N,*}(\theta), \\
\frac{p_{V_M}^{S,*}(\theta)}{p_{V_M}^{N,*}(\theta)} &= \frac{\left(\beta_{V_M}^N\right)^\eta \left(1-\beta_{V_M}^N\right)^{1-\eta}}{\left(\beta_{V_M}^S\right)^\eta \left(1-\beta_{V_M}^S\right)^{1-\eta}} \left(\frac{w^S}{w^N}\right)^{1-\eta} < 1 \text{ (under A.6)} && \Rightarrow p_{V_M}^{S,*}(\theta) < p_{V_M}^{N,*}(\theta), \\
\frac{p_{V_M}^{S,*}(\theta)}{p_O^{N,*}(\theta)} &= \frac{\beta^\eta (1-\beta)^{1-\eta}}{\left(\beta_{V_M}^S\right)^\eta \left(1-\beta_{V_M}^S\right)^{1-\eta}} \left(\frac{w^S}{w^N}\right)^{1-\eta} < 1 && \Rightarrow p_{V_M}^{S,*}(\theta) < p_O^{N,*}(\theta).
\end{aligned} \tag{59}$$

A.8.1 Sectoral price index.

I derive a general expression for the sector's price index that comprehends the H- and M-intensive sectors. As above, the integration V refers to V_H when the sector is H-intensive, and to V_M when it is M-intensive.

The price index in the sector is given by:

$$\begin{aligned}
P^{1-\sigma} = &\int_{\underline{\theta}}^{\theta_V^N} p_O^N(\theta)^{1-\sigma} H \frac{g(\theta)}{1-G(\underline{\theta})} d\theta + \int_{\theta_V^N}^{\theta_O^S} p_V^N(\theta)^{1-\sigma} H \frac{g(\theta)}{1-G(\underline{\theta})} d\theta \\
&+ \int_{\theta_O^S}^{\theta_V^S} p_O^S(\theta)^{1-\sigma} H \frac{g(\theta)}{1-G(\underline{\theta})} d\theta + \int_{\theta_V^S}^{\infty} p_V^S(\theta)^{1-\sigma} H \frac{g(\theta)}{1-G(\underline{\theta})} d\theta,
\end{aligned} \tag{60}$$

with H denoting the number of final good producers active in the market. After a simple algebra transformation, I get:

$$\begin{aligned}
P^{1-\sigma} = H\Bigg[&\int_{\underline{\theta}}^{\infty} p_O^N(\theta)^{1-\sigma} \frac{g(\theta)}{1-G(\underline{\theta})} d\theta + \chi_V^N \int_{\theta_V^N}^{\infty} [p_V^N(\theta)^{1-\sigma} - p_O^N(\theta)^{1-\sigma}] \frac{g(\theta)}{1-G(\theta_V^N)} d\theta \\
&+ \chi_O^S \int_{\theta_O^S}^{\infty} [p_O^S(\theta)^{1-\sigma} - p_V^N(\theta)^{1-\sigma}] \frac{g(\theta)}{1-G(\theta_O^S)} d\theta + \chi_V^S \int_{\theta_V^S}^{\infty} [p_V^S(\theta)^{1-\sigma} - p_O^S(\theta)^{1-\sigma}] \frac{g(\theta)}{1-G(\theta_V^S)} d\theta \Bigg],
\end{aligned} \tag{61}$$

with $\chi_V^N = \frac{1-G(\theta_V^N)}{1-G(\underline{\theta})}$ denoting the share of final good producers that are under $V^N \cup O^S \cup V^S$, the variable $\chi_V^S = \frac{1-G(\theta_V^S)}{1-G(\underline{\theta})}$ referring to the share of final good producers under foreign integration V^S, and

$\chi_O^S = \frac{1-G(\theta_O^S)}{1-G(\underline{\theta})}$ denoting the share of final good producers under offshoring. In other words, χ_O^S denotes the share of producers under foreign outsourcing and integration. Therefore, the share of final good producers under foreign outsourcing is $\chi_O^S - \chi_V^S$, the share of producers under V^N is $\chi_V^N - \chi_O^S$, and the share of final good producers under domestic outsourcing is $1 - \chi_V^N$.

Using the expressions from equation (56), the price index can be expressed as:

$$\begin{aligned}
P^{1-\sigma} =& H\Bigg[\int_{\underline{\theta}}^{\infty} p_O^N(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta})}d\theta + \left[\left(\frac{\beta^\eta(1-\beta)^\eta}{(\beta_V^N)^\eta(1-\beta_V^N)^{1-\eta}}\right)^{1-\sigma} - 1\right]\chi_V^N\int_{\theta_V^N}^{\infty} p_O^N(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\theta_V^N)}d\theta \\
&+ \left[\left(\frac{(\beta_V^N)^\eta(1-\beta_V^N)^{1-\eta}}{\beta^\eta(1-\beta)^{1-\eta}}\left(\frac{w^S}{w^N}\right)^{1-\eta}\right)^{1-\sigma} - 1\right]\chi_O^S\int_{\theta_O^S}^{\infty} p_V^N(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\theta_O^S)}d\theta \\
&+ \left[\left(\frac{\beta^\eta(1-\beta)^\eta}{(\beta_V^S)^\eta(1-\beta_V^S)^{1-\eta}}\right)^{1-\sigma} - 1\right]\chi_V^S\int_{\theta_V^S}^{\infty} p_O^S(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\theta_V^S)}d\theta\Bigg].
\end{aligned} \tag{62}$$

Replacing with the expressions for prices, I get:

$$\begin{aligned}
P^{1-\sigma} =& H\left(\frac{\alpha}{w^N}\right)^{\sigma-1}\Bigg\{\Big[\beta^\eta(1-\beta)^\eta\Big]^{\sigma-1}(\bar{\theta})^{\sigma-1} + \chi_V^N\left[\Big[(\beta_V^N)^\eta(1-\beta_V^N)^{1-\eta}\Big]^{\sigma-1} - \Big[\beta^\eta(1-\beta)^{1-\eta}\Big]^{\sigma-1}\right](\bar{\theta}_V^N)^{\sigma-1} \\
&+ \chi_O^S\left[\left[\left(\frac{w^N}{w^S}\right)^{1-\eta}\beta^\eta(1-\beta)^{1-\eta}\right]^{\sigma-1} - \Big[(\beta_V^N)^\eta(1-\beta_V^N)^{1-\eta}\Big]^{\sigma-1}\right](\bar{\theta}_O^S)^{\sigma-1} \\
&+ \chi_V^S\left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)}\left[\Big[(\beta_V^S)^\eta(1-\beta_V^S)^{1-\eta}\Big]^{\sigma-1} - \Big[\beta^\eta(1-\beta)^{1-\eta}\Big]^{\sigma-1}\right](\bar{\theta}_V^S)^{\sigma-1}\Bigg\},
\end{aligned} \tag{63}$$

with

$$\begin{aligned}
\bar{\theta} \equiv \left[\int_{\underline{\theta}}^{\infty}\theta^{\sigma-1}\frac{g(\theta)}{1-G(\underline{\theta})}d\theta\right]^{\frac{1}{\sigma-1}} \quad &; \quad \bar{\theta}_V^N \equiv \left[\int_{\theta_V^N}^{\infty}\theta^{\sigma-1}\frac{g(\theta)}{1-G(\theta_V^N)}d\theta\right]^{\frac{1}{\sigma-1}} \\
\bar{\theta}_O^S \equiv \left[\int_{\theta_O^S}^{\infty}\theta^{\sigma-1}\frac{g(\theta)}{1-G(\theta_O^S)}d\theta\right]^{\frac{1}{\sigma-1}} \quad &; \quad \bar{\theta}_V^S \equiv \left[\int_{\theta_V^S}^{\infty}\theta^{\sigma-1}\frac{g(\theta)}{1-G(\theta_V^S)}d\theta\right]^{\frac{1}{\sigma-1}}.
\end{aligned} \tag{64}$$

Note that the expressions in equation (64) represent the mean productivities of the final good producer from the cutoff indicated in the subindex up to the most productive firm in the market. For instance, $\bar{\theta}$ indicates the mean productivity in the market, while $\bar{\theta}_O^S$ refers to the mean productivity of the offshoring final good producers under any offshoring type. Instead, $\bar{\theta}_V^S$ indicates the mean productivity of the final good producers under foreign integration. Finally, $\bar{\theta}_V^N$ refers to the mean productivity of the final good producers in the market with a productivity $\theta \geq \theta_V^N$.

Equivalently, I can express the price index at any period t as a function of price indices of producers under each organisational type. Starting from equation (61), I get:

$$\begin{aligned}
P_t^{1-\sigma} =& \left(P_t^{O_t^N}\right)^{1-\sigma} + \chi_{V,t}^N\left[\left(P_t^{V_t^N}\right)^{1-\sigma} - \left(P_t^{V_t^N|O_t^N}\right)^{1-\sigma}\right] \\
&+ \chi_{O,t}^S\left[\left(P_t^{O_t^S}\right)^{1-\sigma} - \left(P_t^{O_t^S|V_t^N}\right)^{1-\sigma}\right] + \chi_{V,t}^S\left[\left(P_t^{V_t^S}\right)^{1-\sigma} - \left(P_t^{V_t^S|O_t^S}\right)^{1-\sigma}\right],
\end{aligned} \tag{65}$$

with

$$P_t^{V_t^N} = \left[\int_{\theta_{V,t}^N}^{\infty}\left(p_V^N(\theta)\right)^{1-\sigma}H_t\frac{g(\theta)}{1-G(\theta_{V,t}^N)}d\theta\right]^{\frac{1}{1-\sigma}}, P_t^{V_t^S} = \left[\int_{\theta_{V,t}^S}^{\infty}\left(p_{V,j}^S(\theta)\right)^{1-\sigma}H_t\frac{g(\theta)}{1-G(\theta_{V,t}^S)}d\theta\right]^{\frac{1}{1-\sigma}},$$

$$
\begin{aligned}
P_t^{O_t^S|V_{j,t}^N} &= \left[\int_{\theta_{O,t}^S}^{\infty} \left(p_V^N(\theta)\right)^{1-\sigma} H_t \frac{g(\theta)}{1-G(\theta_{O,t}^S)} d\theta\right]^{\frac{1}{1-\sigma}}, \\
P_t^{V_t^S|O_t^S} &= \left[\int_{\theta_{V,t}^S}^{\infty} \left(p_O^S(\theta)\right)^{1-\sigma} H_t \frac{g(\theta)}{1-G(\theta_{V,t}^S)} d\theta\right]^{\frac{1}{1-\sigma}},
\end{aligned}
$$

where $P_t^{V_{j,t}^N}$ refers to the price index of all producers with $\theta \geq \theta_{V,t}^N$, as if they were all under domestic integration. $P_t^{V_t^S}$ indicates the price index of all the producers under foreign integration. $P_t^{O_t^S|V_t^N}$ denotes the price index of all the producers under offshoring ($\theta \geq \theta_{O,t}^S$) under the cost structure of domestic integration, and $P_t^{V_t^S|O_t^S}$ refers to the price index of all the producers under foreign integration ($\theta \geq \theta_{V,t}^S$) under the cost structure of foreign outsourcing.

A.8.2 Sectoral aggregate consumption index.

The aggregate consumption index is:

$$
\begin{aligned}
Q =& \gamma E H^{\frac{1}{\sigma-1}} \left[\int_{\underline{\theta}}^{\infty} p_O^N(\theta)^{1-\sigma} \frac{g(\theta)}{1-G(\underline{\theta})} d\theta + \chi_V^N \int_{\theta_V^N}^{\infty} [p_V^N(\theta)^{1-\sigma} - p_O^N(\theta)^{1-\sigma}] \frac{g(\theta)}{1-G(\theta_V^N)} d\theta \right. \\
&\left. + \chi_O^S \int_{\theta_O^S}^{\infty} [p_O^S(\theta)^{1-\sigma} - p_V^N(\theta)^{1-\sigma}] \frac{g(\theta)}{1-G(\theta_O^S)} d\theta + \chi_V^S \int_{\theta_V^S}^{\infty} [p_V^S(\theta)^{1-\sigma} - p_O^S(\theta)^{1-\sigma}] \frac{g(\theta)}{1-G(\theta_V^S)} d\theta \right]^{\frac{1}{\sigma-1}},
\end{aligned}
$$

or by the equivalent expression:

$$
\begin{aligned}
Q =& \frac{\alpha\gamma E H^{\frac{1}{\sigma-1}}}{w^N} \left\{ \left[\beta^\eta (1-\beta)^\eta\right]^{\sigma-1} (\bar{\theta})^{\sigma-1} + \chi_V^N \left[\left[(\beta_V^N)^\eta (1-\beta_V^N)^{1-\eta}\right]^{\sigma-1} - \left[\beta^\eta (1-\beta)^{1-\eta}\right]^{\sigma-1} \right] (\bar{\theta}_V^N)^{\sigma-1} \right. \\
&+ \chi_O^S \left[\left[\left(\frac{w^N}{w^S}\right)^{1-\eta} \beta^\eta (1-\beta)^{1-\eta} \right]^{\sigma-1} - \left[(\beta_V^N)^\eta (1-\beta_V^N)^{1-\eta}\right]^{\sigma-1} \right] (\bar{\theta}_O^S)^{\sigma-1} \\
&\left. + \chi_V^S \left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)} \left[\left[(\beta_V^S)^\eta (1-\beta_V^S)^{1-\eta}\right]^{\sigma-1} - \left[\beta^\eta (1-\beta)^{1-\eta}\right]^{\sigma-1} \right] (\bar{\theta}_V^S)^{\sigma-1} \right\}^{\frac{1}{\sigma-1}}.
\end{aligned}
$$

A.8.3 Zero Cutoff Profit Condition (ZCPC) and Free Entry Condition (FEC)

ZCPC. The market productivity cutoff, denoted as $\underline{\theta}^*$, is implicitly defined by (54), and the revenues of the market productivity cutoff final good producers by (55).

The average revenue is given by:

$$
\begin{aligned}
\bar{r} =& \int_{\underline{\theta}^*}^{\theta_V^{N,*}} r_O^N(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^*)} d\theta + \int_{\theta_V^{N,*}}^{\theta_O^{S,*}} r_V^N(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^*)} d\theta + \int_{\theta_O^{S,*}}^{\theta_V^{S,*}} r_O^S(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^*)} d\theta + \int_{\theta_V^{S,*}}^{\infty} r_V^S(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^*)} d\theta, \\
=& r_O^N(\bar{\theta}) + \chi_V^N \left[r_V^N(\bar{\theta}_V^N) - r_O^N(\bar{\theta}_V^N)\right] + \chi_O^S \left[r_O^S(\bar{\theta}_O^S) - r_V^N(\bar{\theta}_O^S)\right] + \chi_V^S \left[r_V^S(\bar{\theta}_V^S) - r_O^S(\bar{\theta}_V^S)\right],
\end{aligned}
$$

$$
\begin{aligned}
\bar{r} =& r_O^N(\bar{\theta}) + \chi_V^N \left[\left(\frac{(\beta_V^N)^\eta (1-\beta_V^N)^{1-\eta}}{\beta^\eta (1-\beta)^{1-\eta}} \right)^{\sigma-1} - 1 \right] r_O^N(\bar{\theta}_V^N) \\
&+ \chi_O^S \left[\left(\frac{\beta^\eta (1-\beta)^{1-\eta}}{(\beta_V^N)^\eta (1-\beta_V^N)^{1-\eta}} \left(\frac{w^N}{w^S}\right)^{1-\eta} \right)^{\sigma-1} - 1 \right] r_V^N(\bar{\theta}_O^S) + \chi_V^S \left[\left(\frac{(\beta_V^S)^\eta (1-\beta_V^S)^{1-\eta}}{\beta^\eta (1-\beta)^{1-\eta}} \right)^{\sigma-1} - 1 \right] r_O^S(\bar{\theta}_V^S).
\end{aligned}
$$

Dividing by $r_O^N(\underline{\theta}^*)$ and replacing $r_O^N(\underline{\theta}^*)$ with (55):

$$\bar{r} = \Bigg\{ \left(\frac{\bar{\theta}^*}{\underline{\theta}^*}\right)^{\sigma-1} + \chi_V^{N,*} \left[\left(\frac{\left(\beta_V^N\right)^\eta \left(1-\beta_V^N\right)^{1-\eta}}{\beta^\eta(1-\beta)^{1-\eta}} \right)^{\sigma-1} - 1 \right] \left(\frac{\bar{\theta}_V^{N,*}}{\underline{\theta}^*}\right)^{\sigma-1}$$
$$+ \chi_O^{S,*} \left[\left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)} - \left(\frac{\left(\beta_V^N\right)^\eta \left(1-\beta_V^N\right)^{1-\eta}}{\beta^\eta(1-\beta)^{1-\eta}} \right)^{\sigma-1} \right] \left(\frac{\bar{\theta}_O^{S,*}}{\underline{\theta}^*}\right)^{\sigma-1} \tag{66}$$
$$+ \chi_V^{S,*} \left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)} \left[\left(\frac{\left(\beta_V^S\right)^\eta \left(1-\beta_V^S\right)^{1-\eta}}{\beta^\eta(1-\beta)^{1-\eta}} \right)^{\sigma-1} - 1 \right] \left(\frac{\bar{\theta}_V^{S,*}}{\underline{\theta}^*}\right)^{\sigma-1} \Bigg\} \frac{w^N f_O^N}{1-\alpha[\beta\eta+(1-\beta)(1-\eta)]}.$$

Regarding profits,

$$\begin{aligned}
\bar{\pi} = & \int_{\underline{\theta}^*}^{\theta_V^{N,*}} \pi_O^N(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^*)} d\theta + \int_{\theta_V^{N,*}}^{\theta_O^{S,*}} \pi_V^N(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^*)} d\theta \\
& + \int_{\theta_O^{S,*}}^{\theta_V^{S,*}} \pi_O^S(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^*)} d\theta + \int_{\theta_V^{S,*}}^{\infty} \pi_V^S(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^{n.t.i.})} d\theta - \chi_O^{S,*} w^N (1-\lambda) s^r, \\
= & \pi_O^N(\bar{\theta}^*) + \chi_V^{N,*} \pi_{V^N/O^N}^{prem}(\bar{\theta}_V^{N,*}) + \chi_O^{S,*} \pi_{O^S/V^N}^{prem}(\bar{\theta}_O^{S,*}) + \chi_V^{S,*} \pi_{V^S/O^S}^{prem}(\bar{\theta}_V^{S,*}) - \chi_O^{S,*} w^N (1-\lambda) s^r.
\end{aligned}$$

Expressing profits premiums in terms of $r_O^N(\underline{\theta}^*)$, and substituting with (55), I get:

$$\begin{aligned}
\bar{\pi} = & \left[\left(\frac{\bar{\theta}^*}{\underline{\theta}^*}\right)^{\sigma-1} - 1 \right] w^N f_O^N \\
& + \chi_V^{N,*} \left[\frac{1-\alpha\left[\beta_V^N \eta + (1-\beta_V^N)(1-\eta)\right]}{1-\alpha[\beta\eta+(1-\beta)(1-\eta)]} \left(\frac{\left(\beta_V^N\right)^\eta \left(1-\beta_V^N\right)^{1-\eta}}{\beta^\eta(1-\beta)^{1-\eta}} \right)^{\sigma-1} - 1 \right] \left(\frac{\bar{\theta}_V^{N,*}}{\underline{\theta}^*}\right)^{\sigma-1} w^N f_O^N \\
& + \chi_O^{S,*} \left[\left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)} - \frac{1-\alpha\left[\beta_V^N \eta + (1-\beta_V^N)(1-\eta)\right]}{1-\alpha[\beta\eta+(1-\beta)(1-\eta)]} \left(\frac{\left(\beta_V^N\right)^\eta \left(1-\beta_V^N\right)^{1-\eta}}{\beta^\eta(1-\beta)^{1-\eta}} \right)^{\sigma-1} \right] \left(\frac{\bar{\theta}_O^{S,*}}{\underline{\theta}^*}\right)^{\sigma-1} w^N f_O^N \\
& + \chi_V^{S,*} \left[\frac{1-\alpha\left[\beta_V^S \eta + (1-\beta_V^S)(1-\eta)\right]}{1-\alpha[\beta\eta+(1-\beta)(1-\eta)]} \left(\frac{\left(\beta_V^S\right)^\eta \left(1-\beta_V^S\right)^{1-\eta}}{\beta^\eta(1-\beta)^{1-\eta}} \right)^{\sigma-1} - 1 \right] \left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)} \left(\frac{\bar{\theta}_V^{S,*}}{\underline{\theta}^*}\right)^{\sigma-1} w^N f_O^N \\
& - \chi_V^{N,*} w^N \left(f_V^N - f_O^N\right) - \chi_O^{S,*} w^N \left(f_O^S + (1-\lambda)s^r - f_V^N\right) - \chi_V^{S,*} w^N \left(f_V^S - f_O^S\right).
\end{aligned} \tag{67}$$

FEC. The present value of a final good producer, conditional on successful entry, is:

$$\bar{v} = \int_{\underline{\theta}^{n.t.i.}}^{\infty} v(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^{n.t.i.})} d\theta = \frac{\bar{\pi}^{n.t.i.}}{1-\lambda},$$

and the net value of entry is given by:

$$v^e = [1-G(\underline{\theta}^*)]\bar{v} - w^N s^e = \frac{[1-G(\underline{\theta}^*)]}{1-\lambda}\bar{\pi} - w^N s^e.$$

By FEC, $v^e = 0$, therefore:

$$\bar{\pi} = \frac{(1-\lambda) w^N s^e}{1-G(\underline{\theta}^*)}.$$

Number of active final good producers. The number (mass) of active final good producers is:

$$H^* = \frac{\gamma E}{\bar{r}},$$

with $\bar{r}$ given by equation (66).

B Initial conditions by sector type: Non-tradable intermediate inputs

When the offshoring types are not available for the final good producers, the respective shares $\chi_O^S = \chi_{V_H}^S = \chi_{V_M}^S = 0$. I denote the steady-state values for the economy under such a situation with superscript $n.t.i.$.

B.1 Balanced intensity sectors.

B.1.1 Price index and aggregate consumption index under initial conditions

The price index is given by:

$$(P^{n.t.i.})^{1-\sigma} = H^{n.t.i.} \int_{\underline{\theta}^{n.t.i.}}^{\infty} p_O^N(\theta)^{1-\sigma} \frac{g(\theta)}{1 - G(\underline{\theta}^{n.t.i.})} d\theta,$$

and the aggregate consumption index is:

$$Q^{n.t.i.} = \gamma E (H^{n.t.i.})^{\frac{1}{\sigma-1}} \left[\int_{\underline{\theta}^{n.t.i.}}^{\infty} p_O^N(\theta)^{1-\sigma} \frac{g(\theta)}{1 - G(\underline{\theta}^{n.t.i.})} d\theta \right]^{\frac{1}{\sigma-1}}.$$

Comparing this $n.t.i.$ steady-state conditions with the respective perfect information steady-state with tradable intermediate inputs denoted by $*$, it is easy to see that:

$$\underline{\theta}^{n.t.i.} < \underline{\theta}^* \quad ; \quad P^{n.t.i.} > P^* \quad ; \quad Q^{n.t.i} < Q^*.$$

B.1.2 Zero Cutoff Profit Condition (ZCPC) and Free Entry Condition (FEC)

ZCPC. The final good producer's value function is:

$$v^{n.t.i.}(\theta) = \max\{0; v^{N,n.t.i.}(\theta)\},$$

with

$$v^{N,n.t.i.}(\theta) = \max\left\{0; \sum_{t=0}^{\infty} \lambda^t \pi_O^N(\theta)\right\} = \max\left\{0; \frac{\pi_O^N(\theta)}{1-\lambda}\right\}.$$

By the ZCPC, the market productivity cutoff, denoted as $\underline{\theta}^{n.t.i.}$, is implicitly defined by:

$$\frac{\pi_O^N(\underline{\theta}^{n.t.i.})}{1-\lambda} = 0 \quad \Rightarrow \quad \underline{\theta}^{n.t.i.} = (\gamma E)^{\frac{\sigma}{1-\sigma}} Q^{n.t.i.} \left[\frac{w^N f_O^N}{\psi_O^N(\eta)}\right]^{\frac{1}{\sigma-1}}.$$

Using the ZCPC, the revenues of the market productivity cutoff final good producers is:

$$\pi_O^N(\underline{\theta}^{n.t.i.}) = 0 \quad \Rightarrow \quad r_O^N(\underline{\theta}^{n.t.i.}) = \frac{w^N f_O^N}{1 - \alpha[\beta\eta + (1-\beta)(1-\eta)]}. \tag{68}$$

The revenues of a final good producer with mean productivity is:

$$\frac{r_O^N(\bar{\theta}^{n.t.i.})}{r_O^N(\underline{\theta}^{n.t.i.})} = \left(\frac{\bar{\theta}^{n.t.i.}}{\underline{\theta}^{n.t.i.}}\right)^{\sigma-1} \quad \Rightarrow \quad r_O^N(\bar{\theta}^{n.t.i.}) = \left(\frac{\bar{\theta}^{n.t.i.}}{\underline{\theta}^{n.t.i.}}\right)^{\sigma-1} r_O^N(\underline{\theta}^{n.t.i.}). \tag{69}$$

Using expression from above, the average revenue in the initial conditions is:

$$\bar{r}^{n.t.i.} \equiv r_O^N(\bar{\theta}^{n.t.i.}) = \left(\frac{\bar{\theta}^{n.t.i.}}{\underline{\theta}^{n.t.i.}}\right)^{\sigma-1} \frac{w^N f_O^N}{1-\alpha[\beta\eta+(1-\beta)(1-\eta)]},$$

and the ZCPC leads to:

$$\begin{aligned}\bar{\pi}^{n.t.i.} \equiv \pi_O^N(\bar{\theta}^{n.t.i.}) &= r_O^N(\bar{\theta}^{n.t.i.})\left[1-\alpha[\beta\eta+(1-\beta)(1-\eta)]\right] - w^N f_O^N,\\ &= \left[\left(\frac{\bar{\theta}^{n.t.i.}}{\underline{\theta}^{n.t.i.}}\right)^{\sigma-1} - 1\right] w^N f_O^N.\end{aligned}$$

FEC. All the final good producers, except for those at the market productivity cutoff, earn positive profits. Therefore, given the positive expected profits, final good producers decide to sink the entry cost s^e and enter into the market.

The present value of a final good producer, conditional on successful entry, is:

$$\bar{v} = \int_{\underline{\theta}^{n.t.i.}}^{\infty} v(\theta)\frac{g(\theta)}{1-G(\underline{\theta}^{n.t.i.})}d\theta = \frac{\bar{\pi}^{n.t.i.}}{1-\lambda},$$

and the net value of entry is given by:

$$v^e = [1-G(\underline{\theta}^{n.t.i.})]\bar{v} - w^N s^e = \frac{[1-G(\underline{\theta}^{n.t.i.})]}{1-\lambda}\bar{\pi}^{n.t.i.} - w^N s^e.$$

By FEC, $v^e = 0$, therefore:

$$\bar{\pi}^{n.t.i.} = \frac{(1-\lambda)w^N s^e}{1-G(\underline{\theta}^{n.t.i.})}. \tag{70}$$

Number of active final good producers. The number (mass) of active final good producers is:

$$H^{n.t.i.} = \frac{\gamma E}{\bar{r}^{n.t.i.}} = \frac{\gamma E\left[1-\alpha[\beta\eta+(1-\beta)(1-\eta)]\right]}{\bar{\pi}^{n.t.i.} + w^N f_O^N},$$

with $\bar{\pi}^{n.t.i.}$ from equation (70).

B.2 H-intensive and M-intensive sectors.

As before, V refers to V_H when the sector is H-intensive, and to V_M when the sector is M-intensive.

B.2.1 Price index and aggregate consumption index under initial conditions

The price index is:

$$\begin{aligned}(P^{n.t.i.})^{1-\sigma} =& H^{n.t.i.}\left[\int_{\underline{\theta}^{n.t.i.}}^{\infty} p_O^N(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta}^{n.t.i.})}d\theta\right.\\ &\left. + \chi_V^{N,n.t.i.}\int_{\theta_V^{N,n.t.i.}}^{\infty}[p_V^N(\theta)^{1-\sigma} - p_O^N(\theta)^{1-\sigma}]\frac{g(\theta)}{1-G(\theta_V^{N,n.t.i.})}d\theta\right],\end{aligned}$$

Equivalently, the price index can be expressed as:

$$(P^{n.t.i.})^{1-\sigma} = \left(P^{O^N,n.t.i.}\right)^{1-\sigma} + \chi_V^N\left[\left(P^{V^N,n.t.i.}\right)^{1-\sigma} - \left(P^{V^N,n.t.i.|O^N}\right)^{1-\sigma}\right],$$

with

$$P^{O^N,n.t.i.} = \left[\int_{\underline{\theta}^{n.t.i.}}^{\infty} \left(p_O^N(\theta)\right)^{1-\sigma} \frac{g(\theta)}{1-G(\underline{\theta}^{n.t.i.})} d\theta\right]^{\frac{1}{1-\sigma}}, P^{V^N,n.t.i.} = \left[\int_{\theta_V^{N,n.t.i.}}^{\infty} \left(p_V^N(\theta)\right)^{1-\sigma} \frac{g(\theta)}{1-G(\theta_V^{N,n.t.i.})} d\theta\right]^{\frac{1}{1-\sigma}},$$

and

$$P^{V^N,n.t.i.|O^N} = \left[\int_{\theta_V^{N,n.t.i.}}^{\infty} \left(p_O^N(\theta)\right)^{1-\sigma} \frac{g(\theta)}{1-G(\theta_V^{N,n.t.i.})} d\theta\right]^{\frac{1}{1-\sigma}}.$$

The aggregate consumption index is:

$$\begin{aligned} Q^{n.t.i.} =& \gamma E(H^{n.t.i.})^{\frac{1}{\sigma-1}} \left[\int_{\underline{\theta}^{n.t.i.}}^{\infty} p_O^N(\theta)^{1-\sigma} \frac{g(\theta)}{1-G(\underline{\theta}^{n.t.i.})} d\theta \right. \\ & \left. + \chi_V^{N,n.t.i.} \int_{\theta_V^{N,n.t.i.}}^{\infty} [p_V^N(\theta)^{1-\sigma} - p_O^N(\theta)^{1-\sigma}] \frac{g(\theta)}{1-G(\theta_V^{N,n.t.i.})} d\theta\right]^{\frac{1}{\sigma-1}}, \end{aligned}$$

Comparing the initial conditions with the respective perfect information equilibrium, I get:

$$\underline{\theta}^{n.t.i.} < \underline{\theta}^* \quad ; \quad \theta_V^{N,n.t.i.} < \theta_V^{N,*} \quad ; \quad P^{n.t.i.} > P^* \quad ; \quad Q^{n.t.i} < Q^*.$$

B.2.2 Zero Cutoff Profit Condition (ZCPC) and Free Entry Condition (FEC)

ZCPC. By the ZCPC, the market productivity cutoff, denoted as $\underline{\theta}^{n.t.i.}$, is implicitly defined by:

$$\frac{\pi_O^N(\underline{\theta}^{n.t.i.})}{1-\lambda} = 0 \quad \Rightarrow \quad \underline{\theta}^{n.t.i.} = (\gamma E)^{\frac{\sigma}{1-\sigma}} Q^{n.t.i.} \left[\frac{w^N f_O^N}{\psi_O^N(\eta)}\right]^{\frac{1}{\sigma-1}}.$$

and the revenues of the market productivity cutoff final good producers are:

$$\pi_O^N(\underline{\theta}^{n.t.i.}) = 0 \quad \Rightarrow \quad r_O^N(\underline{\theta}^{n.t.i.}) = \frac{w^N f_O^N}{1-\alpha[\beta\eta + (1-\beta)(1-\eta)]}. \tag{71}$$

The average revenue in the initial conditions is:

$$\begin{aligned} \bar{r}^{n.t.i.} &= \int_{\underline{\theta}^{n.t.i.}}^{\theta_V^{N,n.t.i.}} r_O^N(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^{n.t.i.})} d\theta + \int_{\theta_V^{N,n.t.i.}}^{\infty} r_V^N(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^{n.t.i.})} d\theta, \\ &= r_O^N(\bar{\theta}^{n.t.i.}) + \chi_V^{N,n.t.i.} \left[\left(\frac{(\beta_V^N)^{\eta} - (1-\beta_V^N)^{1-\eta}}{\beta^{\eta}(1-\beta)^{1-\eta}}\right)^{\sigma-1} - 1\right] r_O^N(\bar{\theta}_V^{N,n.t.i.}). \end{aligned}$$

Dividing by $r_O^N(\underline{\theta}^{n.t.i.})$ and replacing with (71):

$$\bar{r}^{n.t.i.} = \left[\left(\frac{\bar{\theta}^{n.t.i.}}{\underline{\theta}^{n.t.i.}}\right)^{\sigma-1} + \chi_V^{N,n.t.i.} \left[\left(\frac{(\beta_V^N)^{\eta} - (1-\beta_V^N)^{1-\eta}}{\beta^{\eta}(1-\beta)^{1-\eta}}\right)^{\sigma-1} - 1\right] \left(\frac{\bar{\theta}_V^{N,n.t.i.}}{\underline{\theta}^{n.t.i.}}\right)^{\sigma-1}\right] \frac{w^N f_O^N}{1-\alpha[\beta\eta + (1-\beta)(1-\eta)]}$$

Thus, by the ZCPC:

$$\bar{\pi}^{n.t.i.} = \int_{\underline{\theta}^{n.t.i.}}^{\theta_V^{N,n.t.i.}} \pi_O^N(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^{n.t.i.})} d\theta + \int_{\theta_V^{N,n.t.i.}}^{\infty} \pi_V^N(\theta) \frac{g(\theta)}{1-G(\underline{\theta}^{n.t.i.})} d\theta = \pi_O^N(\bar{\theta}^{n.t.i.}) + \chi_V^{N,n.t.i.} \pi_{V^N/O^N}^{prem}(\bar{\theta}_V^{N,n.t.i.}).$$

Replacing profit and profit premium with respective expressions, and using equations (69) and (68), I get:

$$\begin{aligned} \bar{\pi}^{n.t.i.} =& \left[\left(\frac{\bar{\theta}^{n.t.i.}}{\underline{\theta}^{n.t.i.}}\right)^{\sigma-1} - 1\right] w^N f_O^N + \\ & \chi_V^{N,n.t.i.} \left(\frac{\bar{\theta}_V^{N,n.t.i.}}{\underline{\theta}^{n.t.i.}}\right)^{\sigma-1} w^N f_O^N \left[\left(\frac{(\beta_V^N)^{\eta}(1-\beta_V^N)^{1-\eta}}{\beta^{\eta}(1-\beta)^{1-\eta}}\right)^{\sigma-1} \frac{[1-\alpha[\beta_V^N\eta + (1-\beta_V^N)(1-\eta)]]}{[1-\alpha[\beta\eta + (1-\beta)(1-\eta)]]} - 1\right] \\ & - \chi_V^{N,n.t.i.} w^N [f_V^N - f_O^N]. \end{aligned}$$

FEC. All the final good producers, except for those at the market productivity cutoff, earn positive profits. Therefore, given the positive expected profits, the final good producers decide to sink the entry cost s^e and enter into the market.

The present value of a final good producer, conditional on successful entry, is:

$$\bar{v} = \int_{\underline{\theta}^{n.t.i.}}^{\infty} v(\theta) \frac{g(\theta)}{1 - G(\underline{\theta}^{n.t.i.})} d\theta = \frac{\overline{\pi}^{n.t.i.}}{1 - \lambda},$$

and the net value of entry is given by:

$$v^e = [1 - G(\underline{\theta}^{n.t.i.})]\bar{v} - w^N s^e = \frac{[1 - G(\underline{\theta}^{n.t.i.})]}{1 - \lambda} \overline{\pi}^{n.t.i.} - w^N s^e.$$

By FEC, $v^e = 0$, therefore:

$$\overline{\pi}^{n.t.i.} = \frac{(1 - \lambda) w^N s^e}{1 - G(\underline{\theta}^{n.t.i.})}.$$

Number of active final good producers. The number (mass) of active final good producers is:

$$H^{n.t.i.} = \frac{\gamma E}{\overline{r}^{n.t.i.}} = \frac{\gamma E \left[1 - \alpha[\beta\eta + (1 - \beta)(1 - \eta)]\right]}{\left[\left(\frac{\bar{\theta}^{n.t.i.}}{\underline{\theta}^{n.t.i.}}\right)^{\sigma-1} + \chi_V^{N,n.t.i.} \left[\left(\frac{(\beta_V^N)^{\eta} - (1 - \beta_V^N)^{1-\eta}}{\beta^{\eta}(1-\beta)^{1-\eta}}\right)^{\sigma-1} - 1\right] \left(\frac{\bar{\theta}_V^{N,n.t.i.}}{\underline{\theta}^{n.t.i.}}\right)^{\sigma-1}\right] w^N f_O^N}.$$

C Uncertainty - Dynamic model: Sectoral equilibrium path

C.1 Proofs: Bayesian learning mechanism

From the "physical" state, final good producers in North receive information about $\theta_{k,t}^S$ for $k = O, V_H, V_M$, i.e. the least productive producers sourcing under type k. With this information, they compute the respective $f_{k,t}^S$.

Using Bayes' rule, the posterior at period t for type k is given by:

$$Y(f_k^S | f_k^S \leq f_{k,t}^S) = \frac{Y(f_k^S | f_k^S \leq f_{k,t-1}^S) Y(f_{k,t}^S | f_k^S)}{Y(f_{k,t}^S | f_k^S \leq f_{k,t-1}^S)},$$

where $Y(f_k^S | f_k^S \leq f_{k,t-1}^S)$ refers to the prior distribution at period t, $Y(f_{k,t}^S | f_k^S)$denotes the likelihood functions, and the denominator is the scaling factor.

As it is shown in Larch and Navarro (2021), the likelihood function takes the form:

$$Y(f_{k,t}^S | f_k^S) = \begin{cases} 1 & \text{if } f_{k,t}^S \geq f_k^S, \\ 0 & \text{if } f_{k,t}^S < f_k^S. \end{cases}$$

Therefore, the posterior in t for type k becomes a truncation of the upper bound of the prior:

$$Y(f_k^S | f_k^S \leq f_{k,t}^S) = \frac{Y(f_k^S | f_k^S \leq f_{k,t-1}^S)}{Y(f_{k,t}^S | f_k^S \leq f_{k,t-1}^S)}.$$

From equation (12), the producers hold the prior beliefs in type k as long as any producer offshore under that type. In other words, they are not able to update their priors if no new information is revealed by some of their competitors. Once at least one producer offshores under k new information reveals to the other still under domestic sourcing and the update of the prior beliefs follows the mechanism described above. The updating of type k stops once the true value f_k^S is revealed.

C.2 Proof: OSLA rule as optimal policy

I follow the same procedure as Larch and Navarro (2021). Therefore, I show only the main steps of the proofs, and highlight the aspects where they differ significantly from each other.

Consider the Bellman's equation (13). The goal of this section is to find the optimal waiting policy, i.e. how many periods is optimal to wait given the information set at t. By policy iteration, I show that, in expectation at t, waiting for one period and exploring in the next one, i.e. the One-Step-Look-Ahead (OSLA) rule, dominates waiting for longer periods.

I define $V_{k,t}^{w,1}(\theta;.), ..., V_{k,t}^{w,n}(\theta;.)$ as the value of waiting in t for $1, ..., n$ periods, respectively. I define k'^N as the current organisational form of the producer taking the decision, i.e. $k'^N = O^N, V_H^N, V_M^N$.

The value of waiting is:

$$\begin{aligned}
V_{k,t}^{w,1}(\theta;\theta_t,\theta_{t+1}) =& 0 + \frac{\left[Y(f_{k,t}^S) - Y(f_{k,t+1}^S)\right]}{Y(f_{k,t}^S)}\lambda\mathbb{E}_t\left[\max\left\{0; \frac{\pi_{k^S/k'^N}^{prem}(\theta)}{1-\lambda} - w^N s^r\right\}\Big| f_{k,t+1}^S < f^S \leq f_{k,t}^S\right] \\
&+ \frac{Y(f_{k,t+1}^S)}{Y(f_{k,t}^S)}\lambda\left[\mathbb{E}_t\left[\max\left\{0; \sum_{\tau=t+1}^{\infty}\lambda^{\tau-t-1}\pi_{k^S/k'^N,\tau}^{prem}(\theta)\right\}\Big| f_k^S \leq f_{k,t+1}^S\right] - w^N s^r\right], \\
&\vdots \\
V_{k,t}^{w,n}(\theta;\theta_t,\theta_{t+n}) =& 0 + \frac{\left[Y(f_{k,t}^S) - Y(f_{k,t+n}^S)\right]}{Y(f_{k,t}^S)}\lambda^n\mathbb{E}_t\left[\max\left\{0; \frac{\pi_{k^S/k'^N}^{prem}(\theta)}{1-\lambda} - w^N s^r\right\}\Big| f_{k,t+n}^S < f_k^S \leq f_{k,t}^S\right] \\
&+ \frac{Y(f_{k,t+n}^S)}{Y(f_{k,t}^S)}\lambda^n\left[\mathbb{E}_t\left[\max\left\{0; \sum_{\tau=t+n}^{\infty}\lambda^{\tau-t-n}\pi_{k^S/k'^N,\tau}^{prem}(\theta)\right\}\Big| f_k^S \leq f_{k,t+n}^S\right] - w^N s^r\right].
\end{aligned}$$

If the waiting period goes to infinity:

$$\lim_{n\to\infty} V_{k,t}^{w,n}(\theta;\theta_t,\theta_{t+n}) = 0.$$

As in Larch and Navarro (2021), I concentrate the analysis on the case where there is a trade-off in the decision. In other words, in the case of producers with a non-negative value of offshoring under type k in period t[103]. Therefore, the value of waiting for these producers for any period $n = 1, ..., \infty$ is non-negative, i.e. $V_{k,t}^{w,n}(\theta;.) \geq 0\ \forall n \geq 1$.

[103]When the value of offshoring is negative, the producer does not face any trade-off in the decision.

Following Segura-Cayuela and Vilarrubia (2008) and Larch and Navarro (2021), I consider the marginal producer for type k who compares the value of exploring the offshoring potential under k with the value of waiting for one period and explore in the next one, i.e. $\mathcal{D}_{k,t}(\theta;.) = V^{o}_{k,t}(\theta;.) - V^{w,1}_{k,t}(\theta;.) = 0$. The intuition of the proof is as follows and makes use of assumption A.3. The value of waiting for n periods before exploring the offshoring potential under type k falls at a rate λ^n for producers that weakly prefer exploring now than waiting for one period. Since $\lambda < 1$, waiting for any number of periods $n > 1$ is dominated by waiting for one period. In other words, if in expectation at t waiting for one period does not convince a producer to wait, waiting for two or more periods is less preferred, as the new information revealed every further period is less. Therefore, the equilibrium path is defined by the final good producers deciding between exploring offshoring in k in t or waiting for one period.

I continue with the formal proof. I start by comparing the value of waiting for one period with the value of waiting for two periods, i.e. $V^{w,1}_{k,t}(\theta;.); V^{w,2}_{k,t}(\theta;.)$. As mentioned above, I focus the analysis on the marginal producer, i.e. the indifferent one between explore offshoring under k today or wait for one period.[104]

$$
\begin{aligned}
\mathcal{D}_{k,t}(\theta;\theta_t,\tilde{\theta}_{t+1}) &= V^{o}_{k,t}(\theta;\theta_t) - V^{w,1}_{k,t}(\theta;\theta_t,\tilde{\theta}_{t+1}) = 0, \\
&= \max\left\{0;\mathbb{E}_t\left[\pi^{prem}_{k^S/k'^N,t}(\theta)\middle| f^S_k \le f^S_{k,t}\right]\right\} - w^N s^r\left[1-\lambda\frac{Y(f^S_{k,t+1})}{Y(f^S_{k,t})}\right] \\
&+ \frac{[Y(f^S_{k,t}) - Y(f^S_{k,t+1})]}{Y(f^S_{k,t})}\lambda\mathbb{E}_t\left[\max\left\{0;\frac{\pi^{prem}_{k^S/k'^N}(\theta)}{1-\lambda}\right\}\right. \\
&\left. - \max\left\{0;\frac{\pi^{prem}_{k^S/K'^N}(\theta)}{1-\lambda} - w^N s^r\right\}\middle| f^S_{k,t+1} < f^S_k \le f^S_{k,t}\right] = 0.
\end{aligned}
$$

Equivalently, the expression of the trade-off function for waiting for two periods is given by:

$$
\begin{aligned}
\mathcal{D}_{k,t}(\theta;\theta_t,\tilde{\theta}_{t+2}) &= V^{0}_{k,t}(\theta;\theta_t) - V^{w,2}_{k,t}(\theta;\theta_t,\tilde{\theta}_{t+2}), \\
&= \max\left\{0;\mathbb{E}_t\left[\pi^{prem}_{k^S/k'^N,t}(\theta) + \lambda\pi^{prem}_{k^S/k'^N,t+1}(\theta)\middle| f^S_k \le f^S_{k,t}\right]\right\} - w^N s^r\left[1-\lambda^2\frac{Y(f^S_{k,t+2})}{Y(f^S_{k,t})}\right] \\
&+ \frac{[Y(f^S_{k,t}) - Y(f^S_{k,t+2})]}{Y(f^S_{k,t})}\lambda^2\mathbb{E}_t\left[\max\left\{0;\frac{\pi^{prem}_{k^S/k'^N}(\theta)}{1-\lambda}\right\}\right. \\
&\left. - \max\left\{0;\frac{\pi^{prem}_{k^S/k'^N}(\theta)}{1-\lambda} - w^N s^r\right\}\middle| f^S_{k,t+2} < f^S_k \le f^S_{k,t}\right].
\end{aligned}
$$

I consider the case in which the third term of the RHS is zero for both trade-off functions.[105] There-

[104] I show the derivation of the trade-off function in the main part of the paper, and the respective proofs are in Appendix C.3.

[105] This assumption allows me to focus on the most restrictive condition. It can be easily shown that if the value of waiting for one period is optimal in this case, it is also optimal in the other cases.

fore, the trade-off functions become:

$$\mathcal{D}_{k,t}(\theta;\theta_t,\tilde{\theta}_{t+1}) = \mathbb{E}_t\left[\pi^{prem}_{k^S/k'^N,t}(\theta)\Big|f^S_k \leq f^S_{k,t}\right] - w^N s^r\left[1-\lambda\frac{Y(f^S_{k,t+1})}{Y(f^S_{k,t})}\right],$$

$$\mathcal{D}_{k,t}(\theta;\theta_t,\tilde{\theta}_{t+2}) = \mathbb{E}_t\left[\pi^{prem}_{k^S/k'^N,t}(\theta)+\lambda\pi^{prem}_{k^S/k'^N,t+1}(\theta)\Big|f^S_k \leq f^S_{k,t}\right] - w^N s^r\left[1-\lambda^2\frac{Y(f^S_{k,t+2})}{Y(f^S_{k,t})}\right].$$

If the value of waiting for one period dominates the value of waiting for two periods, thence:

$$V^0_t(\theta;.) - V^{w,1}_t(\theta;.) - \left[V^0_t(\theta;.) - V^{w,2}_t(\theta;.)\right] \overset{!}{<} 0 \Leftrightarrow \quad V^{w,2}_t(\theta;.) - V^{w,1}_t(\theta;.) \overset{!}{<} 0.$$

By replacing with the respective trade-off functions in this last expression, I have:

$$\mathbb{E}_t\left[\pi^{prem}_{k^S/k'^N,t+1}(\theta)\Big|f^S_k \leq f^S_{k,t}\right] \overset{!}{>} w^N s^r\left[\frac{Y(f^S_{k,t+1})}{Y(f^S_{k,t})} - \lambda\frac{Y(f^S_{k,t+2})}{Y(f^S_{k,t})}\right].$$

From the marginal producer condition above, I know:

$$\mathbb{E}_t\left[\pi^{prem}_{k^S/k'^N,t}(\theta)\Big|f^S_k \leq f^S_{k,t}\right] = w^N s^r\left[1-\lambda\frac{Y(f^S_{k,t+1})}{Y(f^S_{k,t})}\right].$$

By Assumption A.3,

$$1-\lambda Y\left(f^S_{k,t+1}|f^S_k \leq f^S_{k,t}\right) > Y\left(f^S_{k,t+1}|f^S_k \leq f^S_{k,t}\right) - \lambda Y\left(f^S_{k,t+2}|f^S_k \leq f^S_{k,t}\right),$$

and thus,

$$\mathbb{E}_t\left[\pi^{prem}_{k^S/k'^N,t+1}(\theta)\Big|f^S_k \leq f^S_{k,t}\right] > w^N s^r\left[\frac{Y(f^S_{k,t+1})}{Y(f^S_{k,t})} - \lambda\frac{Y(f^S_{k,t+2})}{Y(f^S_{k,t})}\right] \Rightarrow \quad V^{w,2}_{k,t}(\theta;.) - V^{w,1}_{k,t}(\theta;.) < 0.$$

From the result above, it is easy to see that $V^{w,n}_{k,t}(\theta;.) > V^{w,n+1}_{k,t}(\theta;.)$ for any period n. Therefore,

$$V^{w,1}_{k,t}(\theta;.) > V^{w,2}_{k,t}(\theta;.) > .... > V^{w,n}_{k,t}(\theta;.).$$

In other words, for those producers in a trade-off condition, in expectation at t, waiting for one period dominates waiting for longer periods.[106]

C.3 Trade-off function

$$\mathcal{D}_{k,t}(\theta;\theta_t,\tilde{\theta}_{t+1}) = V^o_{k,t}(\theta;\theta_t,\tilde{\theta}_{t+1}) - V^{w,1}_{k,t}(\theta;\theta_t,\tilde{\theta}_{t+1}).$$

Decomposing the value of offshoring,

$$\begin{aligned}V^o_{k,t}(\theta;.) = &\max\left\{0;\mathbb{E}_t\left[\pi^{prem}_{k^S/k'^N,t}(\theta)\Big|f^S_k \leq f^S_{k,t}\right]\right\} - w^N s^r \\ &+ \frac{[Y(f^S_{k,t}) - Y(f^S_{k,t+1})]}{Y(f^S_{k,t})}\lambda\mathbb{E}_t\left[\max\left\{0;\frac{\pi^{prem}_{k^S/k'^N}(\theta)}{1-\lambda}\right\}\Big|f^S_{k,t+1} < f^S_k \leq f^S_{k,t}\right] \\ &+ \frac{Y(f^S_{k,t+1})}{Y(f^S_{k,t})}\lambda\mathbb{E}_t\left[\max\left\{0;\sum_{\tau=t+1}^{\infty}\lambda^{\tau-t-1}\pi^{prem}_{k^S/k'^N,\tau}(\theta)\right\}\Big|f^S_k \leq f^S_{k,t+1}\right],\end{aligned}$$

[106] Following similar steps as Larch and Navarro (2021), it is possible to there is no degeneration in producers' choices when $V^o_t(\theta;.) < 0$. In other words, there is no reversion of the trade-off function sign under this situation, so producers will never find it optimal to explore offshoring under k in t when $V^o_{k,t}(\theta;.) < 0$.

where $\frac{[Y(f^S_{k,t})-Y(f^S_{k,t+1})]}{Y(f^S_{k,t})}$ denotes the probability that f^S_k is revealed in period t, while $\frac{Y(f^S_{k,t+1})}{Y(f^S_{k,t})}$ indicates the probability it is not revealed but the uncertainty reduces given the new information flow.

Introducing $f^S_k(\theta)$,

$$\begin{aligned}V^o_{k,t}(\theta;.) =& \max\left\{0;\mathbb{E}_t\left[\pi^{prem}_{k^S/k'^N,t}(\theta)\Big|f^S_k \leq f^S_{k,t}\right]\right\} - w^N s^r \\ &+ \frac{[Y(f^S_{k,t}) - Y(f^S_k(\theta))]}{Y(f^S_{k,t})}\lambda 0 \\ &+ \frac{[Y(f^S_k(\theta)) - Y(f^S_{k,t+1})]}{Y(f^S_{k,t})}\lambda\mathbb{E}_t\left[\frac{\pi^{prem}_{k^S/k'^N}(\theta)}{1-\lambda}\Big|f^S_{k,t+1} < f^S_k \leq f^S_k(\theta)\right] \\ &+ \frac{Y(f^S_{k,t+1})}{Y(f^S_{k,t})}\lambda\mathbb{E}_t\left[\max\left\{0;\sum_{\tau=t+1}^{\infty}\lambda^{\tau-t-1}\pi^{prem}_{k^S/k'^N,\tau}(\theta)\right\}\Big|f^S_k \leq f^S_{k,t+1}\right].\end{aligned}$$

The probability of f^S_k being revealed above the maximum affordable fixed cost for the producer θ is $\frac{[Y(f^S_{k,t})-Y(f^S_k(\theta))]}{Y(f^S_{k,t})}$, and the probability of being revealed below is $\frac{[Y(f^S_k(\theta))-Y(f^S_{k,t+1})]}{Y(f^S_{k,t})}$.

$$\begin{aligned}\Rightarrow V^o_{k,t}(\theta;.) =& \max\left\{0;\mathbb{E}_t\left[\pi^{prem}_{k^S/k'^N,t}(\theta)\Big|f^S_k \leq f^S_{k,t}\right]\right\} - w^N s^r \\ &+ \frac{[Y(f^S_k(\theta)) - Y(f^S_{k,t+1})]}{Y(f^S_{k,t})}\lambda\mathbb{E}_t\left[\frac{\pi^{prem}_{k^S/k'^N}(\theta)}{1-\lambda}\Big|f^S_{k,t+1} < f^S_k \leq f^S_k(\theta)\right] \\ &+ \frac{Y(f^S_{k,t+1})}{Y(f^S_{k,t})}\lambda\mathbb{E}_t\left[\sum_{\tau=t+1}^{\infty}\lambda^{\tau-t-1}\pi^{prem}_{k^S/k'^N,\tau}(\theta)\Big|f^S_k \leq f^S_{k,t+1}\right].\end{aligned}$$

Decomposition in an equivalent way the value of waiting one period,

$$\begin{aligned}V^{w,1}_{k,t}(\theta;.) =& 0 + \frac{\left[Y(f^S_{k,t}) - Y(f^S_{k,t+1})\right]}{Y(f^S_{k,t})}\lambda\mathbb{E}_t\left[\max\left\{0;\frac{\pi^{prem}_{k^S/k'^N}(\theta)}{1-\lambda} - w^N s^r\right\}\Big|f^S_{k,t+1} < f^S_k \leq f^S_{k,t}\right] \\ &+ \frac{Y(f^S_{k,t+1})}{Y(f^S_{k,t})}\lambda\left[\mathbb{E}_t\left[\max\left\{0;\sum_{\tau=t+1}^{\infty}\lambda^{\tau-t-1}\pi^{prem}_{k^S/k'^N,\tau}(\theta)\right\}\Big|f^S_k \leq f^S_{k,t+1}\right] - w^N s^r\right],\end{aligned}$$

$$\begin{aligned}\Rightarrow V^{w,1}_{k,t}(\theta;.) =& \frac{\left[Y(f^S_k(\theta)) - Y(f^S_{k,t+1})\right]}{Y(f^S_{k,t})}\lambda \\ &\times\mathbb{E}_t\left[\max\left\{0;\frac{\pi^{prem}_{k^S/k'^N}(\theta)}{1-\lambda} - w^N s^r\right\}\Big|f^S_{k,t+1} < f^S_k \leq f^S_k(\theta)\right] \\ &+ \frac{Y(f^S_{k,t+1})}{Y(f^S_{k,t})}\lambda\left[\mathbb{E}_t\left[\sum_{\tau=t+1}^{\infty}\lambda^{\tau-t-1}\pi^{prem}_{k^S/k'^N,\tau}(\theta)\Big|f^S_k \leq f^S_{k,t+1}\right] - w^N s^r\right].\end{aligned}$$

Replacing the value of offshoring and the value of waiting for one period in the trade off function gives the following equivalent expression,

$$\begin{aligned}\mathcal{D}_{k,t}(\theta;.) =& \max\left\{0;\mathbb{E}_t\left[\pi^{prem}_{k^S/k'^N,t}(\theta)\Big|f^S_k \leq f^S_{k,t}\right]\right\} - w^N s^r\left[1-\lambda\frac{Y(f^S_{k,t+1})}{Y(f^S_{k,t})}\right] \\ &+ \frac{[Y(f^S_k(\theta)) - Y(f^S_{k,t+1})]}{Y(f^S_{k,t})}\lambda\mathbb{E}_t\Bigg[\frac{\pi^{prem}_{k^S/k'^N}(\theta)}{1-\lambda} \\ &- \max\left\{0;\frac{\pi^{prem}_{k^S/k'^N}(\theta)}{1-\lambda} - w^N s^r\right\}\Big|f^S_{k,t+1} < f^S_k \leq f^S_k(\theta)\Bigg].\end{aligned}$$

By Proposition 1, the probability of f_k^S being revealed below $f_k^S(\theta)$ while producer θ is waiting is zero. If it would not be zero, this means that a final good producer with a lower productivity (i.e. $\tilde{\theta}_{t+1} < \theta$) has tried offshoring before the producer θ, which is not possible due to Proposition 1.

Therefore, the trade off function becomes:

$$\mathcal{D}_{k,t}(\theta;\theta_t,\tilde{\theta}_{t+1}) = \max\left\{0;\mathbb{E}_t\left[\pi^{prem}_{k^S/k'^N,t}(\theta)\Big|f_k^S \leq f_{k,t}^S\right]\right\} - w^N s^r\left[1-\lambda\frac{Y(f_{k,t+1}^S)}{Y(f_{k,t}^S)}\right].$$

C.4 Balanced-intensity sectors: The trade-off function and equilibrium paths.

Outsourcing dominates integration for both domestic and offshoring firms. Thence, when the final good producers must decide whether to explore the offshoring potential or wait, they compare the profit they earn under domestic outsourcing with the expected profits under arm's length trade.

The trade-off function, which drives the offshoring exploration decision, is given by:

$$\mathcal{D}_{O,t}(\theta;\theta_t^S,\tilde{\theta}_{t+1}^S) = \max\left\{0;\mathbb{E}_t\left[\pi^{prem}_{O^S/O^N,t}(\theta)\Big|f_O^S \leq f_{O,t}^S\right]\right\} - w^N s^r\left[1-\lambda\frac{Y(f_{O,t+1}^S)}{Y(f_{O,t}^S)}\right]. \tag{72}$$

The least productive final good producer that explores the offshoring potential in period t, i.e. $\tilde{\theta}_{t+1}^S = \tilde{\theta}_{O,t+1}^S$, is defined by Lemma Bint-2.

Lemma Bint-2 (Per-period offshoring exploration productivity cutoff) *The offshoring exploration productivity cutoff at any period t is given by:*

$$\tilde{\theta}_{O,t+1}^S = (\gamma E)^{\frac{\sigma}{1-\sigma}}\tilde{Q}_t\left[\frac{w^N\left[\mathbb{E}(f_O^S|f_O^S \leq f_{O,t}^S) - f_O^N + s^r\left(1-\lambda\frac{Y(f_{O,t+1}^S)}{Y(f_{O,t}^S)}\right)\right]}{\psi_O^S(\eta)-\psi_O^N(\eta)}\right]^{\frac{1}{\sigma-1}}.$$

Proof of Lemma Bint-2. The offshoring exploration productivity cutoff at any period t, $\tilde{\theta}_{t+1}^S = \tilde{\theta}_{O,t+1}^S$, is defined as the fixed point in the trade-off function:

$$\mathcal{D}_{O,t}(\tilde{\theta}_{t+1};\theta_t,\tilde{\theta}_{t+1}) = 0 \quad\Rightarrow\quad \mathbb{E}_t[\pi^{prem}_{O^S/O/N,t}(\tilde{\theta}_{t+1})|f_O^S \leq f_{O,t}^S] = w^N s^r\left[1-\lambda\frac{Y(\tilde{f}_{O,t+1}^S)}{Y(f_{O,t}^S)}\right].$$

The RHS represents the gains from waiting, while the LHS denotes the costs from waiting. Therefore, the offshoring exploration productivity cutoff is given by the indifferent producer.

Substituting $\pi_t^{S,prem}(\tilde{\theta}_{t+1})$ with its expression,

$$\tilde{\theta}_{t+1}^{\sigma-1}(\gamma E)^{\sigma}\tilde{Q}_{t+1}^{1-\sigma}[\psi_O^S(\eta)-\psi_O^N(\eta)] = w^N\left[\mathbb{E}_t(f_O^S|f_O^S \leq f_{O,t}^S) - f_O^N + s^r\left(1-\lambda\frac{Y(\tilde{f}_{O,t+1}^S)}{Y(f_{O,t}^S)}\right)\right],$$

$$\tilde{\theta}_{t+1} = (\gamma E)^{\frac{\sigma}{1-\sigma}}\tilde{Q}_{t+1}\left[\frac{w^N\left[\mathbb{E}_t(f_O^S|f_O^S \leq f_{O,t}^S) - f_O^N + s^r\left(1-\lambda\frac{Y(\tilde{f}_{O,t+1}^S)}{Y(f_{O,t}^S)}\right)\right]}{\psi_O^S(\eta)-\psi_O^N(\eta)}\right]^{\frac{1}{\sigma-1}}.$$

□

C.4.1 Convergence: Long-run properties of the trade-off function.

The steady-states of the Balanced-intensity sectors characterised by Lemma Bint-4 are the result of the fixed point of the trade-off function defined by:

$$\mathcal{D}_{O,\infty}(\theta_{O,\infty};\theta_\infty,\theta_\infty)=0 \quad\Rightarrow\quad \mathbb{E}_t\left[\pi^{prem}_{O^S/O^N}(\theta^S_{O,\infty})\Big|f^S_O\le f^S_{O,\infty}\right]=w^N s^r\,(1-\lambda)\,.$$

Lemma Bint-4 (Convergence of offshoring productivity cutoff) *The sector converges asymptotically to the perfect information equilibrium, i.e.* $\theta^S_{O,t}\xrightarrow{t\to\infty}\theta^{S,*}_O$*, when:*

$$\text{Case I: } f^S_O=\underline{f}^S_O\Rightarrow f^S_{O,\infty}=\underline{f}^S_O,$$

$$\text{Case II: } \underline{f}^S_O+(1-\lambda)s^r<f^S_O.$$

Hysteresis takes places when:

$$\text{Case III: } \underline{f}^S_O+(1-\lambda)s^r=f^S_O\Rightarrow\theta^S_{O,t}\xrightarrow{t\to\infty}\theta^{S,\neg r}_O,$$

$$\text{Case IV: } \underline{f}^S_O+(1-\lambda)s^r>f^S_O>\underline{f}^S_O\Rightarrow\theta^S_{O,t}\xrightarrow{t\to\infty}\theta^S_{O,\infty},$$

with $\theta^{S,*}_O>\theta^S_{O,\infty}>\theta^{S,\neg r}_O$*, and* $\theta^{S,\neg r}_O$ *denoting the case where the marginal final good producers obtain zero per period offshoring profit premium from arm's length trade, i.e. they cannot recover the offshoring sunk cost.*

Proof By Assumption A.4,

$$\mathbb{E}_t[\pi^{prem}_{O^S/O^N,t}(\bar{\bar{\theta}})|f^S_O\le\bar{f}^S_O]-w^Ns^r(1-\lambda)>0,$$

$$\frac{r^N_{O,t}(\bar{\bar{\theta}})}{\sigma}W-w^N\mathbb{E}_t(f^S_O|f^S_O\le\bar{f}^S_O)-w^N[s^r(1-\lambda)-f^N_O]>0\quad\text{with } W\equiv\left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)}-1.$$

Taking the limit of the trade off function as $t\to\infty$,

$$\mathcal{D}_O(\theta_\infty;\theta_\infty,\theta_\infty)=\frac{r^N_O(\theta_\infty)}{\sigma}W-w^N\mathbb{E}\left(f^S_O|f^S_O\le f^S_{O,\infty}\right)-w^N\left[s^r(1-\lambda)-f^N_O\right].$$

Totally differentiating $\mathcal{D}(\theta_\infty;\theta_\infty,\theta_\infty)$ with respect to each of its arguments:

$$\frac{d\mathcal{D}_O(\theta_\infty;\theta_\infty,\theta_\infty)}{d\theta_\infty}=\frac{W}{\sigma}\frac{\partial r^N_O(\theta_\infty)}{\partial\theta_\infty}-w^N\frac{\partial\mathbb{E}(f^S_O|f^S_O\le f^S_{O,\infty})}{\partial f^S_{O,\infty}}\frac{\partial f^S_{O,\infty}}{\partial\theta_\infty},$$

with $f^S_{O,\infty}$ given by:

$$f^S_{O,\infty}\equiv f^S_O(\theta_\infty)=\frac{r^N_O(\theta_\infty)}{\sigma w^N}\left[\left(\frac{w^N}{w^S}\right)^{(1-\eta)(\sigma-1)}-1\right]+f^N_O.$$

Therefore,

$$\begin{aligned}\frac{d\mathcal{D}_O(\theta_\infty;\theta_\infty,\theta_\infty)}{d\theta_\infty}&=\frac{W}{\sigma}\frac{dr^N_O(\theta_\infty)}{d\theta_\infty}-w^N\frac{W}{w^N\sigma}\frac{dr^N_O(\theta_\infty)}{d\theta_\infty}\frac{\partial\mathbb{E}(f^S_O|f^S_O\le f^S_{O,\infty})}{\partial f^S_{O,\infty}},\\&=\frac{dr^N_O(\theta_\infty)}{d\theta_\infty}\frac{W}{\sigma}\left[1-\frac{\partial\mathbb{E}(f^S_O|f^S_O\le f^S_{O,\infty})}{\partial f^S_{O,\infty}}\right].\end{aligned}$$

From this expression, $\frac{dr_O^N(\theta_\infty)}{d\theta_\infty} > 0$ and $\frac{W}{\sigma} > 0$.

Taking Assumption A.3,

$$\frac{\partial[f_{O,t}^S - \mathbb{E}(f_O^S|f_O^S \leq f_{O,t}^S)]}{\partial f_{O,t}^S} > 0 \Rightarrow 1 - \frac{\partial\mathbb{E}(f_O^S|f_O^S \leq f_{O,t}^S)}{\partial f_{O,t}^S} > 0 \Rightarrow \frac{\partial\mathbb{E}(f_O^S|f_O^S \leq f_{O,t}^S)}{\partial f_{O,t}^S} < 1.$$

Thence, the expression in brackets:

$$\left[1 - \frac{\partial\mathbb{E}(f_O^S|f_O^S \leq f_\infty^S)}{\partial f_{O,\infty}^S}\right] > 0.$$

Only in the limit, when the distribution collapses with the lower bound,

$$\frac{\partial\mathbb{E}(f_O^S|f_O^S \leq f_{O,t}^S)}{\partial f_{O,t}^S} = 1 \Rightarrow \frac{d\mathcal{D}_O(\theta_\infty;\theta_\infty,\theta_\infty)}{d\theta_\infty} = 0.$$

Therefore, it is possible to see that this problem has at most one fixed point. Therefore, the fixed point defined in Lemma Bint-4 is unique. □

In conclusion, it is possible to observe that the steady-state exists and is unique. However, the resting point depends on how optimistic are the initial prior beliefs. The Figure 11a illustrates the cases characterised in Lemma Bint-4.

C.4.2 Competition effect and welfare considerations.

The convergence in the offshoring productivity cutoff pushes simultaneously to a convergence in the market productivity cutoff. The least productive final good producers must leave the market as the competition in the final good market intensifies.

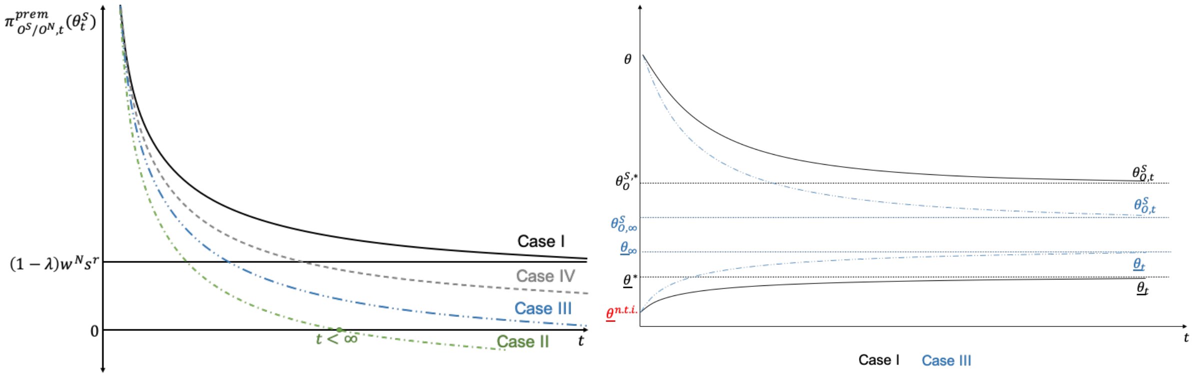
Convergence properties of market productivity cutoff. I characterise the steady-state of the market productivity cutoff, and Figure 11b illustrates the equilibrium paths of the domestic and offshoring productivity cutoffs in the long run for the Case I (*solid line*) and the Case III (*dashed line*). On the other hand, the Case IV is represented as any path in between paths I and III.

As the offshoring productivity cutoff converges to the steady-state defined by Lemma Bint-4, the intensified competition pushes sequentially the least productive final good producers out of the market.

$$\begin{cases} \text{Cases I and II: } \underline{\theta}_t \uparrow \underline{\theta}^* & \text{if } \theta_{O,t}^S \downarrow \theta_O^{S,*}, \\ \text{Case III: } \underline{\theta}_t \uparrow \underline{\theta}^{\neg r} & \text{if } \theta_{O,t}^S \downarrow \theta_O^{S,\neg r}, \\ \text{Case IV: } \underline{\theta}_t \uparrow \underline{\theta}_\infty \in (\underline{\theta}^*;\underline{\theta}^{\neg r}) & \text{if } \theta_{O,t}^S \downarrow \theta_{O,\infty}^S \in (\theta_O^{S,\neg r};\theta_O^{S,*}). \end{cases}$$

To conclude, by Lemma Bint-4 it is possible to show that $P_t \downarrow P^*$ and $Q_t \uparrow Q^*$[107], and thus the informational spillovers allow the economy to realise the welfare gains from offshoring in the long run.

[107] The aggregate consumption may increase slightly above the perfect information equilibrium value due to the hysteresis described above in cases III and IV.



(a) Offshoring eq. paths

(b) Productivity cutoffs eq. paths

Figure 11: Balanced-intensity sectors

C.5 Proofs of Lemmas and Propositions.

C.5.1 Proof of Lemma 1.

The profit premium $\pi^{prem}_{k^S/k'^N}(\theta)$ is increasing in θ. Therefore, it is easy to see that $\frac{\partial \mathcal{D}_{k,t}(\theta;\theta_t,\tilde{\theta}_{t+1})}{\partial \theta} \geq 0$.

Moreover, the producers facing a trade-off have a positive value of offshoring under k in t, i.e. $\mathbb{E}_t \left[\pi^{prem}_{k^S/k'^N,t}(\theta) \middle| f^S_k \leq f^S_{k',t} \right] > 0$. Therefore, the trade-off function for type k is strictly increasing in θ for these final good producers.

C.5.2 Proof of Lemma 2.

I start by characterizing the exploration cutoff productivities for the first period $t = 0$, and then I define them for any $t > 0$.

Exploration in $t = 0$. Although it is possible to characterise the exploration cutoff for any possible initial condition, I divide the analysis into three cases. Assuming a risk for repetition, the separation of the analysis helps in the understanding of the underlying decision.

I consider first the case where, given the priors $Y(f^S_O), Y(f^S_V)$, the final good producers find optimal to explore offshoring only under V^S. In other words, given the priors, the trade-off function $\mathcal{D}_{O,t=0}(\theta; .) < 0$ for $\theta \leq \bar{\bar{\theta}}$. Therefore, the exploration cutoff is defined by the fixed point below:

$$\mathcal{D}_{V,t=0}(\tilde{\theta}^S_{V,t=1}; \theta^S_{t=0}, \theta^S_{V,t=1}) = 0,$$

$$\mathbb{E}_{t=0}\left[\pi^{prem}_{V^S/V^N,t=0}(\tilde{\theta}^S_{V,t=1}) | f^S_V \leq \bar{f}^S_V\right] - w^N s^r \left[1 - \lambda \frac{Y(\tilde{f}^S_{V,t=1})}{Y(f^S_V)}\right] = 0.$$

By replacing with the respective expressions, the exploration productivity cutoff in $t=0$ is given by:

$$\tilde{\theta}^S_{V,t=1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_{t=1} \left[\frac{w^N \left[\mathbb{E}_{t=0}(f^S_V | f^S_V \leq \bar{f}^S_V) - f^N_V + s^r \left(1 - \lambda \frac{Y(\tilde{f}^S_{V,t=1})}{Y(f^S_V)} \right) \right]}{\psi^S_V(\eta) - \psi^N_V(\eta)} \right]^{\frac{1}{\sigma-1}}. \tag{73}$$

The second case takes place when the prior beliefs promote exploration only in foreign outsourcing, i.e. $\mathcal{D}_{V,t=0}(\theta;.) < 0$ for $\theta \leq \bar{\bar{\theta}}$. Therefore, the exploration productivity cutoff is defined by the fixed point:

$$\mathcal{D}_{O,t=0}(\tilde{\theta}^S_{O,t=1}; \theta^S_{t=0}, \theta^S_{O,t=1}) = 0.$$

Replacing with the expressions, the exploration productivity cutoff in $t=0$ is given by:

$$\tilde{\theta}^S_{O,t=1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_{t=1} \left[\frac{w^N \left[\mathbb{E}_{t=0}(f^S_O | f^S_O \leq \bar{f}^S_O) - f^N_V + s^r \left(1 - \lambda \frac{Y(\tilde{f}^S_{O,t=1})}{Y(f^S_O)} \right) \right]}{\psi^S_O(\eta) - \psi^N_V(\eta)} \right]^{\frac{1}{\sigma-1}}. \tag{74}$$

Finally, the third case is defined as the situation where the prior beliefs drive exploration under both offshoring types, O^S and V^S_k. Therefore, the cutoff is defined by the fixed point of the following system of equations.

$$\begin{cases} \mathcal{D}_{V,t=0}(\tilde{\theta}^S_{V,t=1}; \theta^S_{t=0}, \theta^S_{t=1}) = 0, \\ \mathcal{D}_{O,t=0}(\tilde{\theta}^S_{O,t=1}; \theta^S_{t=0}, \theta^S_{t=1}) = 0. \end{cases}$$

Both equations are connected by the expected effects of the exploration flows in the price index and thus in $\tilde{Q}_{t=1}$. Replacing the trade-off function by the respective expressions:

$$\begin{cases} \mathbb{E}_{t=0} \left[\pi^{prem}_{V^S/V^N,t=0}(\tilde{\theta}^S_{V,t=1}) | f^S_V \leq \bar{f}^S_V \right] - w^N s^r \left[1 - \lambda \frac{Y(\tilde{f}^S_{V,t=1})}{Y(f^S_V)} \right] = 0, \\ \mathbb{E}_{t=0} \left[\pi^{prem}_{O^S/V^N,t=0}(\tilde{\theta}^S_{O,t=1}) | f^S_O \leq \bar{f}^S_O \right] - w^N s^r \left[1 - \lambda \frac{Y(\tilde{f}^S_{O,t=1})}{Y(f^S_O)} \right] = 0. \end{cases}$$

$$\begin{cases} (\tilde{\theta}^S_{V,t=1})^{\sigma-1} (\gamma E)^{\sigma} \tilde{Q}^{1-\sigma}_{t+1} [\psi^S_V(\eta) - \psi^N_V(\eta)] = w^N \left[\mathbb{E}_t(f^S_V | f^S_V \leq \bar{f}^S_V) - f^N_V + s^r \left(1 - \lambda \frac{Y(\tilde{f}^S_{V,t=1})}{Y(f^S_V)} \right) \right], \\ (\tilde{\theta}^S_{O,t=1})^{\sigma-1} (\gamma E)^{\sigma} \tilde{Q}^{1-\sigma}_{t+1} [\psi^S_O(\eta) - \psi^N_V(\eta)] = w^N \left[\mathbb{E}_t(f^S_O | f^S_O \leq \bar{f}^S_O) - f^N_V + s^r \left(1 - \lambda \frac{Y(\tilde{f}^S_{O,t=1})}{Y(f^S_O)} \right) \right]. \end{cases}$$

The solution to this system is thus given by:

$$\begin{cases} \tilde{\theta}^S_{V,t=1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_{t=1} \left[\frac{w^N \left[\mathbb{E}_{t=0}(f^S_V | f^S_V \leq \bar{f}^S_V) - f^N_V + s^r \left(1 - \lambda \frac{Y(\tilde{f}^S_{V,t=1})}{Y(f^S_V)} \right) \right]}{\psi^S_V(\eta) - \psi^N_V(\eta)} \right]^{\frac{1}{\sigma-1}}, \\ \tilde{\theta}^S_{O,t=1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_{t=1} \left[\frac{w^N \left[\mathbb{E}_{t=0}(f^S_O | f^S_O \leq \bar{f}^S_O) - f^N_V + s^r \left(1 - \lambda \frac{Y(\tilde{f}^S_{O,t=1})}{Y(f^S_O)} \right) \right]}{\psi^S_O(\eta) - \psi^N_V(\eta)} \right]^{\frac{1}{\sigma-1}}. \end{cases}$$

and the exploration cutoff in $t=0$, $\tilde{\theta}^S_{t=1}$, is defined as: $\tilde{\theta}^S_{t=1} = \min \left\{ \tilde{\theta}^S_{V,t=1}; \tilde{\theta}^S_{O,t=1} \right\}$.

Exploration in $t > 0$. If after exploration in $t = 0$ all the producers that have explored their offshoring potential have chosen V^S, then the offshoring exploration productivity cutoff is defined for any following period by condition below with $k = V$, up to the period in which after exploring, a producer chooses arm's length trade. From that period on, the exploration cutoff is given by the condition below for $k = O$.

Instead, if after exploration in $t = 0$ at least one producer chooses foreign outsourcing, then for any $t > 0$ the exploration cutoff is given by the condition below with $k = O$.

$$\mathcal{D}_{k,t}(\tilde{\theta}^S_{k,t}; \theta^S_t, \theta^S_{t+1}) = 0,$$
$$\mathbb{E}_t \left[\pi^{prem}_{k^S/V^N,t}(\tilde{\theta}^S_{k,t}) | f^S_k \leq f^S_{k,t} \right] - w^N s^r \left[1 - \lambda \frac{Y(\tilde{f}^S_{k,t+1})}{Y(f^S_{k,t})} \right] = 0.$$

By replacing with the respective expressions, the exploration productivity cutoff in t is given by:

$$\tilde{\theta}^S_{k,t+1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_{t+1} \left[\frac{w^N \left[\mathbb{E}_t(f^S_k | f^S_k \leq f^S_{k,t}) - f^N_V + s^r \left(1 - \lambda \frac{Y(\tilde{f}^S_{k,t+1})}{Y(f^S_{k,t})} \right) \right]}{\psi^S_k(\eta) - \psi^N_V(\eta)} \right]^{\frac{1}{\sigma-1}}. \tag{75}$$

C.5.3 Proof of Lemma 3.

The foreign integration productivity cutoff is defined by equation (17), i.e. by the maximum between the offshoring exploration productivity cutoff (θ^S_{t+1}) and the productivity cutoff denoted by $\theta^{S,\bullet}_{V,t+1}$.

I define $\hat{t}$ as the earliest period in which: $\tilde{\theta}^S_{\hat{t}+1} \leq \theta^{S,\bullet}_{V,t+1}$. Thus, for any period $t < \hat{t}$, the foreign integration productivity cutoff is defined by (Lemma 2):

$$\theta^S_{V,t+1} = \tilde{\theta}^S_{t+1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N \left[\mathbb{E}(f^S_V | f^S_V \leq f^S_{V,t}) - f^N_V + s^r \left(1 - \lambda \frac{Y(f^S_{V,t+1})}{Y(f^S_{V,t})} \right) \right]}{\psi^S_V(\eta) - \psi^N_V(\eta)} \right]^{\frac{1}{\sigma-1}} \quad \text{for } t < \hat{t}.$$

For any $t \geq \hat{t}$, the offshoring productivity cutoff, defined by Lemma 2, is $\tilde{\theta}^S_{t+1} = \tilde{\theta}^S_{O,t+1}$, and the foreign integration productivity cutoff is given by equation (18). For any $t \geq \hat{t}$, the foreign productivity cutoff is defined by the condition $\pi^{prem}_{V^S/O^S,t}(\theta^{S,\bullet}_{V,t+1}) = 0$. As less productive producers explore the offshoring potential, the price index reduces and the aggregate consumption index increases. Thus, equation (18) shows that the foreign integration productivity cutoff increases as new (less productive) final good producers explore offshoring.

C.5.4 Proof of Lemma 4.

By assumption A.4, $\mathcal{D}_{k,t}(\bar{\bar{\theta}}; \bar{\bar{\theta}}, \bar{\bar{\theta}}) > 0$ for at least one $k = O^S, V^S_H, V^S_M$. Therefore, for the type k where this condition holds, I get: $\mathbb{E}\left[\pi^{\text{prem}}_{k^S/V^N,t=0}(\bar{\bar{\theta}}) | f^S_k \leq \bar{f}^S_k \right] - w^N s^r (1 - \lambda) > 0$. For exploration decision in $t = 0$ and posterior dynamics, see appendix C.5.2.

I show now the convergence dynamics for vertical integration V, with $V = V_H$ or V_M. Later I show the respective long-run dynamic conditions for O^S. Together, they define the long-run steady state of the differentiated sectors for H- and M-intensive cases.

I assume that the condition above holds for $k = V^S$.

$$\mathbb{E}\left[\pi^{\text{prem}}_{V^S/V^N,t=0}(\bar{\bar{\theta}})|f^S_V \leq \bar{f}^S_V\right] - w^N s^r(1-\lambda) > 0,$$
$$r^N_{V,t=0}(\bar{\bar{\theta}})B^S_V - w^N \mathbb{E}(f^S_V|f^S_V \leq \bar{f}^S_V) - w^N \left[s^r(1-\lambda) - f^N_V\right] > 0,$$

with

$$B^S_V \equiv \Bigg[\left[\left(\frac{\beta^S_V}{\beta^N_V}\right)^{\eta} \left(\frac{1-\beta^S_V}{1-\beta^N_V}\right)^{1-\eta} \left(\frac{w^N}{w^S}\right)^{1-\eta} \right]^{\sigma-1}$$
$$\times \left[1 - \alpha[\beta^S_V \eta + (1-\beta^S_V)(1-\eta)]\right] - \left[1 - \alpha[\beta^N_V \eta + (1-\beta^N_V)(1-\eta)]\right] \Bigg].$$

Taking the limit of the trade-off function as $t \to \infty$,

$$\mathcal{D}_{V^S,\infty}(\theta_\infty;\theta_\infty,\theta_\infty = r^N_{V,\infty}(\theta_\infty)B^S_V - w^N \mathbb{E}(f^S_V|f^S_V \leq f^S_{V,\infty}) - w^N \left[s^r(1-\lambda) - f^N_V\right].$$

By totally differentiating the trade-off function:

$$\frac{d\mathcal{D}_{V^S,\infty}(\theta_\infty;\theta_\infty,\theta_\infty)}{d\theta_\infty} = B^S_V \frac{\partial r^N_{V,\infty}(\theta_\infty)}{\partial\theta_\infty} - w^N \frac{\partial \mathbb{E}(f^S_V|f^S_V \leq f^S_{V,\infty})}{\partial f^S_{V,\infty}} \frac{\partial f^S_{V,\infty}}{\partial \theta_\infty},$$

with

$$f^S_{V,\infty} \equiv \frac{r^N_{V,\infty}(\theta_\infty)}{w^N} B^S_V + f^N_V \quad \Rightarrow \quad \frac{\partial f^S_{V,\infty}}{\partial\theta_\infty} = \frac{B^S_V}{w^N}\frac{\partial r^N_{V,\infty}(\theta_\infty)}{\partial\theta_\infty}.$$

Replacing this into the previous expression:

$$\frac{d\mathcal{D}_{V^S,\infty}(\theta_\infty;\theta_\infty,\theta_\infty)}{d\theta_\infty} = B^S_V \frac{\partial r^N_{V,\infty}(\theta_\infty)}{\partial\theta_\infty} \left[1 - \frac{\partial \mathbb{E}(f^S_V|f^S_V \leq f^S_{V,\infty})}{\partial f^S_{V,\infty}}\right].$$

From this expression, $\frac{\partial r^N_{V,\infty}(\theta_\infty)}{\partial\theta_\infty} > 0$ and $B^S_V > 0$. Also, from assumption A.3,

$$\frac{\partial\left[f^S_{V,t} - \mathbb{E}(f^S_V|f^S_V \leq f^S_{V,t})\right]}{\partial f^S_{V,t}} > 0 \quad \Rightarrow 1 - \frac{\partial \mathbb{E}(f^S_V|f^S_V \leq f^S_{V,t})}{\partial f^S_{V,t}} > 0 \quad \Rightarrow \quad \frac{\partial \mathbb{E}(f^S_V|f^S_V \leq f^S_{V,t})}{\partial f^S_{V,t}} < 1.$$

Therefore,

$$\left[1 - \frac{\partial \mathbb{E}(f^S_V|f^S_V \leq f^S_{V,\infty})}{\partial f^S_{V,\infty}}\right] > 0.$$

Only in the limit, i.e. when the distribution collapses with the lower bound ($f^S_{V,t} = \underline{f}^S_V$),

$$\frac{\partial \mathbb{E}(f^S_V|f^S_V \leq f^S_{V,t})}{\partial f^S_{V,t}} = 1 \Rightarrow \frac{d\mathcal{D}_{V^S,\infty}(\theta_\infty;\theta_\infty,\theta_\infty)}{d\theta_\infty} = 0.$$

Thus, this trade-off function has a unique fixed point. However, from proposition 3, the exploration driven by this fixed point stops at a period $t < \infty$, when after exploration the producers choose arm's length trade instead. From that date, the exploration is driven by the respective trade-off function. Therefore, I analyse below the convergence conditions of the latter.

For any $t > \hat{t}$, with $\hat{t}$ defined in section 3.2.2, the trade-off function that drives exploration is given by:

$$\begin{aligned}\mathcal{D}_{O^S,t}(\theta;\theta_t,\tilde{\theta}_{t+1} &= \mathbb{E}\left[\pi^{\text{prem}}_{O^S/V^N,t}(\theta)|f^S_O \le f^S_{O,t}\right] - w^N s^r(1-\lambda), \\ &= r^N_{V,t}(\theta)B^S_O - w^N\mathbb{E}(f^S_O|f^S_O \le f^S_{O,t}) - w^N\left[s^r(1-\lambda) - f^N_V\right],\end{aligned}$$

with

$$\begin{aligned}B^S_O \equiv &\Bigg[\left[\left(\frac{\beta}{\beta^N_V}\right)^{\eta}\left(\frac{1-\beta}{1-\beta^N_V}\right)^{1-\eta}\left(\frac{w^N}{w^S}\right)^{1-\eta}\right]^{\sigma-1} \\ &\times\left[1-\alpha[\beta\eta+(1-\beta)(1-\eta)]\right] - \left[1-\alpha[\beta^N_V\eta+(1-\beta^N_V)(1-\eta)]\right]\Bigg].\end{aligned}$$

Taking the limit, as before, of the trade-off function as $t \to \infty$,

$$\mathcal{D}_{O^S,\infty}(\theta_\infty;\theta_\infty,\theta_\infty = r^N_{V,\infty}(\theta_\infty)B^S_O - w^N\mathbb{E}(f^S_O|f^S_O \le f^S_{O,\infty}) - w^N\left[s^r(1-\lambda) - f^N_V\right].$$

By totally differentiation of the trade off function,

$$\frac{d\mathcal{D}_{O^S,\infty}(\theta_\infty;\theta_\infty,\theta_\infty)}{d\theta_\infty} = B^S_O\frac{\partial r^N_{V,\infty}(\theta_\infty)}{\partial\theta_\infty} - w^N\frac{\partial\mathbb{E}(f^S_O|f^S_O \le f^S_{O,\infty})}{\partial f^S_{O,\infty}}\frac{\partial f^S_{O,\infty}}{\partial\theta_\infty},$$

with

$$f^S_{O,\infty} \equiv \frac{r^N_{O,\infty}(\theta_\infty)}{w^N}B^S_O + f^N_V \quad\Rightarrow\quad \frac{\partial f^S_{O,\infty}}{\partial\theta_\infty} = \frac{B^S_O}{w^N}\frac{\partial r^N_{V,\infty}(\theta_\infty)}{\partial\theta_\infty}.$$

Replacing this into the previous expression:

$$\frac{d\mathcal{D}_{O^S,\infty}(\theta_\infty;\theta_\infty,\theta_\infty)}{d\theta_\infty} = B^S_O\frac{\partial r^N_{V,\infty}(\theta_\infty)}{\partial\theta_\infty}\left[1 - \frac{\partial\mathbb{E}(f^S_O|f^S_O \le f^S_{O,\infty})}{\partial f^S_{O,\infty}}\right].$$

From this expression, $\frac{\partial r^N_{V,\infty}(\theta_\infty)}{\partial\theta_\infty} > 0$ and $B^S_O > 0$. As before, from assumption A.3, I get:

$$\left[1 - \frac{\partial\mathbb{E}(f^S_O|f^S_O \le f^S_{O,\infty})}{\partial f^S_{O,\infty}}\right] > 0.$$

In the limit, i.e. when the distribution collapses with the lower bound ($f^S_{O,t} = \underline{f}^S_O$),

$$\frac{\partial\mathbb{E}(f^S_O|f^S_O \le f^S_{O,t})}{\partial f^S_{O,t}} = 1 \Rightarrow \frac{d\mathcal{D}_{O^S,\infty}(\theta_\infty;\theta_\infty,\theta_\infty)}{d\theta_\infty} = 0.$$

In conclusion, the sectoral equilibrium path has at most one fixed point. Therefore, the fixed point defined by Lemma 4 is unique.

C.5.5 Proof of Lemma 5.

At any period t, the price index is given by equation (65) in Appendix A.8.1.[108] The initial price index is defined by $P^{n.t.i}$ (see Appendix B.2.1).

[108] See alternative expressions in Appendix A.8.1 defined by equations (60), (62) and (63).

As more final good producers explore the offshoring potential, in $t < \hat{t}$, the foreign integration productivity cutoff reduces, $\theta^S_{V,t} \downarrow$. This increases the shares $\chi^S_{V,t}$ and $\chi^S_{O,t}$, with $\chi^S_{V,t} = \chi^S_{O,t}$. The lower prices of the producers under foreign integration reduces the price index.[109]

For $t \geq \hat{t}$, the producers exploring the offshoring potential choose foreign outsourcing. Thus, the foreign outsourcing productivity cutoff reduces, i.e. $\theta^S_{O,t} \downarrow$, and thus the share $\chi^S_{O,t}$ increases. The new offshoring producers that switch the supply chain from domestic integration to foreign outsourcing charge lower prices, which leads to a lower price index in the sector.[110]

C.5.6 Proof of Lemma 6.

It follows from Lemma 5 and $\frac{\partial \underline{\theta}_{t+1}}{\partial P_t} < 0$, with $\underline{\theta}_{t+1}$ given by:[111]

$$\underline{\theta}_{t+1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N f^N_O}{\psi^N_O(\eta)} \right]^{\frac{1}{\sigma-1}}.$$

C.5.7 Proof of Proposition 1.

For part a), it follows from Lemma 5 and $\frac{\partial \theta^N_{V,t+1}}{\partial P_t} < 0$, with $\theta^N_{V,t+1}$ given by:[112]

$$\theta^N_{V,t+1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N \left[f^N_V - f^N_O \right]}{\psi^N_V(\eta) - \psi^N_O(\eta)} \right]^{\frac{1}{\sigma-1}}.$$

For part b), it follows from Lemma 5 and $\frac{\partial \theta^S_{V,t+1}}{\partial P_t} < 0$ for any $t > \hat{t}$, with $\theta^S_{V,t+1}$ given by Lemma 3.

C.6 Alternative learning mechanism: unobservable organisational type.

Assumption A. 7 (Regularity condition)**.** *Final good producers know that the organisational fixed cost of arm's length trade cannot be larger than the fixed cost of any type of integration. Furthermore, they also know that the offshoring organisational fixed costs cannot be smaller than the respective fixed costs of domestic sourcing.*

By the regularity condition A.7, the evolution of the foreign outsourcing type drives the offshoring equilibrium path. Thus, the learning mechanism does not require that firms observe the sourcing type chosen by the others. Therefore, the following results can be derived from this condition:

$$f^N_V \leq f^S_O \leq f^S_V \quad \text{and} \quad f^S_{O,t} \leq f^S_{V,t} \quad \forall t \geq 0 \quad ; V = V_H, V_M.$$

[109]The reduction of the price index leads to the least productive producers to leave the market, which reinforces the reduction in the price index.

[110]The reduction in the price index leads to the following effects: it increases the market productivity cutoff, which reinforces the reduction in the sector's price index; it increases the productivity cutoff of domestic and foreign integration. The latter two effects diminish the first order effect.

[111]The market entry productivity cutoff, $\underline{\theta}_{t+1}$, is defined by the zero profit condition $\pi^N_O(\underline{\theta}_{t+1}) = 0$.

[112]The productivity cutoff of domestic integration at the end of any period t is defined by the condition $\pi^{prem}_{V^N/O^N}(\theta^N_{V,t+1}) = \pi^N_V(\theta^N_{V,t+1}) - \pi^N_O(\theta^N_{V,t+1}) = 0$.

In this situation, I define $f^S_{\hat{V},t}$ as the maximum affordable fixed cost for the least productive firm offshoring from South in period t, under the assumption that the firm has chosen integration. Also, define $f^S_{\hat{O},t}$ in the same way but under the assumption that the firm has chosen arm's length trade, whenever $f^S_{\hat{O},t} \leq \bar{f}^S_O$. Thence, the learning mechanism is given by:

$$f^S_V \sim \begin{cases} Y(f^S_V | f^S_V \leq f^S_{\hat{V},t}) = \frac{Y(f^S_V | f^S_V \leq f^S_{\hat{V},t-1})}{Y(f^S_{\hat{V},t} | f^S_V \leq f^S_{\hat{V},t-1})} & \text{if } \tilde{f}^S_{\hat{V},t} = f^S_{\hat{V},t} < f^S_{\hat{V},t-1}, \\ f^S_{\hat{V},t} & \text{if } \tilde{f}^S_{\hat{V},t} < f^S_{\hat{V},t}, \\ \underline{f}^S_V & \text{if } f^S_{\hat{V},t} \leq \underline{f}^S_V. \end{cases}$$

$$f^S_O \sim \begin{cases} Y(f^S_O) \text{ with } f^S_O \in [\underline{f}^S_O, \bar{f}^S_O] & \text{if } f^S_{\hat{O},t} \geq \bar{f}^S_O, \\ Y(f^S_O | f^S_O \leq f^S_{\hat{O},t}) = \frac{Y(f^S_O | f^S_O \leq f^S_{\hat{O},t-1})}{Y(f^S_{\hat{O},t} | f^S_O \leq f^S_{\hat{O},t-1})} & \text{if } \tilde{f}^S_{\hat{O},t} = f^S_{\hat{O},t} < f^S_{\hat{O},t-1}, \\ f^S_{\hat{O},t} & \text{if } \tilde{f}^S_{\hat{O},t} < f^S_{\hat{O},t}. \end{cases}$$

It is straightforward to see that the true value f^S_O is revealed in the long run, while the f^S_V may not reveal itself. Firms that remain under domestic sourcing may end up with a wrong belief about the fixed costs of integration. However, by regularity condition A.7, this knowledge is irrelevant for defining the offshoring exploration equilibrium path.

D Multiple countries

D.1 Price indices

D.1.1 Balanced-intensity sectors

The sector's price index at any period t is given by:

$$\begin{aligned} P_t^{1-\sigma} =& H_t\left[\int_{\underline{\theta}_t}^{\theta^S_{O,t}} p^N_O(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta}_t)}d\theta + \int_{\theta^S_{O,t}}^{\theta^E_{O,t}} p^S_O(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta}_t)}d\theta + \int_{\theta^E_{O,t}}^{\infty} p^E_O(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta}_t)}d\theta\right], \\ P_t^{1-\sigma} =& H_t\left[\int_{\underline{\theta}_t}^{\infty} p^N_O(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta}_t)}d\theta + \chi^S_{O,t}\int_{\theta^S_{O,t}}^{\infty}[p^S_O(\theta)^{1-\sigma} - p^N_O(\theta)^{1-\sigma}]\frac{g(\theta)}{1-G(\theta^S_{O,t})}d\theta \right. \\ &\left. + \chi^E_{O,t}\int_{\theta^E_{O,t}}^{\infty}[p^E_O(\theta)^{1-\sigma} - p^S_O(\theta)^{1-\sigma}]\frac{g(\theta)}{1-G(\theta^E_{O,t})}d\theta\right], \\ P_t^{1-\sigma} =& \left(P_t^{O^N_t}\right)^{1-\sigma} + \chi^S_{O,t}\left[\left(P_t^{O^S_t}\right)^{1-\sigma} - \left(P_t^{O^S_t|O^N_t}\right)^{1-\sigma}\right] + \chi^E_{O,t}\left[\left(P_t^{O^E_t}\right)^{1-\sigma} - \left(P_t^{O^E_t|O^S_t}\right)^{1-\sigma}\right], \end{aligned} \tag{76}$$

with $P_t^{O^N_t}$ defined by equation (51), $P_t^{O^S_t}$ by (52), $P_t^{O^S_t|O^N_t}$ by (53),

$$P_t^{O^E_t} = \left[\int_{\theta^E_{O,t}}^{\infty} \left(p^E_O(\theta)\right)^{1-\sigma}\frac{g(\theta)}{1-G(\theta^E_{O,t})}d\theta\right]^{\frac{1}{1-\sigma}}, \tag{77}$$

and

$$P_t^{O_t^E|O_t^S} = \left[\int_{\theta_{O,t}^E}^{\infty} \left(p_O^S(\theta)\right)^{1-\sigma} \frac{g(\theta)}{1-G(\theta_{O,t}^E)} d\theta\right]^{\frac{1}{1-\sigma}}. \tag{78}$$

D.1.2 H-intensive and M-intensive sectors

The sector's price index at any given period t is given by:

$$\begin{aligned}
P_t^{1-\sigma} =& H_t\Bigg[\int_{\underline{\theta}_t}^{\theta_{V,t}^N} p_O^N(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta}_t)}d\theta + \int_{\theta_{V,t}^N}^{\theta_{O,t}^S} p_V^N(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta}_t)}d\theta \\
&+ \int_{\theta_{O,t}^S}^{\theta_{V,t}^S} p_O^S(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta}_t)}d\theta + \int_{\theta_{V,t}^S}^{\theta_{O,t}^E} p_V^S(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta}_t)}d\theta \\
&+ \int_{\theta_{O,t}^E}^{\theta_{V,t}^E} p_O^E(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta}_t)}d\theta + \int_{\theta_{V,t}^E}^{\infty} p_V^E(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta}_t)}d\theta\Bigg],
\end{aligned}$$

$$\begin{aligned}
P_t^{1-\sigma} =& H_t\Bigg[\int_{\underline{\theta}_t}^{\infty} p_O^N(\theta)^{1-\sigma}\frac{g(\theta)}{1-G(\underline{\theta}_t)}d\theta + \chi_{V,t}^N\int_{\theta_{V,t}^N}^{\infty}[p_V^N(\theta)^{1-\sigma} - p_O^N(\theta)^{1-\sigma}]\frac{g(\theta)}{1-G(\theta_{V,t}^N)}d\theta \\
&+ \chi_{O,t}^S\int_{\theta_{O,t}^S}^{\infty}[p_O^S(\theta)^{1-\sigma} - p_V^N(\theta)^{1-\sigma}]\frac{g(\theta)}{1-G(\theta_{O,t}^S)}d\theta + \chi_{V,t}^S\int_{\theta_{V,t}^S}^{\infty}[p_V^S(\theta)^{1-\sigma} - p_O^S(\theta)^{1-\sigma}]\frac{g(\theta)}{1-G(\theta_{V,t}^S)}d\theta \\
&+ \chi_{O,t}^E\int_{\theta_{O,t}^E}^{\infty}[p_O^E(\theta)^{1-\sigma} - p_V^S(\theta)^{1-\sigma}]\frac{g(\theta)}{1-G(\theta_{O,t}^E)}d\theta + \chi_{V,t}^E\int_{\theta_{V,t}^E}^{\infty}[p_V^E(\theta)^{1-\sigma} - p_O^E(\theta)^{1-\sigma}]\frac{g(\theta)}{1-G(\theta_{V,t}^E)}d\theta,
\end{aligned}$$

$$\begin{aligned}
P_t^{1-\sigma} =& \left(P_t^{O_t^N}\right)^{1-\sigma} + \chi_{V,t}^N\left[\left(P_t^{V_t^N}\right)^{1-\sigma} - \left(P_t^{V_t^N|O_t^N}\right)^{1-\sigma}\right] \\
&+ \chi_{O,t}^S\left[\left(P_t^{O_t^S}\right)^{1-\sigma} - \left(P_t^{O_t^S|V_t^N}\right)^{1-\sigma}\right] + \chi_{V,t}^S\left[\left(P_t^{V_t^S}\right)^{1-\sigma} - \left(P_t^{V_t^S|O_t^S}\right)^{1-\sigma}\right] \\
&+ \chi_{O,t}^E\left[\left(P_t^{O_t^E}\right)^{1-\sigma} - \left(P_t^{O_t^E|V_t^S}\right)^{1-\sigma}\right] + \chi_{V,t}^E\left[\left(P_t^{V_t^E}\right)^{1-\sigma} - \left(P_t^{V_t^E|O_t^E}\right)^{1-\sigma}\right]
\end{aligned} \tag{79}$$

D.2 Lemmas and Propositions.

D.2.1 Lemma MC-1

Lemma MC-1(Sequential offshoring exploration in East) *The final good producers with higher productivity have an incentive to explore the offshoring potential in East in earlier periods.*

$$\frac{\partial \mathcal{D}_{k/k',t}(\theta;\theta_t^E,\tilde{\theta}_{t+1}^E)}{\partial\theta} \geq 0.$$

Proof. It follows from proofs of Lemma 1 in Appendix C.5.1. □

As in Lemma 1, the trade-off function is strictly increasing in θ for those final good producers that are facing a real trade-off, i.e. those with a positive value of offshoring in East.

D.2.2 Lemma MC-2

When the final good producers must decide whether to explore the offshoring potential in East or wait, they compare the profits under their current organisational type k' with the expected profit under each feasible organisational type in East net of the offshoring sunk cost.

Lemma MC-2 (Per-period offshoring exploration productivity cutoff in East) *The offshoring exploration productivity cutoff in any period t, denoted as $\tilde{\theta}^S_{t+1}$, is given by:*

$$\tilde{\theta}^E_{t+1} = \min\left\{\tilde{\theta}^E_{O,t+1}; \tilde{\theta}^E_{V,t+1}\right\},$$

with

$$\tilde{\theta}^E_{O,t+1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N \left[\mathbb{E}(f^E_O | f^E_O \leq f^E_{O,t}) - f^S_V + s^r \left(1 - \lambda \frac{Y(f^E_{O,t+1})}{Y(f^E_{O,t})}\right)\right]}{\psi^E_O(\eta) - \psi^S_V(\eta)}\right]^{\frac{1}{\sigma-1}},$$

$$\tilde{\theta}^E_{V,t+1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N \left[\mathbb{E}(f^E_V | f^E_V \leq f^E_{V,t}) - f^S_V + s^r \left(1 - \lambda \frac{Y(f^E_{V,t+1})}{Y(f^E_{V,t})}\right)\right]}{\psi^E_V(\eta) - \psi^S_V(\eta)}\right]^{\frac{1}{\sigma-1}}.$$

Proof. From Assumption A.5 and Lemma MC-1, the exploration sequence to East is led by the most productive final good producers in the market. In the initial conditions defined by (S), those final good producers are organised under foreign integration in South, i.e. $k' = V^S$.[113]

Thus, $\tilde{\theta}^E_{O,t+1}$ and $\tilde{\theta}^E_{V,t+1}$ are defined by the fixed points:

$$\mathcal{D}_{V,t}(\tilde{\theta}^E_{V,t+1}; \theta^E_t, \tilde{\theta}^E_{t+1}) = 0 \Rightarrow \quad \mathbb{E}_t\left[\pi^{prem}_{V^E/V^S,t}(\tilde{\theta}^E_{V,t+1}) \middle| f^E_V \leq f^E_{V,t}\right] = w^N s^r \left[1 - \lambda \frac{Y(f^E_{V,t+1})}{Y(f^E_{V,t})}\right],$$

$$\mathcal{D}_{O,t}(\tilde{\theta}^E_{O,t+1}; \theta^E_t, \tilde{\theta}^E_{t+1}) = 0 \Rightarrow \quad \mathbb{E}_t\left[\pi^{prem}_{O^E/V^S,t}(\tilde{\theta}^E_{O,t+1}) \middle| f^E_O \leq f^E_{O,t}\right] = w^N s^r \left[1 - \lambda \frac{Y(f^E_{O,t+1})}{Y(f^E_{O,t})}\right].$$

□

D.2.3 Lemma MC-3

After exploration, the final good producer discovers all the organisational fixed costs of offshoring from the East, and she must choose the one organisational type. After paying $w^N s^r$ in period t, the final good producer discovers the true values of f^E_O, $f^E_{V_H}$ and $f^E_{V_M}$, and she must choose an organisational type. The final good producer with productivity θ chooses foreign integration in East, V^E, when:

$$\pi^{prem}_{V^E/O^E,t}(\theta) = \pi^E_{V,t}(\theta) - \pi^E_{O,t}(\theta) \geq 0.$$

She chooses arm's length trade in East, O^E, when:

$$\pi^{prem}_{O^E/k',t}(\theta) = \pi^E_{O,t}(\theta) - \pi^{l'}_{k',t}(\theta) \geq 0 \quad \text{and} \quad \pi^{prem}_{V^E/O^E,t}(\theta) < 0.$$

Otherwise, she remains under her current organisational type k'.

[113] In other words, I assume that exploration of East leads to a partial relocation of suppliers from South to East. Moreover, I assume that in the new steady state, the sector still shows both types of offshoring in South (i.e. O^S, V^S). I assume this for simplicity and to avoid a taxonomy of cases. Without any loss, this assumption can be easily relaxed and thus extend the analysis to more general cases of partial or full relocation.

Lemma MC-3 (Foreign integraton productivity cutoff in East) *The foreign integration productivity cutoff in East at the end of period t,* $\theta^E_{V,t+1}$ *, i.e. the least productive final good producer that has chosen* V^E *after paying the sunk cost in period t, is given by:*

$$\theta^E_{V,t+1} = \max\left\{\tilde{\theta}^E_{t+1}; \theta^{E,\bullet}_{V,t+1}\right\}, \tag{80}$$

with

$$\pi^{prem}_{V^E/O^E,t}(\theta^{E,\bullet}_{V,t+1}) = 0 \quad \Rightarrow \quad \theta^{E,\bullet}_{V,t+1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N \left[f^E_V - f^E_O\right]}{\psi^E_V(\eta) - \psi^E_O(\eta)}\right]^{\frac{1}{\sigma-1}}. \tag{81}$$

Proof. Define now $\hat{t}$ as the earliest period in which $\tilde{\theta}^E_{t+1} \leq \theta^{E,\bullet}_{V,t+1}$. It follows from proofs of Lemma 3 in Appendix C.5.3. □

D.2.4 Lemma MC-4.

Lemma MC-4 (Convergence of offshoring productivity cutoff in East) *The sector converges asymptotically to the perfect information equilibrium,* $\theta^E_t \xrightarrow{t\to\infty} \theta^{E,*} = \theta^{E,*}_O$*, when:*

$$\textit{Case I: } f^E_O = \underline{f}^E_O \Rightarrow f^E_{O,\infty} = \underline{f}^E_O,$$
$$\textit{Case II: } \underline{f}^E_O + (1-\lambda)s^r < f^E_O.$$

Hysteresis takes places when:

$$\textit{Case III: } \underline{f}^E_O + (1-\lambda)s^r = f^E_O \Rightarrow \theta^E_t \xrightarrow{t\to\infty} \theta^{E,\neg r}_O,$$
$$\textit{Case IV: } \underline{f}^E_O + (1-\lambda)s^r > f^E_O > \underline{f}^E_O \Rightarrow \theta^E_t \xrightarrow{t\to\infty} \theta^E_{O,\infty},$$

with $\theta^{E,*}_O > \theta^E_{O,\infty} > \theta^{E,\neg r}_O$*, and* $\theta^{E,\neg r}_O$ *denoting the case where firms cannot fully recover* $w^N s^r$*.*

Proof. It follows from proofs of Lemma 4 in Appendix C.5.4. □

D.2.5 Lemma MC-5.

Lemma MC-5 (Price index effect of relocation of offshore suppliers) *As the offshoring productivity cutoff in East converges to the steady state (Lemma MC-4), the price index in the final good market reduces:*

$$\begin{cases} \text{Cases I and II: } P_t \searrow P^* & \text{if } \theta^E_t \searrow \theta^{E,*}, \\ \text{Case III: } P_t \searrow P^{\neg r} & \text{if } \theta^E_t \searrow \theta^{E,\neg r}, \\ \text{Case IV: } P_t \searrow P_\infty \in (P^*; P^{\neg r}) & \text{if } \theta^E_t \searrow \theta^E_\infty \in (\theta^{E,\neg r}; \theta^{E,*}). \end{cases}$$

Proof. It follows from proofs of Lemma 5 in Appendix C.5.5. □

D.2.6 Lemma MC-6.

Lemma MC-6 (Convergence of market and offshoring productivity cutoffs) *As the East offshoring productivity cutoff converges to the steady state (Lemma MC- 4), the price index in the final good market reduces (Lemma MC-5), and:*

(a) *the market productivity cutoff increases:*

$$\begin{cases} \text{Cases I and II: } \underline{\theta}_t \nearrow \underline{\theta}^* & \text{if } \theta_t^E \searrow \theta^{E,*}, \\ \text{Case III: } \underline{\theta}_t \nearrow \underline{\theta}^{\neg r} & \text{if } \theta_t^E \searrow \theta^{E,\neg r}, \\ \text{Case IV: } \underline{\theta}_t \nearrow \underline{\theta}_\infty \in (\underline{\theta}^*; \underline{\theta}^{\neg r}) & \text{if } \theta_t^E \searrow \theta_\infty^E \in (\theta^{E,\neg r}; \theta^{E,*}), \end{cases}$$

(b) *the foreign outsourcing productivity cutoff in South, i.e. the sector's offshoring productivity cutoff, increases:*

$$\begin{cases} \text{Cases I and II: } \theta_{O,t}^S \nearrow \theta_O^{S,*} & \text{if } \theta_t^E \searrow \theta^{E,*}, \\ \text{Case III: } \theta_{O,t}^S \nearrow \theta_O^{S,\neg r} & \text{if } \theta_t^E \searrow \theta^{E,\neg r}, \\ \text{Case IV: } \theta_{O,t}^S \nearrow \theta_{O,\infty}^S \in (\theta_O^{S,*}; \theta_O^{S,\neg r}) & \text{if } \theta_t^E \searrow \theta_\infty^E \in (\theta^{E,\neg r}; \theta^{E,*}). \end{cases}$$

Proof. For part a), it follows from Lemma MC-5 and $\frac{\partial \underline{\theta}_{t+1}}{\partial P_t} < 0$, with:

$$\underline{\theta}_{t+1} = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N f_O^N}{\psi_O^N(\eta)} \right]^{\frac{1}{\sigma-1}},$$

For part b), it follows from Lemma MC-5 and $\frac{\partial \theta_{O,t+1}^S}{\partial P_t} < 0$, with:

$$\theta_{O,t+1}^S = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N [f_O^S - f_V^N]}{\psi_O^S(\eta) - \psi_V^N(\eta)} \right]^{\frac{1}{\sigma-1}}.$$

□

D.2.7 Proof of Proposition 2.

For part a), it follows from Lemma MC-5 and $\frac{\partial \theta_{V,t+1}^N}{\partial P_t} < 0$, with:

$$\theta_{V,t+1}^N = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N \left[f_V^N - f_O^N\right]}{\psi_V^N(\eta) - \psi_O^N(\eta)} \right]^{\frac{1}{\sigma-1}}.$$

For part b), it follows from Lemma MC-5 and $\frac{\partial \theta_{V,t+1}^S}{\partial P_t} < 0$, with:

$$\theta_{V,t+1}^S = (\gamma E)^{\frac{\sigma}{1-\sigma}} \tilde{Q}_t \left[\frac{w^N \left[f_V^S - f_O^S\right]}{\psi_V^S(\eta) - \psi_O^S(\eta)} \right]^{\frac{1}{\sigma-1}}.$$

For part c), it follows from Lemma MC-5 and $\frac{\partial \theta_{V,t+1}^E}{\partial P_t} < 0$ for any $t > \hat{t}$, with $\theta_{V,t+1}^E$ given by Lemma MC-3.

E Empirics

In section E.1, I complement the data description of section 4.1. In section E.2, I introduce the empirical static models related to the generalisation of the organisational choice problem in Antràs and Helpman (2004), where the focus relies on the determinants of the organisational choices among offshoring firms. In section E.3, I follow with the appendices to the empirical models related to the dynamic approach with uncertainty.

E.1 Data

I use the "liberal" criteria of Rauch (1999)'s classification of commodities: i) good traded on an organised exchange, ii) reference priced, and iii) differentiated. I define a variable *diff* which takes the value 0 if Rauch's category is "*w*", 0.5 if r, and 1 if it is a differentiated good ("*d*"). I build a concordance table between Rauch's product classification (SITC) and NAICS 2012, and thus I obtain a continuous *diff* index $\in [0, 1]$ at NAICS 2012, increasing in the differentiation of the sector. After reclassification to BEA codes, I merge it with the input-output matrix and obtain differentiation measures for H and M sectors.

For the determinants of the H-intensity, I use data from the Census Bureau manufacturing survey on: *capital expenditure, machinery expenditure, advertising expenditure*, and *total shipments* (total sales). The expenditure share in R&D comes instead from the Business R&D and Innovation Survey (BRDIS) survey of the National Center for Science and Engineering Statistics (NCSES) of the National Science Foundation.

For the measures of tacit knowledge and routines at the management level, I use the O*NET database together with the employment survey (OES) of the Bureau of Labor Statistics. I describe it in detail in section E.2.1. This measure is built separately for sectors H and M.

The data on tariffs comes from World Integrated Trade Solutions (WITS), the Rule of Law institutional measures from the World Governance Indicators and data on GDP per capita and GDP from the World Development Indicator, both from the World Bank. The data on distances comes from CEPII. Finally, the data on FTA comes from "Mario Larch's Regional Trade Agreements Database from Egger and Larch (2008)".

E.2 Empirical static model: determinants of the organisational choices under perfect information

For the determinants of the sectoral component-intensity η, I build on the works of Yeaple (2006); Nunn (2007); Nunn and Trefler (2013) and Antràs (2015). The first departure from this literature comes from the quadratic functional form of the empirical model. I test for the non-linear relation that comes from the generalisation of the organisational choice of Antràs and Helpman (2004).

I build also a synthetic measure of η_j by two alternative approaches: *Factor Analysis (FA)* and *Principal Component Analysis (PCA)*. From these methods, I am able to reduce the multidimensionality of the previous models to a unique index for η_j. In the case of FA, I use the first factor as measure of the H-intensity. In the case of PCA, instead, the measure of η_j consists of the first component. The analysis of the eigenvalues of the respective approaches show that the first factor of the FA is a better measure for η_j than the respective first component of PCA (see figure 15 in Appendix E.2.4).[114]

I introduce a novel measure for the tacit knowledge and routines at the management level for H and M sectors. As described in section 2.1, it motivates the effects of δ_{V_H} and δ_{V_M}, respectively, on the organisational choices. The more important the tacit knowledge and routines in the potentially integrated party, the higher the efficiency losses (i.e. lower δ_V) that would be faced if the controlled party is seized after the investments are executed. I explain in detail the construction of this measure in section E.2.1.

E.2.1 Measure of tacit routines and non-codifiable knowledge

I use the dataset on occupational classification: "Education, Training, and Experience" from the O*NET database. In particular, I use the index "On the job training" for managers. The intuition is the following: the training time required for the manager "on the job" may represent the importance of knowledge acquired in that position, and the time required by a new manager to assimilate the tacit routines associated with her/his position in that facility. The more important is the tacit component of the routines in the firm, the higher the time required to adapt and assimilate it as a manager.

I focus on the managers because, according to the theoretical model above, they are exposed to be fired after the investments in specific-assets are executed. I normalize the index to the range of $[1, 10]$, which is increasing in the "on the job training" period. It is easy to observe that this measure capture the inverse of δ_V, i.e. as the training period increases, the tacit knowledge and importance of routines is higher, therefore the efficiency loss after firing the manager of the respective facility increases ($\delta_V \to 0$).

Regarding the construction of the index, using data from the O*NET database, I compute first the

[114] See Antràs (2015) for a similar approach.

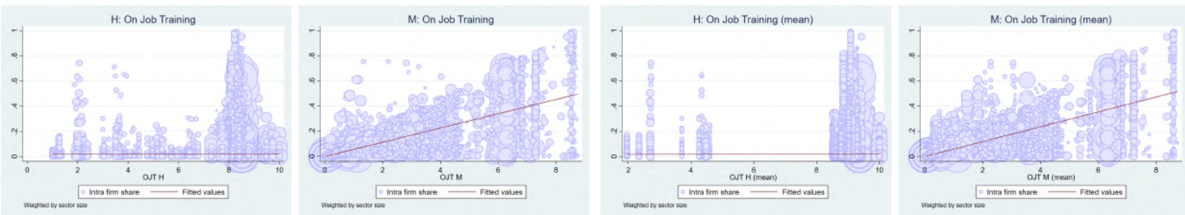
index category ”on the job training” (Element ID: 3.A.3, scale ID: *OJ*) for each manager position in the O*NET SOC code. Thus, the index for each O*NET SOC code is given by:

$$OJT_{\text{O*NET SOC code}} = \sum_{c=1}^{9} c \times \frac{data_c}{100},$$

where *OJT* denotes the ”on the job training” of general and operation managers, c refers to the category with $c = 1, ..., 9$, the variable $data_c$ indicates the data value for the category c, and 9 refers to the total number of categories for the scale ID.

Second, using the cross-walk tables provided by O*NET, I merge it with the OES database, and create an index by NAICS and year, i.e. $OJT_{j,t}$. Finally, I merge it with the input-output table by BEA codes for H and M industries, and re-scale the index to $[1, 10]$.

Figure 12 shows the tacit knowledge measure for managers in relation to the intra-firm import share. The left figures illustrate the relationship with yearly data, while the right figures shows it for the mean values of the tacit knowledge. From the theory, a positive relationship between these two variables is expected for all the cases.



(a) Yearly.

(b) Mean values.

Figure 12: Intra-firm import share and tacit knowledge and routines.

I measure *M OJT* using data that comes from US manufacturing firms. However, it aims to capture the routines and knowledge in foreign sectors, i.e. foreign suppliers M. The underlying assumption is that the relevance of routines and tacit knowledge is symmetric across countries for a given sector.

E.2.2 Definition of other variables

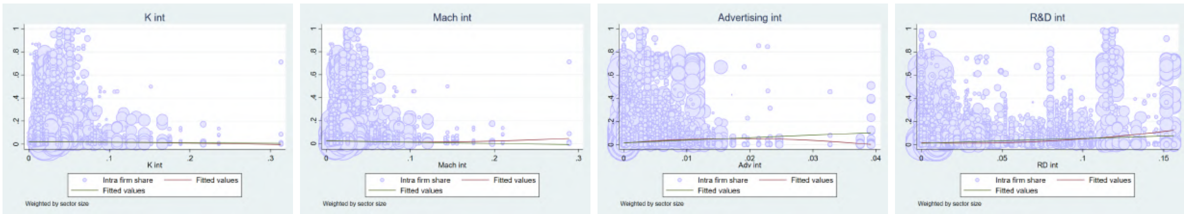
For the main variables related to the determinants of capital intensity, I follow the previously empirical literature. From the manufacturing survey of the Census Bureau, I get the following intensity measures:

- Capital intensity: $k\ int_{j,t} = \frac{\text{Total Capital Expenditure}_{j,t}}{\text{Total shipments}_{j,t}}$,
- Machinery intensity: $mach\ int_{j,t} = \frac{\text{Machinery Capital Expenditure}_{j,t}}{\text{Total shipments}_{j,t}}$,
- Advertising intensity: $adv\ int_{j,t} = \frac{\text{Advertising and Promotional Serv Exp. }_{j,t}}{\text{Total shipments}_{j,t}}$.

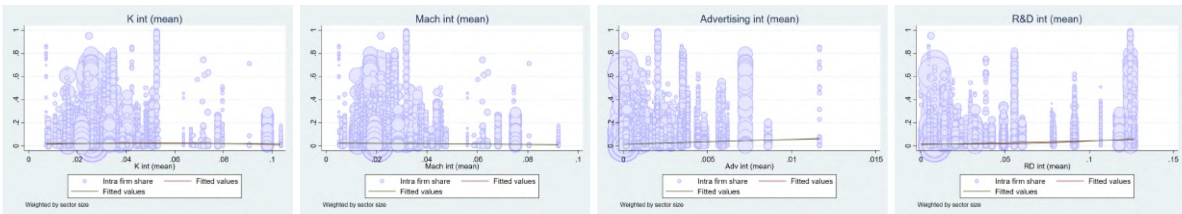
As robustness, I use the machinery intensity as a alternative to the total capital intensity.

The R&D intensity intensity measure is constructed from the Business R&D and Innovation Survey (BRDIS) survey of the National Center for Science and Engineering Statistics (NCSES) of the National Science Foundation, and it is defined as: $rd\ int_{j,t} = \frac{\text{R\&D Expenditure}_{j,t}}{\text{Total Sales}_{j,t}}$.

Figure 13 shows a linear and quadratic relationship between the H-intensity measures and the intra-firm import share. I show also the relationship relative to the indices for η_j from a factor analysis (FA) and a principal component analysis (PCA). The latter are illustrated in figure 14.

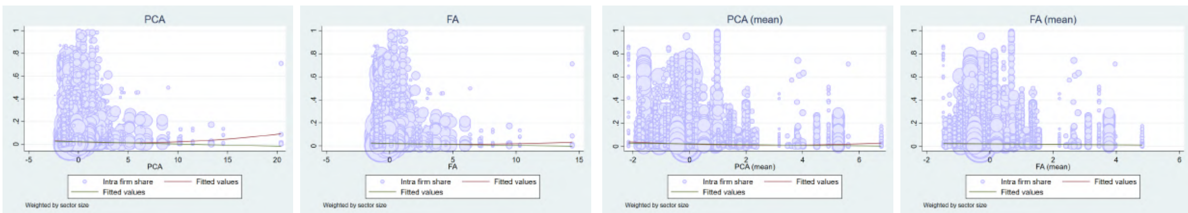


(a) Yearly.



(b) Mean values.

Figure 13: Component-intensity: individual measures.



(a) Yearly. (b) Mean values.

Figure 14: Intra-firm share and measures of η (*FA* and *PCA*).

E.2.3 The model

The input-out matrix structure allows me to exploit the variation across inputs-intensity and supplier's countries in final good producer sectors. For the construction of the variables at the final good producer sector level, I aggregate the M-sector dimension, where the variables are weighted by the relevance of the sector M in sector H imports according to the input-output import matrix ($MshrH_{m,j}$).

Given the non-linear nature of the model, I estimate it by a fractional logit model, which is given by:

$$\mathbb{E}\Big[IFshr_{j,l,t}\Big|\boldsymbol{x}\Big] = \frac{\exp(\boldsymbol{x}'_{j,l,t}\boldsymbol{\beta})}{1+\exp(\boldsymbol{x}'_{j,l,t}\boldsymbol{\beta})}, \tag{82}$$

with $IFshr_{j,l,t}$ as the intra-firm import share from country l in year t of sector j, and

$$\begin{aligned}\boldsymbol{x}'_{j,l,t}\boldsymbol{\beta} =& \beta_1 k\ int_{j,t} + \beta_2 k\ int^2_{j,t} + \beta_3 rd\ int_{j,t} + \beta_4 rd\ int^2_{j,t} + \beta_5 adv\ int_{j,t} + \beta_6 adv\ int^2_{j,t} \\ &+ \beta_7 \ln(H\ OJT_{j,t}) + \beta_8 \ln(M\ OJT_{j,t}) + other\ controls + \gamma_{lt},\end{aligned} \tag{83}$$

where $H\ OJT_{j,t}$ refers to the "on the job training" index for managers in the final good sector j in year t. Instead, $M\ OJT_{j,t}$ refers to the "on the job training" index for managers for supplier industries. The model measures it as the weighted mean of the index for each input m used by sector j. Given that both indices are increasing in the training time, a higher *OJT* represents a lower δ_V, which translates into a higher efficiency loss when the party that owns the assets fires the manager of the other party.

The variables identifying the H-intensity comes from the literature (Yeaple, 2006; Nunn and Trefler, 2013; Antràs, 2015), and they have been defined in section E.2.2. Based on Rauch's classification, I include also the degree of differentiation of the supplier sectors, $M\ diff \in [0,1]$. In the model, it is defined by the weighted mean of the index for the intermediate inputs used by sector j. Additionally, I control for the H differentiation level, with $H\ diff \in [0,1]$. Finally, γ_{lt} indicates country-year fixed effects.

For the specification with PCA or FA, the vector $\boldsymbol{x}$ is given by:

$$\begin{aligned}\boldsymbol{x}'_{j,l,t}\boldsymbol{\beta} &= \beta_1 FA_{j,t} + \beta_2 FA^2_{j,t} + \beta_3 \ln(H\ OJT_{j,t}) + \beta_4 \ln(M\ OJT_{j,t}) + other\ controls + \gamma_{lt}, \\ \boldsymbol{x}'_{j,l,t}\boldsymbol{\beta} &= \beta_1 PCA_{j,t} + \beta_2 PCA^2_{j,t} + \beta_3 \ln(H\ OJT_{j,t}) + \beta_4 \ln(M\ OJT_{j,t}) + other\ controls + \gamma_{lt}.\end{aligned} \tag{84}$$

Results. The results reported in Table 8 provide evidence consistent with a non-linear *U-shape* relationship, as predicted by the generalised model where the property rights are allocated to the relatively more important party on the relationship. In other words, the empirical results provide some support for the prediction that the intra-firm import share is higher at both extremes of the η_j distribution.

Columns (1)-(8) identifies the models as defined above, while in columns (9)-(16) I introduce the main determinants of η in mean values with the aim of capturing the underlying H technological intensity. The FA measure shows a theory-consistent effect through all the specifications, while it is weaker for the case of the PCA. Regarding the individual measures, they all show a theory-consistent effect, except for the R&D intensity.

Table 8: Empirical evidence for the generalised model of organisational choices. Coefficients.

	Determinants of η_j: yearly data [columns: (1)-(8)]								**Determinants of η_j: mean data** [columns: (9)-(16)]							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$
$PCA_{j,.}$	-0.0682***		-0.100***						-0.0251		-0.0632***					
	(0.0225)		(0.0222)						(0.0213)		(0.0211)					
$PCA^2_{j,.}$	0.00793***		0.00960***						0.0542***		0.0624***					
	(0.00179)		(0.00172)						(0.00755)		(0.00732)					
$FA_{j,.}$		-0.125***		-0.173***						-0.102***		-0.174***				
		(0.0319)		(0.0314)						(0.0301)		(0.0301)				
$FA^2_{j,.}$		0.0174***		0.0211***						0.0709***		0.105***				
		(0.00363)		(0.00343)						(0.0221)		(0.0190)				
$K\ int_{j,.}$					-6.210***		-7.681***						-9.662*		-19.15***	
					(1.981)		(1.951)						(5.600)		(5.575)	
$K\ int^2_{j,.}$					28.24***		33.13***						100.9		192.4***	
					(9.487)		(9.182)						(64.62)		(62.52)	
$Mach\ int_{j,.}$						-7.773***		-9.604***						-13.25**		-23.43***
						(2.139)		(2.097)						(6.443)		(6.473)
$Mach\ int^2_{j,.}$						37.70***		44.27***						203.6**		317.0***
						(10.76)		(10.39)						(93.11)		(91.33)
$Adv\ int_{j,.}$					-108.2***	-107.9***	-105.3***	-105.0***					-286.8***	-288.6***	-308.0***	-313.4***
					(9.624)	(9.580)	(9.600)	(9.552)					(27.00)	(26.85)	(28.06)	(28.07)
$Adv\ int^2_{j,.}$					2474.2***	2486.8***	2374.9***	2390.5***					16679.2***	16670.4***	19950.3***	20352.4***
					(309.8)	(307.9)	(309.7)	(307.8)					(3631.1)	(3627.1)	(3778.3)	(3792.1)
$RD\ int_j$					18.37***	19.37***	17.29***	18.50***					15.07***	14.91***	14.63***	14.79***
					(1.915)	(1.961)	(1.905)	(1.949)					(2.021)	(1.989)	(1.981)	(1.955)
$RD\ int^2_j$					-54.11***	-62.12***	-51.83***	-61.74***					-28.01	-27.46	-32.45*	-34.88**
					(16.79)	(17.17)	(16.74)	(17.09)					(17.67)	(17.52)	(17.51)	(17.41)
$\ln(H\ OJT_{j,.})$	-0.236***	-0.232***	-0.439***	-0.436***	-0.106*	-0.110*	-0.186***	-0.194***	-0.109*	-0.132**	-0.334***	-0.362***	0.0608	0.0737	-0.0673	-0.0583
	(0.0640)	(0.0639)	(0.0664)	(0.0662)	(0.0630)	(0.0631)	(0.0636)	(0.0636)	(0.0601)	(0.0601)	(0.0642)	(0.0654)	(0.0626)	(0.0606)	(0.0657)	(0.0637)
$\ln(M\ OJT_{j,.})$	0.598***	0.596***	0.687***	0.686***	0.967***	0.970***	0.972***	0.976***	0.261***	0.259***	0.361***	0.367***	0.674***	0.670***	0.698***	0.693***
	(0.0441)	(0.0442)	(0.0446)	(0.0447)	(0.0464)	(0.0464)	(0.0460)	(0.0460)	(0.0315)	(0.0320)	(0.0336)	(0.0341)	(0.0331)	(0.0329)	(0.0333)	(0.0331)
$H\ diff_j$	0.351***	0.327***	0.479***	0.451***	-0.264***	-0.248***	-0.207**	-0.186**	0.119	0.0717	0.257***	0.206**	-0.623***	-0.609***	-0.575***	-0.549***
	(0.0916)	(0.0916)	(0.0917)	(0.0915)	(0.0855)	(0.0865)	(0.0856)	(0.0866)	(0.0890)	(0.0911)	(0.0888)	(0.0899)	(0.0824)	(0.0829)	(0.0818)	(0.0826)
$M\ diff_j$	2.889***	2.916***	2.532***	2.558***	1.391***	1.365***	1.379***	1.344***	3.587***	3.662***	3.171***	3.233***	2.082***	2.091***	2.026***	2.037***
	(0.156)	(0.157)	(0.159)	(0.160)	(0.174)	(0.173)	(0.173)	(0.172)	(0.140)	(0.144)	(0.147)	(0.150)	(0.162)	(0.161)	(0.162)	(0.161)
$\ln(sigma_j)$	0.140***	0.137***	0.145***	0.142***	0.216***	0.220***	0.210***	0.215***	0.0842**	0.0906***	0.0949***	0.0937***	0.174***	0.170***	0.168***	0.167***
	(0.0321)	(0.0320)	(0.0307)	(0.0305)	(0.0277)	(0.0280)	(0.0280)	(0.0283)	(0.0328)	(0.0329)	(0.0315)	(0.0313)	(0.0282)	(0.0286)	(0.0282)	(0.0286)
$\ln(1+tariff_{l,j,t})$	-8.840**	-8.676**	-11.07***	-10.90***	6.039	6.405*	4.005	4.411	0.148	-1.574	-2.276	-4.254	14.48***	15.03***	10.88***	11.71***
	(3.572)	(3.577)	(3.619)	(3.617)	(3.889)	(3.878)	(4.026)	(4.005)	(3.519)	(3.563)	(3.536)	(3.580)	(3.470)	(3.456)	(3.544)	(3.516)
$\ln(skill\ int_j)$			0.523***	0.534***			0.226***	0.232***			0.535***	0.579***			0.352***	0.350***
			(0.0513)	(0.0510)			(0.0476)	(0.0473)			(0.0528)	(0.0532)			(0.0491)	(0.0489)
Observations	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979

Fixed effects: country-year (lt). The subindex "." indicates t in columns (1)-(8), while in columns (9)-(16) those variables are included at their respective mean values. Coefficients reported. Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

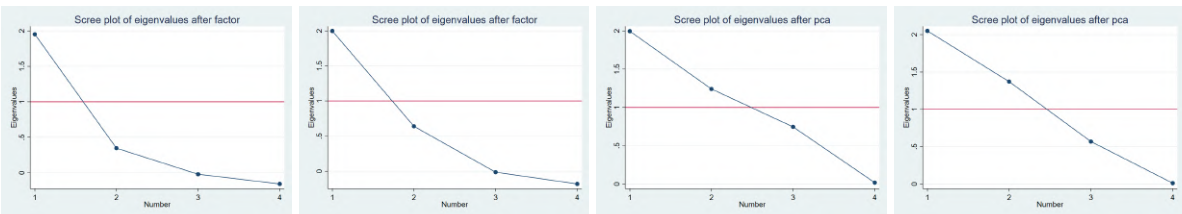
About the role of tacit knowledge and routines, the table shows that *M OJT* has a significant and positive effect on the intra-firm import share, as predicted by theory, while it is not the case for the effect of *H OJT*. On the other hand, the differentiation level of the final good (*H diff*) and the mean differentiation level of the inputs (*M diff*) have both a positive effect on the intra-firm import share, which is consistent with more contract dependent relationships.

Finally, when I cluster the standard errors at the final good sector, most of the effects vanish at the reported significance levels. Table 9 reports the results and it shows evidence that weakens the conclusions from above, indicating the need for further empirical investigation.

To sum up, the data shows some evidence in favour of the generalisation of the organisational space and the respective organisational characterisation of the sectors defined above, but it is not conclusive. A firm-level data or a higher disaggregation of sectoral-level data beyond the publicly available may provide stronger evidence. However, a deeper investigation is out of the scope of this paper.

E.2.4 Eigenvalues for Factor Analysis and Principal Component Analysis

Figure 15 shows the values of the eigenvalues for each of the approaches. I use the first component of each method as a direct measure of η. The graphs show that the first component of the factor analysis is a better summary of the H-intensity. Nevertheless, I report the results for both measures.



(a) Eigenvalues FA (b) Eigenvalues mean FA (c) Eigenvalues PCA (d) Eigenvalues mean PCA

Figure 15: Eigenvalues: Factor analysis and principal component analysis

Table 9: Empirical evidence for the generalised model of organisational choices. Cluster s.e. at sector j. Coefficients.

	Determinants of η_j: yearly data [columns: (1)-(8)]								**Determinants of η_j: mean data** [columns: (9)-(16)]							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$	$IFshr_{l,j,t}$
$PCA_{j,.}$	-0.0682		-0.100						-0.0251		-0.0632					
	(0.104)		(0.0976)						(0.103)		(0.0993)					
$PCA^2_{j,.}$	0.00793		0.00960*						0.0542**		0.0624***					
	(0.00602)		(0.00576)						(0.0216)		(0.0211)					
$FA_{j,.}$		-0.125		-0.173						-0.102		-0.174				
		(0.155)		(0.142)						(0.165)		(0.157)				
$FA^2_{j,.}$		0.0174		0.0211*						0.0709		0.105**				
		(0.0123)		(0.0116)						(0.0503)		(0.0478)				
$K\ int_{j,.}$					-6.210		-7.681						-9.662		-19.15*	
					(4.745)		(4.921)						(10.07)		(10.57)	
$K\ int^2_{j,.}$					28.24*		33.13*						100.9		192.4	
					(16.69)		(17.74)						(114.2)		(118.5)	
$Mach\ int_{j,.}$						-7.773		-9.604						-13.25		-23.43*
						(5.789)		(5.944)						(11.89)		(12.45)
$Mach\ int^2_{j,.}$						37.70*		44.27**						203.6		317.0*
						(21.36)		(22.42)						(160.4)		(163.8)
$Adv\ int_{j,.}$					-108.2***	-107.9***	-105.3***	-105.0***					-286.8***	-288.6***	-308.0***	-313.4***
					(28.72)	(28.36)	(25.73)	(25.29)					(65.24)	(63.61)	(70.14)	(68.92)
$Adv\ int^2_{j,.}$					2474.2***	2486.8***	2374.9***	2390.5***					16679.2**	16670.4**	19950.3**	20352.4***
					(726.6)	(725.1)	(633.1)	(630.5)					(7207.2)	(7036.4)	(7924.6)	(7834.3)
$RD\ int_j$					18.37***	19.37***	17.29***	18.50***					15.07***	14.91***	14.63***	14.79***
					(3.825)	(3.856)	(3.976)	(3.849)					(3.603)	(3.615)	(3.636)	(3.616)
$RD\ int^2_j$					-54.11*	-62.12**	-51.83*	-61.74**					-28.01	-27.46	-32.45	-34.88
					(28.79)	(28.23)	(29.43)	(28.10)					(30.38)	(29.42)	(29.57)	(28.94)
$\ln(H\ OJT_{j,.})$	-0.236	-0.232	-0.439*	-0.436*	-0.106	-0.110	-0.186	-0.194	-0.109	-0.132	-0.334	-0.362	0.0608	0.0737	-0.0673	-0.0583
	(0.224)	(0.226)	(0.247)	(0.245)	(0.115)	(0.116)	(0.124)	(0.126)	(0.217)	(0.252)	(0.246)	(0.267)	(0.139)	(0.129)	(0.131)	(0.124)
$\ln(M\ OJT_{j,.})$	0.598***	0.596***	0.687***	0.686***	0.967***	0.970***	0.972***	0.976***	0.261*	0.259*	0.361***	0.367***	0.674***	0.670***	0.698***	0.693***
	(0.163)	(0.163)	(0.125)	(0.126)	(0.107)	(0.108)	(0.0977)	(0.0989)	(0.146)	(0.146)	(0.107)	(0.109)	(0.0881)	(0.0866)	(0.0810)	(0.0808)
$H\ diff_j$	0.351	0.327	0.479	0.451	-0.264	-0.248	-0.207	-0.186	0.119	0.0717	0.257	0.206	-0.623**	-0.609**	-0.575**	-0.549**
	(0.480)	(0.491)	(0.424)	(0.429)	(0.318)	(0.309)	(0.287)	(0.280)	(0.461)	(0.480)	(0.403)	(0.413)	(0.278)	(0.272)	(0.233)	(0.233)
$M\ diff_j$	2.889***	2.916***	2.532***	2.558***	1.391***	1.365***	1.379***	1.344***	3.587***	3.662***	3.171***	3.233***	2.082***	2.091***	2.026***	2.037***
	(0.670)	(0.680)	(0.486)	(0.493)	(0.378)	(0.374)	(0.342)	(0.340)	(0.658)	(0.684)	(0.472)	(0.486)	(0.340)	(0.338)	(0.301)	(0.305)
$\ln(sigma_j)$	0.140	0.137	0.145	0.142	0.216***	0.220***	0.210***	0.215***	0.0842	0.0906	0.0949	0.0937	0.174***	0.170***	0.168***	0.167***
	(0.116)	(0.116)	(0.0981)	(0.0967)	(0.0726)	(0.0727)	(0.0682)	(0.0682)	(0.116)	(0.119)	(0.102)	(0.103)	(0.0596)	(0.0598)	(0.0535)	(0.0548)
$\ln(1 + tariff_{l,j,t})$	-8.840	-8.676	-11.07*	-10.90*	6.039	6.405	4.005	4.411	0.148	-1.574	-2.276	-4.254	14.48***	15.03***	10.88**	11.71***
	(7.596)	(7.593)	(6.323)	(6.260)	(5.173)	(5.196)	(4.838)	(4.820)	(7.661)	(8.106)	(6.472)	(6.877)	(4.990)	(4.934)	(4.664)	(4.543)
$\ln(skill\ int_j)$			0.523**	0.534**			0.226	0.232			0.535**	0.579**			0.352***	0.350***
			(0.256)	(0.252)			(0.153)	(0.153)			(0.265)	(0.268)			(0.123)	(0.126)
Observations	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979

Fixed effects: country-year (lt). The subindex "." indicates t in columns (1)-(8), while in columns (9)-(16) they are included at mean values. Cluster s.e. at final good sector j. Coefficients reported. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

E.3 Empirical dynamic model

E.3.1 Derivation of total imports and offshoring share: sectoral aggregate.

I compute the aggregate imports of sector j under outsourcing in period t:

$$\begin{aligned}X^S_{m,O,j,t} =&\int_{\theta_{O,j,t}}^{\theta_{V,j,t}} x^S_{m,O,j,t}(\theta)H_{j,t}\frac{g(\theta)}{1-G(\underline{\theta}_{j,t})}d\theta\\ =&H_{j,t}\left[\chi^S_{O,j,t}\int_{\theta^S_{O,j,t}}^{\infty} x^S_{m,O,j,t}(\theta)\frac{g(\theta)}{1-G(\theta^S_{O,j,t})}d\theta-\chi^S_{V,j,t}\int_{\theta^S_{V,j,t}}^{\infty} x^S_{m,O,j,t}(\theta)\frac{g(\theta)}{1-G(\theta^S_{V,j,t})}d\theta\right]\\ =&H_{j,t}\frac{\alpha_j^{\sigma_j}(1-\beta_j)(1-\eta_j)}{w^S}\gamma_j EP^{\sigma_j-1}_{j,t}\left[\left(\frac{\beta^S_j}{w^N}\right)^{\eta_j}\left(\frac{1-\beta^S_j}{w^S}\right)^{1-\eta_j}\right]^{\sigma_j-1}\\ &\times\left[\chi^S_{O,j,t}\left(\bar{\theta}^S_{O,j,t}\right)^{\sigma_j-1}-\chi^S_{V,j,t}\left(\bar{\theta}^S_{V,j,t}\right)^{\sigma_j-1}\right]\end{aligned} \tag{85}$$

Adding (97) and (85), I obtain the aggregate total imports of sector j in period t:

$$\begin{aligned}X^S_{m,j,t} =&X^S_{m,O,j,t}+X^S_{m,V,j,t},\\ =&H_{j,t}\left[\chi^S_{O,j,t}x^S_{m,O,j,t}(\bar{\theta}^S_{O,j,t})+\chi^S_{V,j,t}\left[x^S_{m,V,j,t}(\bar{\theta}^S_{V,j,t})-x^S_{m,O,j,t}(\bar{\theta}^S_{O,j,t})\right]\right].\end{aligned} \tag{86}$$

Using $\frac{x^S_{m,V,j,t}(\theta)}{x^S_{m,O,j,t}(\theta)}=\frac{1-\beta^S_{V,j,t}}{1-\beta_j}\left[\left(\frac{\beta^S_{V,j,t}}{\beta_j}\right)^{\eta_j}\left(\frac{1-\beta^S_{V,j,t}}{1-\beta_j}\right)^{1-\eta_j}\right]^{\sigma_j-1}$, I get:

$$X^S_{m,j,t} =H_{j,t}\left[\chi^S_{O,j,t}x^S_{m,O,j,t}(\bar{\theta}^S_{O,j,t})+\chi^S_{V,j,t}\left[\frac{1-\beta^S_{V,j,t}}{1-\beta_j}\left[\left(\frac{\beta^S_{V,j,t}}{\beta_j}\right)^{\eta_j}\left(\frac{1-\beta^S_{V,j,t}}{1-\beta_j}\right)^{1-\eta_j}\right]^{\sigma_j-1}-1\right]x^S_{m,O,j,t}(\bar{\theta}^S_{O,j,t})\right]. \tag{87}$$

Replacing with the respective expressions for $x_{m,.,j,t}(.)$:

$$\begin{aligned}X^S_{m,j,t} =&H_{j,t}\frac{\alpha_j^{\sigma_j}(1-\beta_j)(1-\eta_j)}{w^S}\gamma_j EP^{\sigma_j-1}_{j,t}\left[\left(\frac{\beta^S_j}{w^N}\right)^{\eta_j}\left(\frac{1-\beta^S_j}{w^S}\right)^{1-\eta_j}\right]^{\sigma_j-1}\\ &\times\left[\chi^S_{O,j,t}(\bar{\theta}^S_{O,j,t})^{\sigma_j-1}+\chi^S_{V,j,t}\left[\frac{1-\beta^S_{V,j,t}}{1-\beta_j}\left[\left(\frac{\beta^S_{V,j,t}}{\beta_j}\right)^{\eta_j}\left(\frac{1-\beta^S_{V,j,t}}{1-\beta_j}\right)^{1-\eta_j}\right]^{\sigma_j-1}-1\right](\bar{\theta}^S_{V,j,t})^{\sigma_j-1}\right]\end{aligned} \tag{88}$$

The offshoring share of sector j in period t is:

$$\begin{aligned}\textit{offshr shr}_{j,t} \equiv&\frac{w^S X^S_{m,j,t}}{\gamma_j E}\\ =&H_{j,t}\alpha_j^{\sigma_j}(1-\beta_j)(1-\eta_j)P^{\sigma_j-1}_{j,t}\left[\left(\frac{\beta^S_j}{w^N}\right)^{\eta_j}\left(\frac{1-\beta^S_j}{w^S}\right)^{1-\eta_j}\right]^{\sigma_j-1}\\ &\times\left[\chi^S_{O,j,t}(\bar{\theta}^S_{O,j,t})^{\sigma_j-1}+\chi^S_{V,j,t}\left[\frac{1-\beta^S_{V,j,t}}{1-\beta_j}\left[\left(\frac{\beta^S_{V,j,t}}{\beta_j}\right)^{\eta_j}\left(\frac{1-\beta^S_{V,j,t}}{1-\beta_j}\right)^{1-\eta_j}\right]^{\sigma_j-1}-1\right](\bar{\theta}^S_{V,j,t})^{\sigma_j-1}\right]\end{aligned} \tag{89}$$

E.3.2 Competition effect: first channel. Reduced-form models

Table 10 reports the full table related to the results in Table 1, and additional robustness checks. In particular, it includes the estimation results of the effect of the offshoring share in levels on the intra-firm import share. The table reports the estimated coefficients and the average marginal effects.

Table 10: Competition effect: full table.

	(1)		(2)		(3)	
	$IFshr_{j,t}$		$IFshr_{j,t}$		$IFint_{j,t}$	
	+	++	+	++	+	++
$\ln(\textit{offshr shr}_{j,t})$	-0.180**	-0.0381***				
	(0.0768)	(0.0139)				
$\textit{offshr shr}_{j,t}$			-2.356*	-0.506*	11.69***	0.279***
			(1.427)	(0.289)	(1.319)	(0.0389)
$\textit{offshr shr}^2_{j,t}$					-6.006***	-0.143***
					(1.268)	(0.0331)
$\textit{H diff}_j$	0.806	0.171	0.728	0.156	1.417***	0.0338***
	(0.797)	(0.176)	(0.926)	(0.204)	(0.447)	(0.0118)
$\textit{M diff}_j$	1.970***	0.417***	1.966**	0.422***	1.665***	0.0398***
	(0.715)	(0.123)	(0.766)	(0.136)	(0.594)	(0.0126)
$\ln(\textit{sigma}_j)$	0.599**	0.127**	0.614*	0.132**	0.547***	0.0131***
	(0.295)	(0.0545)	(0.342)	(0.0657)	(0.162)	(0.00368)
$\eta(\bar{FA})_j$	-0.477	-0.101	-0.504	-0.108	-0.501***	-0.0120***
	(0.340)	(0.0647)	(0.381)	(0.0741)	(0.192)	(0.00409)
constant	-3.893***		-2.940***		-8.357***	
	(0.877)		(0.866)		(0.407)	
FEs	t	t	t	t	t	t
Observations	2039	2039	2039	2039	2039	2039

Coefficients (+) and average marginal effects (++). Standard errors in parentheses. Cluster s.e. at sector j.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11 shows the estimated coefficients and the average marginal effects of the models reported in Table 10, but including final good producer sector fixed effects.

Table 11: Competition effect: sector j FEs.

	(1)		(2)		(3)	
	$IFshr_{j,t}$		$IFshr_{j,t}$		$IFint_{j,t}$	
	+	++	+	++	+	++
$\ln(\textit{offshr shr}_{j,t})$	0.0450*	0.00797*				
	(0.0238)	(0.00421)				
$\textit{offshr shr}_{j,t}$			-0.141	-0.0251	16.69***	0.393***
			(0.562)	(0.0996)	(2.007)	(0.0471)
$\textit{offshr shr}^2_{j,t}$					-13.38***	-0.315***
					(2.215)	(0.0522)
FEs	t , j		t , j		t , j	
Observations	2078		2078		2078	

Coefficients (+) and average marginal effects (++). Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Definition of the main variables of model in section 4.3.3. As before, the data on *total sales*$_{j,t}$ comes from the manufacturing survey. The data on total imports and intra-firm imports at the input sector level in year t from country l, *total imp*$_{m,l,t}$ and *IF imp*$_{m,l,t}$, comes from the related-party trade dataset.

The $IFshr_{l,j,t}$ captures the intra-firm share of sector j from country l in period t, and it is defined as:

$$IFshr_{l,j,t} = \sum_m IFshr_{m,l,t} \times MshrH_{m,j} \quad \text{with} \quad IFshr_{m,l,t} = \frac{IF\ imp_{m,l,t}}{total\ imp_{m,l,t}}, \tag{90}$$

The *offshr shr*$_{j,t}$ measures the offshoring share of sector j in period t, and it is given by:

$$\begin{aligned} offshr\ shr_{j,t} =& \frac{tot\ imp_{j,t}}{tot\ sales_{j,t}} \\ & \text{with } tot\ imp_{j,t} = \sum_l tot\ imp_{l,j,t} = \sum_l \sum_m tot\ imp_{m,l,t} \times HshrM_{m,j} \end{aligned} \tag{91}$$

The mean bilateral tariffs of sector j for imports from country l in period t are defined as:

$$tariffs_{l,j,t} = \sum_m tariffs_{m,l,t} \times MshrH_{m,j} \tag{92}$$

Table 12 shows the full table of the estimated coefficients and the average marginal effects of the model reported in Table 2. The table also includes the estimation results of the effect of the offshoring share in levels on the intra-firm import share.

Table 12: Competition effect: full table.

	(1)		(2)		(3)		(4)		(5)		(6)	
	$IFshr_{l,j,t}$		$IFshr_{l,j,t}$		$IFshr_{l,j,t}$		$IFshr_{l,j,t}$		$IFint_{l,j,t}$		$IFint_{l,j,t}$	
	+	++	+	++	+	++	+	++	+	++	+	++
$\ln(offshr\ shr_{j,t})$	-0.0764**	-0.00598**	-0.101***	-0.00756***								
	(0.0353)	(0.00264)	(0.0350)	(0.00244)								
$offshr\ shr_{j,t}$					-0.358	-0.0280	-0.556	-0.0417	8.146***	0.0109***	8.111***	0.0104***
					(0.429)	(0.0333)	(0.409)	(0.0304)	(0.853)	(0.00117)	(0.799)	(0.00107)
$offshr\ shr^2_{j,t}$									-3.676***	-0.00494***	-3.674***	-0.00473***
									(0.881)	(0.00116)	(0.863)	(0.00111)
$H\ diff_j$	-0.247	-0.0193	-0.247	-0.0185	-0.244	-0.0191	-0.240	-0.0180	0.726	0.000975	0.797	0.00102
	(0.376)	(0.0288)	(0.354)	(0.0259)	(0.406)	(0.0313)	(0.384)	(0.0283)	(0.549)	(0.000727)	(0.503)	(0.000643)
$M\ diff_j$	4.179***	0.327***	4.487***	0.336***	4.135***	0.324***	4.422***	0.332***	2.021***	0.00271***	1.919***	0.00247***
	(0.316)	(0.0164)	(0.317)	(0.0153)	(0.331)	(0.0184)	(0.320)	(0.0167)	(0.386)	(0.000505)	(0.322)	(0.000373)
$\ln(sigma_j)$	0.0670	0.00525	0.106	0.00796	0.0527	0.00413	0.0915	0.00686	0.319***	0.000428***	0.358***	0.000460***
	(0.113)	(0.00873)	(0.102)	(0.00748)	(0.122)	(0.00947)	(0.111)	(0.00822)	(0.102)	(0.000129)	(0.101)	(0.000124)
$\eta(\bar{FA})_j$	-0.0553	-0.00433	-0.0995	-0.00745	-0.0487	-0.00382	-0.0914	-0.00686	-0.450***	-0.000604***	-0.435***	-0.000560***
	(0.141)	(0.0109)	(0.134)	(0.00978)	(0.156)	(0.0120)	(0.149)	(0.0109)	(0.169)	(0.000224)	(0.169)	(0.000212)
$\ln(1 + tariff_{l,j,t})$	-3.553	-0.278	-0.498	-0.0373	-0.840	-0.0659	2.474	0.186	-71.23**	-0.0957**	-40.45**	-0.0520**
	(8.747)	(0.675)	(9.749)	(0.729)	(8.169)	(0.638)	(8.941)	(0.677)	(29.69)	(0.0384)	(16.56)	(0.0210)
constant	-3.235***		-3.486***		-2.660***		-2.705***		-10.31***		-10.15***	
	(0.380)		(0.337)		(0.315)		(0.241)		(0.462)		(0.342)	
FEs	l , t	l , t	lt	lt	l , t	l , t	lt	lt	l , t	l , t	lt	lt
Observations	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979	60979

Coefficients (+) and average marginal effects (++). Standard errors in parentheses. Cluster s.e. at sector j. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Definition of the main variables of model in section 4.3.4. The bilateral infra-firm intensity of the sector j is defined as:

$$IFint_{l,j,t} = \frac{IF\ imp_{l,j,t}}{tot\ sales_{j,t}} \quad \text{with} \quad IF\ imp_{l,j,t} = \sum_m imp\ rel_{m,l,t} \times HshrM_{m,j} \tag{93}$$

Table 13 shows that that the offshoring activity has an opposite effect on the intra-firm import share relative to the theoretical predictions, when ρ_j fixed effects are included. In the case of the models related to the effects on the intra-firm intensity, the results and conclusions remain robust in all the specifications.

Table 13: Competition effect: sector j FEs.

	(1)		(2)		(3)		(4)		(5)		(6)	
	$IFshr_{l,j,t}$		$IFshr_{l,j,t}$		$IFshr_{l,j,t}$		$IFshr_{l,j,t}$		$IFint_{l,j,t}$		$IFint_{l,j,t}$	
	+	++	+	++	+	++	+	++	+	++	+	++
$\ln(offshr\ shr_{j,t})$	0.0388**	0.00300**	0.0389*	0.00287*								
	(0.0188)	(0.00145)	(0.0236)	(0.00174)								
$offshr\ shr_{j,t}$					0.948***	0.0731***	1.031***	0.0761***	6.469***	0.00865***	7.799***	0.00999***
					(0.279)	(0.0214)	(0.375)	(0.0271)	(0.891)	(0.00131)	(0.574)	(0.000746)
$offshr\ shr^2_{j,t}$									-2.957***	-0.00396***	-4.000***	-0.00512***
									(0.800)	(0.00111)	(0.594)	(0.000761)
$ln(1+tariff_{l,j,t})$	19.77**	1.527**	30.65***	2.263***	20.64**	1.593**	31.97***	2.359***	-73.86**	-0.0988**	-39.32*	-0.0504*
	(8.635)	(0.669)	(7.469)	(0.554)	(8.236)	(0.638)	(7.069)	(0.523)	(34.04)	(0.0453)	(21.51)	(0.0279)
FEs	j, l, t		j, lt		j, l, t		j, lt		j, l, t		j, lt	
Observations	62188		62188		62188		62188		62188		62188	

Coefficients (+) and average marginal effects (++). Standard errors in parentheses. Cluster s.e. at sector j. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

E.3.3 Competition effect: First channel. Derivation of first and second stages

First stage: Price index. The sector's price index can be expressed as:[115]

$$\begin{aligned} P_{j,t}^{1-\sigma_j} = &\left(P_{j,t}^{O^N_{j,t}}\right)^{1-\sigma_j} + \chi^N_{V,j,t}\left[\left(P_{j,t}^{V^N_{j,t}}\right)^{1-\sigma_j} - \left(P_{j,t}^{V^N_{j,t}|O^N_{j,t}}\right)^{1-\sigma_j}\right] \\ &+ \chi^S_{O,j,t}\left[\left(P_{j,t}^{O^S_{j,t}}\right)^{1-\sigma_j} - \left(P_{j,t}^{O^S_{j,t}|V^N_{j,t}}\right)^{1-\sigma_j}\right] + \chi^S_{V,j,t}\left[\left(P_{j,t}^{V^S_{j,t}}\right)^{1-\sigma_j} - \left(P_{j,t}^{V^S_{j,t}|O^S_{j,t}}\right)^{1-\sigma_j}\right], \end{aligned} \tag{94}$$

where $P_{j,t}^{k^l_{j,t}}$ represents the price index of all the producers $\theta \geq \theta^l_{k,j,t}$ in sector j as if they were all under organisational structure k^l. Finally, $P_{j,t}^{O^S_{j,t}|V^N_{j,t}}$ denotes the price index of all the producers $\theta \geq \theta^S_{O,j,t}$ as if they were under the cost structure of domestic integration, and $P_{j,t}^{V^S_{j,t}|O^S_{j,t}}$ refers to the price index of all the producers $\theta \geq \theta^S_{V,j,t}$ as if they were under the cost structure of foreign outsourcing.

As already mentioned, $\chi^S_{O,j,t}$ indicates the share of final good producers under any type of offshoring in t. Equation (94) shows that as more final good producers offshore, i.e. $\chi^S_{O,j,t} \uparrow$, the lower the price index.[116] In the empirical model, I proxy the changes in the extensive margin of final good producers under offshoring, $\chi^S_{O,j,t}$, by changes in the offshoring intensive margin at the sectoral level, i.e. $offshr\ shr_{j,t}$.

The first-stage regression is thus given by:

$$\ln(P_{j,t}) = b_0 + b_1 \ln(offshr\ shr_{j,t}) + other\ controls + b_l + b_t + u_{j,t}$$

[115] See Appendix A.8 for proofs.

[116] An increase in $\chi^S_{O,j,t}$ generates a reduction in $\chi^S_{V,j,t}$, $\chi^S_{V,j,t}$ and an increase in the market productivity cutoff. While the latter generates a further reduction in the price index, due to the higher mean productivity in the market, the vertical disintegration in the domestic and offshore supply chains induce an increase in the price index. However, those effects come from the initial reduction in the price index. Therefore, it is easy to see that those effects do not overcome the initial impact, and thus the increase in $\chi^S_{O,j,t}$ has a negative net effect on the price index.

Second stage: Intra-firm intensity. From the theoretical model above, I have that intermediate input imports in period t for a final good producer θ under foreign integration, $x^S_{m,V,j,t}(\theta)$, are given by:

$$x^S_{m,V,j,t}(\theta) = \frac{\alpha_j(1-\beta^S_V)(1-\eta_j)}{w^S} r^S_{V,j,t}(\theta), \tag{95}$$

with

$$r^S_{V,j,t}(\theta) = \alpha_j^{\sigma_j-1}\theta^{\sigma_j-1}(\gamma_j E)^{\sigma_j} Q^{1-\sigma_j}_{j,t} \left[\left(\frac{\beta^S_{V,j}}{w^N}\right)^{\eta_j}\left(\frac{1-\beta^S_{V,j}}{w^S}\right)^{1-\eta_j}\right]^{\sigma_j}. \tag{96}$$

Plugging (96) into (95), and replacing $Q_{j,t} = \frac{\gamma_j E}{P_{j,t}}$, I get:

$$x^S_{m,V,j,t}(\theta) = \frac{\alpha_j^{\sigma_j}(1-\beta^S_V)(1-\eta_j)}{w^S}\gamma_j E P^{\sigma_j-1}_{j,t}\left[\left(\frac{\beta^S_{V,j}}{w^N}\right)^{\eta_j}\left(\frac{1-\beta^S_{V,j}}{w^S}\right)^{1-\eta_j}\right]^{\sigma_j}. \tag{97}$$

If I aggregate over all firms under V^S in period t, the intra-firm imports in sector j in period t are:

$$X^S_{m,V,j,t} = \int_{\theta_{V,j,t}}^{\infty} x^S_{m,V,j,t}(\theta) H_{j,t}\frac{g(\theta)}{1-G(\underline{\theta}_{j,t})}d\theta.$$

The intra-firm intensity of sector j in period t is defined as $\mathit{IFint}_{j,t} \equiv \frac{w^S X^S_{m,V,j,t}}{\gamma_j E}$. Replacing with (97), I get the $\mathit{IFint}_{j,t}$ as a function of $P_{j,t}$:

$$\mathit{IFint}_{j,t} = \alpha_j^{\sigma_j}(1-\beta^S_{V,j})(1-\eta_j)\left[\left(\frac{\beta^S_{V,j}}{w^N}\right)^{\eta_j}\left(\frac{1-\beta^S_{V,j}}{w^S}\right)^{1-\eta_j}\right]^{\sigma_j-1} P^{\sigma_j-1}_{j,t}\left[\bar{\theta}^S_{V,j,t}\right]^{\sigma_j-1}\chi^S_{V,j,t}H_{j,t}$$

with $\bar{\theta}^S_{V,j,t}(P_{j,t})$, $\chi^S_{V,j,t}(P_{j,t})$, and $H_{j,t}(P_{j,t})$. Taking logs and grouping all variables that depend on $(P_{j,t})$, the intra-firm intensity is given by:

$$\mathit{IFint}_{j,t} = \exp\left\{\ln\left[\alpha_j^{\sigma_j}(1-\beta^S_{V,j})(1-\eta_j)\left[\left(\frac{\beta^S_{V,j}}{w^N_t}\right)^{\eta_j}\left(\frac{1-\beta^S_{V,j}}{w^S_t}\right)^{1-\eta_j}\right]^{\sigma_j-1}\right] + \ln\left[\mathcal{P}_{j,t}\right]\right\}, \tag{98}$$

with $\mathcal{P}_{j,t} \equiv P^{\sigma_j-1}_{j,t}\left[\bar{\theta}^S_{V,j,t}(P_{j,t})\right]^{\sigma_j-1}\left[\chi^S_{V,j,t}(P_{j,t})\right]^{\sigma_j-1}\left[H_{j,t}(P_{j,t})\right]^{\sigma_j-1}$.

The second-stage regression is given by:

$$\mathbb{E}\left[\mathit{IFint}_{l,j,t}\middle|\boldsymbol{x}\right] = \frac{\exp(\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho})}{1+\exp(\boldsymbol{x}'_{l,j,t}\boldsymbol{\rho})} \quad \text{with} \quad \boldsymbol{x}'_{l,j,t}\boldsymbol{\rho} = \rho_1\widehat{\ln(P_{j,t})} + \mathit{other\ controls} + \rho_l + \rho_t.$$

From the expression of $\mathcal{P}_{j,t}$, it is possible to see that changes in the price index have direct impacts on the $\mathit{IFint}_{j,t}$, as well as indirect impacts through the effects of the price index on $\bar{\theta}^S_{V,j,t}$, $\chi^S_{V,j,t}$ and $H_{j,t}$. Therefore, the second stage captures the net effect of the changes in the predicted price index, i.e. the effect of $\mathcal{P}_{j,t}$ on the intra-firm intensity due to a reduction in the offshoring productivity cutoff.

Competition effect: First channel. Two-stage regression. Tables. Table 14 reports the full table of the first stage shown in Table 4.

Table 14: All first stage coefficients of table 4.

	First stage: All coefficients		
	(1)	(2)	(3)
	$\ln(P_{j,t})$	$\ln(P_{j,t})$	$\ln(P_{j,t})$
$\ln(\textit{offshr shr}_{j,t})$	-0.0312***	-0.0350***	-0.0352***
	(0.00869)	(0.00959)	(0.00979)
$\ln(1+\textit{tariff}_{l,j,t})$		2.797	2.655
		(1.859)	(1.899)
$\textit{H diff}_j$	0.0423	0.0923	0.0929
	(0.152)	(0.151)	(0.152)
$\textit{M diff}_j$	-0.00168	0.0351	0.0376
	(0.0683)	(0.0583)	(0.0596)
$\ln(\textit{sigma}_j)$	0.0704	0.0788	0.0790
	(0.0468)	(0.0499)	(0.0504)
$\eta(\bar{FA})_j$	0.00825	-0.00564	-0.00564
	(0.0227)	(0.0253)	(0.0255)
FEs	t	l , t	lt
R^2	0.292	0.297	0.309
Adjusted R^2	0.285	0.294	0.282

Cluster s.e. at sector j. Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

E.3.4 Competition effect: Both channels. Derivation of first and second stages.

First stage: Price index. The sector's price index can be expressed as:[117]

$$\begin{aligned} P_t^{1-\sigma} = {} & \left(P_t^{O_t^N}\right)^{1-\sigma} + \chi_{V,t}^N \left[\left(P_t^{V_t^N}\right)^{1-\sigma} - \left(P_t^{V_t^N|O_t^N}\right)^{1-\sigma}\right] \\ & + \chi_{O,t}^S \left[\left(P_t^{O_t^S}\right)^{1-\sigma} - \left(P_t^{O_t^S|V_t^N}\right)^{1-\sigma}\right] + \chi_{V,t}^S \left[\left(P_t^{V_t^S}\right)^{1-\sigma} - \left(P_t^{V_t^S|O_t^S}\right)^{1-\sigma}\right] \\ & + \chi_{O,t}^E \left[\left(P_t^{O_t^E}\right)^{1-\sigma} - \left(P_t^{O_t^E|V_t^S}\right)^{1-\sigma}\right] + \chi_{V,t}^E \left[\left(P_t^{V_t^E}\right)^{1-\sigma} - \left(P_t^{V_t^E|O_t^E}\right)^{1-\sigma}\right]. \end{aligned} \tag{99}$$

Second stage: Intra-firm intensity. The intra-firm intensity of sector j in period t is given by:

$$\textit{IFint}_{l,j,t} = \exp\left\{ \ln\left[\alpha_j^{\sigma_j}(1-\beta_{V,j}^l)(1-\eta_j)\left[\left(\frac{\beta_{V,j}^l}{w_t^N}\right)^{\eta_j}\left(\frac{1-\beta_{V,j}^l}{w_t^l}\right)^{1-\eta_j}\right]^{\sigma_j-1}\right] + \ln\left[\mathcal{P}_{j,t}\right]\right\}, \tag{100}$$

with $\mathcal{P}_{j,t} \equiv P_{j,t}^{\sigma_j-1}\left[\bar{\theta}_{V,j,t}^l(P_{j,t})\right]^{\sigma_j-1}\left[\chi_{V,j,t}^l(P_{j,t})\right]^{\sigma_j-1}\left[H_{j,t}(P_{j,t})\right]^{\sigma_j-1}$.

[117] See Appendix D for proofs.

Competition effect: Both channels. Two-stage regression. Tables. Table 15 reports the full table for the two stages.

Table 15: Two-stage regression: Full table.

	Second stage: All coefficients reported		
	Agg. countries	*No aggregation of countries*	
	(1)	(2)	(3)
	$IFint_{j,t}$	$IFint_{l,j,t}$	$IFint_{l,j,t}$
$\widehat{\ln(P_{j,t})}$	-33.52***	-23.42***	-23.38***
	(1.981)	(1.751)	(1.697)
$\ln(1+tariff_{l,j,t})$		53.39**	61.62***
		(21.015)	(19.087)
$H\ diff_j$	2.158***	2.862***	2.902***
	(0.626)	(0.548)	(0.534)
$M\ diff_j$	-0.122	3.639***	3.557***
	(0.668)	(0.582)	(0.526)
$\ln(sigma_j)$	2.263***	1.873***	1.873***
	(0.217)	(0.152)	(0.154)
$\eta(\bar{FA})_j$	0.100	-0.405**	-0.386**
	(0.118)	(0.184)	(0.174)
FEs	t	t , l	lt
	First stage: All coefficients		
	(1)	(2)	(3)
	$\ln(P_{j,t})$	$\ln(P_{j,t})$	$\ln(P_{j,t})$
$\ln(offshr\ shr_{j,t})$	-0.0307***	-0.0340***	-0.0340***
	(0.00841)	(0.00961)	(0.00981)
$\ln(CHN\ mrkt\ shr_{j,t})$	-0.00531	-0.00784**	-0.00826**
	(0.00332)	(0.00323)	(0.00343)
$H\ diff_j$	0.0315	0.0957	0.0963
	(0.149)	(0.152)	(0.153)
$M\ diff_j$	0.0346	0.0790	0.0816
	(0.0763)	(0.0668)	(0.0686)
$\ln(sigma_j)$	0.0647	0.0802	0.0805
	(0.0448)	(0.0505)	(0.0510)
$\eta(\bar{FA})_j$	0.00584	-0.00746	-0.00742
	(0.0234)	(0.0259)	(0.0261)
$\ln(1+tariff_{l,j,t})$		4.138**	4.119**
		(1.685)	(1.709)
FEs	t	t , l	lt
R^2	0.299	0.301	0.314
Adjusted R^2	0.291	0.298	0.285

Second stage: Bootstrapped s.e. (1000 rep). Coefficients reported.
All stages: Cluster s.e. at sector j. Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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