Industry Uncertainty, Exports and FDI

Abstract

In this study, I analyze the firm's choice of serving a foreign market through exports or through foreign affiliate sales under uncertainty. The uncertainty is decomposed into aggregate country-specific uncertainty and disaggregated industry-specific uncertainty. I construct a theoretical model, which predicts that country pairs with less-correlated output fluctuations trade more, relative to affiliate sales, the market with higher industry uncertainty is less likely to be served by foreign affiliates, and that an industry with a higher demand in a country with higher unit cost shock will be attracting less exports. Using detailed industry level data on trade and affiliate sales for a large number of home and destination countries, I find empirical support for my model's predictions. In addition, I find new implications regarding the effects of aggregate and industry level of uncertainty on intensive and extensive margins of trade and FDI.

Keywords: Uncertainty, Proximity-Concentration, Multinational firms, Foreign Direct Investment, International Trade

Navruz Khotamov

Graduate School of Economics

Kyoto University

Kyoto - 2021

1. INTRODUCTION

Recently the trade literature has seen a growth of interest in studying the uncertainty and its impact on firms engaged in exports or on multinational firms (Esposito 2017; Feng et al. 2017; Gervais 2018; Handley 2014; Handley and Limão 2017; Héricourt and Nedoncelle 2018; Lewis 2014; Nguyen 2012; Novy and Taylor 2019; Ramondo et al. 2013).

Multinational firms and exporters are particularly disposed to making decisions under uncertainty when serving foreign markets. The literature has focused primarily on two ways through which firms serve foreign markets: they can export domestically produced goods, or they can supply the destination market with goods produced by foreign affiliates, a form of foreign direct investment (FDI).[1] The choice over production locations weighs the gains from avoiding transportation costs against the diseconomies of scale that result from splitting production across multiple affiliates. This choice, known as *the proximity-concentration tradeoff*, has become the central framework for studying horizontal FDI.[2]

This tradeoff is, usually, accompanied by uncertainties persistent in the home and destination markets both at the aggregate level and at the level of the industry.[3] Aggregate level uncertainties could be related to macroeconomic variables that could affect the profitability of the firms such as aggregate output, wages, exchange rates, economic policy, taxes and others. Industry or sector level uncertainties could be related to more microeconomic variables that could affect the profitability of firms such as sector-specific demand conditions, product or sector-specific technology changes, and others. When making this decision, the firms have to consider uncertainty about future conditions in the markets in which they operate. The role of uncertainty is principal when firms decide on costly investments. Firms have to consider both aggregate economy wide uncertainty, and the respective industry uncertainty in the destination markets.

Uncertainty effects both the exporters and the multinational firms, but in a different mechanism. The mechanism through which uncertainty may positively or negatively affect firms is linked to the convexity or the concavity of the profit function (Klemperer and Meyer, 1986) or of the marginal product of capital as in Hartman (1972) and Abel (1983) configuration. Ramondo and Rappoport (2010) show that it is optimal to open affiliates in economies that are least correlated with world (aggregate) risk, such as small countries. In my paper, the uncertainty comes from the stochastic properties of production cost and demand, both within and across countries and industries.

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[1] Other ways in which firms may serve foreign markets include licensing and exporting from a third country.
[2] See, among others, Markusen (1984), Brainard (1997), and Helpman et al. (2004)
[3] Uncertainties at the firm-level are also important, but in this article, I focus on uncertainties at a higher level of aggregation which could be relevant for a group of firms either at the industry level or at the country level.

This paper is an extension of a paper by Ramondo et al. (2013) who analyze proximity concentration trade-off under country-specific uncertainty. Their model is constructed as an extension of the setup in Helpman et al. (2004) to a stochastic environment. In their model, country-specific productivity shocks endogenously generate pro-cyclical unit costs of production.

I extend their paper both theoretically and empirically. Theoretical extension comes by introducing industry-specific uncertainty and multi-industries, whereas empirical extension comes by expanding the period, number of countries covered, and more importantly two new variables that capture industry-specific uncertainty and the interaction between industry-specific uncertainty and country-specific uncertainty.

The extension of the model used by Ramondo et al. (2013) is important based on several aspects. First, introducing additional source of uncertainty, i.e. industry level uncertainty, I am able to capture the effects of both the aggregate country-specific uncertainty and industry-specific uncertainty on the value of exports and affiliate sales. A number of recent studies have focused on industry-level uncertainty and they find that industry level uncertainty has significant effect on firm investment, and exports (De Sousa et al. 2020). Second, on the empirical side, this extension enables me to analyze the differential effects of country-level uncertainty and industry-level uncertainty on exports, affiliates sales, and their trade-off. Third, the novel dataset provides an opportunity to analyze the intensive and extensive margins of trade and affiliate sales under uncertainty, which deliver a number of interesting implications. Finally, my novel dataset covers an extensive number of both home and host countries (26 and 72 respectively), unlike the paper by Ramondo et al. (2013) where they have only one home country, the Unites States. It is important to cover firms from a number of countries. If focusing only on US firms, there could be some comparative advantage that US firms have on the industry level. By focusing on a larger set of countries, I am able remove this potential selection bias.

The motivation behind this research is to examine the effects of different levels of uncertainty on mode of servicing a foreign market. Even though the recent economic uncertainties are a result of global pandemic, the effect is different per country and industry levels. Consequently, study of both country-level uncertainty and industry-level uncertainty should provide a better insight into the choices of the firms.

The studies on this topic are scarce. The goal of my research is to fill this gap. By decomposing uncertainty into country level uncertainty and industry-level uncertainty, I try to explain the differential effects of these two sources of uncertainty on the proximity concentration tradeoff and on the intensive and extensive margins of trade and affiliate sales.

The objective of this article is to answer two main questions: i) how do country-specific uncertainty and industry-specific uncertainty affect the way a firm chooses to serve a foreign market? ii) what is the effect of different levels of uncertainty on the extensive and intensive margins?

The crucial difference between exporting and using a foreign affiliate is the location of production. Exporters produce in the source country, and, thus, their unit costs of production fluctuate with home-country shocks. Foreign affiliates produce in the destination country, so their unit costs fluctuate with host-country shocks.[4]

Given the assumptions, the model has four key predictions: first, firms will prefer to export rather than use foreign affiliates to serve countries whose business cycles are less correlated with those in their home country; second, firms will prefer to export rather than use foreign affiliates to serve more volatile countries; third, more volatile industries in foreign countries are more likely to be served by exports rather than by affiliate sales; and fourth, the interaction of country-specific and industry specific risk should have an effect on the choice of the firms regarding the proximity concentration trade-off.

I empirically test the predictions of my model for firms in OECD countries that are engaged in exports or affiliate sales. I construct a novel database of trade and affiliate sales covering 26 OECD countries as home countries and 72 destination countries in 11 manufacturing industries for eight consecutive years. I, then, add uncertainty variables for both the country-level uncertainty and the industry-level uncertainty, measured by fluctuations in aggregate country level gross output (GDP) and industry-level gross output (industry output) respectively. My data contains a large number of zeros for affiliate sales, as such I use two different methodologies to test the predictions of the model: i) I separate my sample into a sub-sample consisting only of positive values for both the exports and affiliate sales[5] and then run ordinary least squares (OLS) regression using ratio of exports to affiliate sales as the dependent variable. ii) I run a Zero-One Inflated Beta (ZOIB)[6] regression in my full sample using ratio of exports to affiliate sales plus exports as the dependent variable. I apply ZOIB regression because in my full sample there are a large number of zeros for affiliate sales, and I would like to capture those zeros because they present useful information regarding the extensive margin.

My results, in general, support the predictions of the paper regarding the effects of different levels of uncertainty on the proximity concentration tradeoff and on the intensive and extensive margins of international trade and FDI. My paper contributes to the existing literature by analyzing proximity concentration tradeoff under uncertainty. I extend the paper by Ramondo et al. (2013) by constructing and analyzing a more extensive database

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[4] The assumption that foreign affiliates are subject to host-country risk is consistent with the literature on international portfolio diversification and home bias. Owning shares of multinational firms is an alternative way of achieving such diversification. See, for example, Errunza *et al.* (1999), Rowland and Tesar (2004), and Cai and Warnock (2006).

[5] For the results to be comparable to existing research

[6] ZOIB regression is briefly explained in the empirical part of the paper

covering more countries and a longer period. (26 countries host countries, 72 destination countries, and 8 years). In addition, I analyze two different dependent variables and different, perhaps more suitable, regression estimation given that the data is bounded between 0 and 1, inclusive of the endpoints, Zero-One Inflated Beta Regression. Further contribution is that I deconstruct uncertainty by measuring uncertainty at industry level and introduce new variables to analyze the effect of industry level uncertainty on proximity concentration tradeoff, and effect of combined country level and industry level uncertainties. Finally, I derive new implications regarding proximity concentration trade-off and industry level uncertainty on extensive and intensive margins of trade and FDI.

The paper is organized as follows. In section 2 I review the literature on proximity concentration and uncertainty. Section 3 provides a brief theoretical background. Section 4 provides data description and presents the empirical evidence. In section 5, I conduct a number of robustness checks for the empirical results. Section 7 concludes the article.

2. LITERATURE REVIEW

Two main aspects of my research are proximity concentration tradeoff and uncertainty. These two aspects are covered by extensive research. As such, my research builds on a number of literatures.

The literature on the choice between export and FDI is mainly based on the "proximity concentration trade-off" model (Brainard, 1997; Helpman et al., 2004). This model states that FDI and trade are substitutes with respect to the trade costs and fixed costs of FDI. Brainard (1997) argues that lower trade costs have a positive effect on FDI relative to export sales and that higher FDI fixed costs have a negative effect on FDI relative to export. The firm would choose between proximity (saving on trade costs) and concentration (taking advantage of scale economies). In addition to this result, Helpman et al. (2004) find that a large productivity dispersion of firms has a positive effect on FDI relative to export and that more productive firms use affiliates, intermediate firms use export, and less productive firms serve only the domestic market. I contribute to this line of research by analyzing proximity concentration tradeoff under uncertainty.

Another line of theoretical research exposes that the relationship between FDI and trade appears to depend on market size and the nature of competition between firms (Neary, 2009; Mukherjee and Suetrong, 2012), the size of trade costs and the possibility to export back (Pontes, 2007). Neary (2009), and Mukherjee and Suetrong (2012) find that trade cost reduction may encourage FDI for export purposes. Pontes (2007) finds that the relationship between FDI and trade cost is non-monotonic; it is positive for low trade costs and becomes negative for high trade costs. The results of my estimation also contribute to this type of literature, I also find that larger trade costs have negative effect on foreign direct investment, and that for a certain high level of trade costs FDI becomes zero.

Other research on FDI and trade explores the complementarity between the two. Conconi et al. (2016) show that export and FDI may be complementary when considering the dynamic nature of the internationalization process of firms. Firms test foreign markets by exporting before investing in affiliate sales. Thus, the decision to engage in FDI after exporting depends upon the realization of firm productivity, the fixed cost of FDI and trade costs. In my research, however, I do not consider such aspects. I follow the proximity concentration tradeoff theory in viewing trade and FDI as substitutes.

There is, in addition, an extensive literature on the timing of FDI decisions. This literature is mainly based on the fact that the relationship between export and FDI depends not only on trade costs and fixed costs but also on the increase in exposure to risk resulting from FDI. The real options model has been widely used to address this question. Campa (1993) studies the impact of exchange rate fluctuation on the decision to engage in FDI by firms exporting to the United States. He shows that exchange rate uncertainty increases the waiting option. Pennings and Sleuwaegen (2004) find that the optimal value threshold to switch from export to FDI increases with uncertainty. In my research, however, I do not consider waiting options for FDI or trade decisions. My research, rather, analyzes dynamic behavior of exporting and multinational firms under different levels of uncertainty.

A number of literatures analyze the dynamic behavior of exporting and multinational firms under uncertainty. A part of this literature focuses on the large sunk investments entailed in opening affiliates and analyze the resulting option value of delaying FDI and supplying the market through exports in the meantime. See, for example, Rob and Vettas (2003) and Fillat and Garetto (2010). I rely on a more recent literature focused on output volatilities and business cycle correlations. Ramondo et al. (2013) analyze the proximity concentration tradeoff in the context of stochastic productivity. They theoretically and empirically test for a positive impact of gross output volatility on FDI and export resulting from the convexity of the profit function. My research follows their research closely, however their paper only considers the impact of aggregate level uncertainty not considering the effects of industry level uncertainty, and intensive and extensive margins, and their estimation is on a rather limited dataset[7].

A relatively new area of research analyzes the impact of industry level uncertainty on trade and FDI. Jose De Sousa et al. (2020) analyze the effects of demand uncertainty in foreign markets on the export decision of multinationals on industry level. They find that demand uncertainty in foreign markets affects export decisions and export sales. My research adds to this strand of literature by analyzing the impact of industry uncertainty on both the exports and FDI, and the tradeoff between the two options. To the best of my knowledge, there has not been a research decomposing uncertainty into aggregate level

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[7] They analyze the case of U.S. firms only for three benchmark years, which might be biased because of possible comparative advantage on the industry level for U.S. firms, whereas my research analyzes the cases firms from 26 OECD countries for eight consecutive years.

uncertainty and industry level uncertainty and analyzing the differential effects of the two levels of uncertainty of proximity concentration tradeoff and on the intensive and extensive margins.

Over the last decade the research on uncertainty, especially economic uncertainty has seen a dramatic growth. A large number of papers focus on policy uncertainty. Bloom (2009) finds that high uncertainty leads firms to cut or delay investment expenditures. This study states that increasing uncertainty provides an incentive to delay investments that are costly to reverse. A paper by Handley and Limao (2015) studies trade policy uncertainty, and they find that lower uncertainty about trade policy stimulates investment in export capacity. Caldara et al. (2019) find evidence that higher trade policy uncertainty has reduced U.S. business investment. These studies, mainly, focus on general economic policy uncertainty, and tariff policy uncertainty and their effects on investments, and exports. My research would contribute to this strand of literature by capturing the interaction of decomposed levels of uncertainty on exports, foreign direct investment, and the proximity concentration tradeoff.

3. THEORETICAL BACKGROUND

In this section, I provide some theoretical background. I use the theoretical framework by Ramondo et al. (2013) and add industry-specific uncertainty. There are two sources of uncertainty in the model. Aggregate country-specific productivity shock that affects the demand, as well as unit cost of production in the foreign market, and an industry-specific shock that affects production in a given industry. This implies that exporters unit cost of production is affected by shocks in home country, while unit cost of a multinational is affected by the shocks in foreign country. In the model, the firm's choice between exporting and FDI depends on relative production costs and demand.

3.1. Set-up

The world consists of I countries and, each endowed with an inelastic supply of labor, $Li, i = 1, \dots, I$. Each country is populated with risk-neutral consumers with preferences over the consumption of goods in a number of sectors $k \in \{0,1, \dots K\}$.

Firms set up foreign affiliates and export networks before shocks are realized, and after uncertainty is resolved, production occurs. The vector $s \in S = \{s_1, s_2, \dots, s_n\}$ denotes the (finite number of) states of nature in the second period, each occurring with probability $Pr(s)$. Each state of nature is characterized by a vector of country-specific shocks $A(s) = [A_1(s), A_1(s), \dots A_I(s)]$ and a vector of industry specific shocks $B(s) = [B^1(s), B^2(s), \dots B^K(s)]$.

Sector $k = 0$ is a homogeneous good, which is produced with unit input requirement and is chosen as numeraire. Within each of the remaining sectors, there is a continuum of horizontally differentiated varieties and preferences are assumed to take CES form:

$$Q_i^k(s) = \left(\int_z q_i{}^k(z)^{(\sigma^k)/(\sigma^k-1)} dG_i(z)\right)^{\frac{\sigma^k-1}{\sigma^k}}, \quad \sigma^k > 1 \qquad (1)$$

Sectors are aggregated by:

$$Q_i(s) = A_i(s) \prod_{k=0}^{K} Q_i^k(s)^{\beta^k} \qquad (2)$$

where, $\beta^k \epsilon [0,1]$, and $\sum_{k=0}^{K} \beta^k = 1$

The country-specific productivity shock, $A_i(s)$, could be interpreted either as a taste shock or a productivity shock.

Let country *I* be a reference country, world financial markets are assumed to be frictionless, and the contracts are denominated by the consumption bundle of the reference country, which is taken as numeraire.[8] The second-period budget constraint is denoted by:

$$P_i(s)Q_i(s) - L_i W_i(s) - \Pi_i(s) - B_i(s) = 0, \qquad (3)$$

where $B_i(s)$ are bond holdings, and $\Pi_i(s)$ is the aggregate profits of all firms in country i. Each country is endowed with $B_i(0)$ initial endowment to finance costs of setting up exports and affiliate sales in the first period. The first-period budget is given by:

$$\sum_{s=1}^{S} \rho(s) B_i(s) + F_i^X + F_i^M = B_i(0), \qquad (4)$$

where F_i^X, F_i^M are fixed costs for exporting and FDI, respectively, and $\rho(s)$ is the price of bonds.

With frictionless financial markets and risk-neutral consumers the only variation in the bond prices across states of nature is given by the probability of the state[9]:

$$\rho(s) = \lambda_U \Pr(s), \qquad (5)$$

where λ_U is the risk-free interest rate.

Production of tradable varieties

[8] This is equivalent to a model with currencies in which credit contracts are written in units of U's currency, and the central bank of U implements a monetary policy that stabilizes PU. See Woodford (2003) and Ghironi and Melitz (2005) for the introduction of similar financial contracts in a cashless economy.

[9] In equilibrium, the price of the bonds, *ρ(s),* will be such that these international claims are in zero net supply in each state. The price index for consumption, in equilibrium, will be proportional across countries. The consumption price index in each country is constant relative to the international numeraire across states of nature.

Each country is endowed with a continuum of firms. Differentiated varieties are produced with using labor, l, with a constant returns-to-scale technology, a firm specific productivity $z(\omega)$, drawn from a distribution $G_i(\omega)$, and industry-specific shock, $B^k(s)$, that is common across countries:

$$l^k(z,s) = \frac{q^k(z,s)}{zB^k(s)} \tag{6}$$

Producers face *ad valorem* transportation costs when selling from i to j, $\tau_{ij} > 1$, and have fixed costs for exports or affiliate sales, f_{ij}^x, and f_{ij}^m. Together with CES preferences, the optimal pricing rule is the standard constant markup over the marginal cost, although now the marginal cost includes the industry-specific shock. For a domestic firm or a foreign affiliate located in country j, the price is given by:

$$p_{ij}^{k,m}(z,s) = \frac{\sigma^k}{\sigma^k-1}\frac{W_j(z,s)}{zB^k(s)} \tag{7}$$

A firm exporting from i to j charges the price:

$$p_{ij}^{k,x}(z,s) = \frac{\sigma^k}{\sigma^k-1}\tau_{ij}^k\frac{W_i(z,s)}{zB^k(s)}, \tag{8}$$

The price index for each industry is the given as:

$$P_j^k(s) = \frac{\sigma^k}{\sigma^k-1}\frac{W_j(z,s)}{B^k(s)}Z_j^k(s)^{\frac{1}{1-\sigma^k}} \tag{9}$$

Production of homogeneous good

Homogeneous good is produced using labor with a constant returns-to-scale technology. Homogeneous goods are produced only by domestic firms, that are homogeneous in productivity within and across countries, and have the same price across countries.

Trade and FDI

I assume equilibria in which the exports and FDI are both profitable, that is $\frac{f_{ij}^x}{f_{ij}^m} \leq (\tau_{ij}\frac{W_i(s)}{W_j(s)})^{1-\sigma^k}$.

This assumption generates proximity-concentration tradeoff, implying that marginal cost of producing abroad is less than marginal cost of producing domestically, and that fixed cost of opening an affiliate is higher than fixed cost of setting export networks.

The value of an opening an affiliate in country *j* is given by the expected value of its profits discounted by the price of bonds. From (5), we know that the price is constant across the states of nature, so the value of an affiliate is proportional to its expected profits:

$$V_{ij}^{k,m}(z) = \sum_{s \in S} \rho(s) \pi_{ij}^{k,m}(z,s) = \lambda_U \Pr(s) \pi_{ij}^{k,m}(z,s), \tag{10}$$

Similarly, the value of for a firm exporting to country *j* is:

$$V_{ij}^{k,x}(z) = \sum_{s \in S} \rho(s) \pi_{ij}^{k,x}(z,s) = \lambda_U \Pr(s) \pi_{ij}^{k,x}(z,s), \tag{11}$$

As in the model by Helpman et al. (2004), assuming equilibria in which both FDI and exports are profitable, for any firm from country *i* with productivity z, the choice between exporting and using an affiliate to serve country *j* is characterized by two cutoff productivity values, $z_{ij}^{k,x}$ and $z_{ij}^{k,m}$, such that a firm with $z_{ij}^{k,x} < z < z_{ij}^{k,m}$ will export to *j*, and a firm with $z_{ij}^{k,m} < z$ will use a foreign affiliate to serve country *j*. This characterization holds for each country pair, *i,j*.

Thus, the optimal FDI and export decisions of firms can be characterized by these two cutoff productivity levels, such that firms with these productivity levels earn zero expected profits from entry:

$$V_{ij}^{k,x}\left(z_{ij}^{k,x}\right) = f_{ij}^{k,x} \tag{12}$$

$$V_{ij}^{k,m}\left(z_{ij}^{k,m}\right) - V_{ij}^{k,x}\left(z_{ij}^{k,x}\right) = f_{ij}^{k,m} - f_{ij}^{k,x} \tag{13}$$

The total fixed costs paid by firms from country *i* in setting up export networks and foreign affiliates in the first period are:

$$F_i^{k,m} = \sum_{j=1}^{I} [1 - G_i(z_{ij}^{k,m})] f_{ij}^{k,m} \tag{14}$$

$$F_i^{k,x} = \sum_{j=1}^{I} [G_i(z_{ij}^{k,m}) - G_i(z_{ij}^{k,x})] f_{ij}^{k,x} \tag{15}$$

Aggregate productivity indices

Aggregate productivity indices for domestic, exporting and multinational firms can be defined as:

$$\mathrm{Z}_{ii}^{d} \equiv \int_{z_{min}^{i}}^{\infty} z^{\sigma^k - 1} dG_i(z), \mathrm{Z}_{ji}^{x} \equiv \int_{z_{ji}^{x}}^{z_{ji}^{m}} z^{\sigma^k - 1} dG_j(z), \mathrm{Z}_{ji}^{m} \equiv \int_{z_{ji}^{m}}^{\infty} z^{\sigma^k - 1} dG_j(z), \tag{16}$$

Further, define net exports in industry k in country i as the difference between the industry exports and imports, $NX_i^k(s) = EX_i^k(s) - IM_i^k(s)$. Industry output is related to net industry exports and industry consumption by $Y_i^k(s). = P_i^k(s)\, Q_i^k(s) + NX_i^k(s)$. The following proposition then summarizes the key co-movements implied by the model.

Proposition 1. *Industry absorption,* $Q_i^k(s)$*, and the industry price index,* $P_i^k(s)$*, in country i positively comove with industry output in country i,* $Y_i^k(s)$*. Wage,* $W_i(s)$ *in country i positively comoves with output in country i,* $Y_i(s)$*. Net industry exports in country i,* $NX_i^k(s)$*, negatively comoves with industry output in country i,* $Y_i^k(s)$*.*

$$\widetilde{Q_i^k}(s) = D_{1,i}(s)\,\widetilde{Y_i^k}(s) \tag{17}$$

$$\widetilde{P_i^k}(s) = [1 - m_i^k(s)]\,\widetilde{Y_i^k}(s) \tag{18}$$

$$\widetilde{W_i}(s) = \widetilde{Y_i}(s) \tag{19}$$

$$\widetilde{NX_i^k}(s) = -D_{2,i}(s)\,\widetilde{Y_i^k}(s) \tag{20}$$

where $\tilde{X}(s) \equiv dlogX(s)$ are proportional fluctuations, and D_1 and D_2 are positive in all states of nature, and

$$m_i^k(s) = \sum_{j=1}^{I}(\tau_{ji}\frac{W_j(s)}{W_i(s)})^{1-\sigma^k}\frac{Z_{ji}^{x,k}}{Z_{ji}^{k}}$$

Trade and affiliate sales

This section covers the effect of cross-country industry uncertainty on the choice of a firm between exports and affiliate sales. The value of an affiliate of a firm with productivity z, from country i, located in country j in industry k can be expressed as:

$$V_{ij}^{k,m}(\varphi) = \gamma_1\frac{z^{\sigma^k - 1}}{Z_j^k(s)}E_s\left[E_j^k(s)\right] \tag{21}$$

and the value of an exporting firm with productivity z, from country i exporting to country j in industry k:

$$V_{ij}^{k,x}(\varphi) = \gamma_2 {\tau_{ij}^{k}}^{1-\sigma^k}\frac{z^{\sigma^k - 1}}{Z_j^k(s)}E_s\left[\left[\frac{W_i(z,s)}{W_j(z,s)}\right]^{1-\sigma^k}E_j^k(s)\right] \tag{22}$$

where $E_j^k(s)$ is industry k expenditure in country j, and γ_1 and γ_2 are constant terms.

From (21) we can note that the main source of fluctuations for the profits of a foreign affiliate is the industry expenditure in country j. Whereas, from (22) we can note that the main sources of fluctuations for profits of exporters are industry level expenditure, or industry absorption in country j, and the relative labor cost in i and j. The relative labor cost summarizes how the price charged by a firm from country i compares to those charged by its competitors and, therefore, determines the firm's market share in country j.

From (21) and (22), we can note that maximizing the expected value of an affiliate is equivalent to maximizing the expected value of $E_j^k(s)$, and maximizing the expected value of an exporter is equivalent to maximizing the expected value of the product of industry expenditure and market share. We can express the expected value in terms of variances and covariances by taking a second-order Taylor expansion of the value functions in (21) and (22) around their deterministic values:

$$\hat{V}_{ij}^{m} \approx var\left(\tilde{E}_j^k(s)\right) \tag{23}$$

$$\hat{V}_{ij}^{x} \approx (\sigma^k - 1)\left(-cov\left(\tilde{E}_j^k(s), \widetilde{W}_i - \widetilde{W}_j\right) + \frac{\sigma^k}{2} var\left(\widetilde{W}_i - \widetilde{W}_j\right)\right) \tag{24}$$

where $\tilde{X}(s) \equiv dX(s)/\bar{X}$ are fluctuations around deterministic value for state-dependent variables, and $\hat{X}(s) \equiv dX(s)/\bar{X}$ are fluctuations around deterministic value for non-state-dependent variables.

We can express (23) and (24) in terms of output fluctuations (GDP or industry output), and using equations in preposition 1 to derive:

$$\hat{V}_{ij}^{m} \approx \left(1 - m_j^k\right)\left(1 + \bar{D}_{2,j}\left(var(\widetilde{Y_j^k})\right)\right) \tag{25}$$

$$\hat{V}_{ij}^{x} \approx -(\sigma^k - 1)\left(\bar{D}_{2,j}\right)cov\left(\tilde{Y}_i, \tilde{Y}_j\right) +$$

$$(\sigma^k - 1)\left(\frac{\sigma^k}{2}\left(var\tilde{Y}_i\right) + \left(\bar{D}_{2,j} + \frac{\sigma^k}{2}\left(1 - m_j^k\right)\right) var\left(\tilde{Y}_j\right)\right) \tag{26}$$

The ratio of aggregate exports to affiliate sales in industry k is then given by:

$$R_{ij}^k(s) \equiv \frac{X_{ij}^{k,x}(s)}{X_{ij}^{k,m}(s)} = (\tau_{ij}^k \frac{W_i(s)}{W_j(s)})^{1-\sigma^k} \frac{Z_{ij}^{k,x}}{Z_{ij}^{k,m}} \tag{27}$$

where $X_{ij}^{k,x}(s) = \int_{z_{ij}^{k,m}}^{\infty} p_{ij}^{k,x}(z,s) q_{ij}^{k,x}(z,s) dG_i(z)$ and $X_{ij}^{k,m}(s) = \int_{z_{ij}^{k,m}}^{\infty} p_{ij}^{k,m}(z,s) q_{ij}^{k,m}(z,s) dG_i(z)$

I assume Pareto distribution of the firm productivity given by $G_i(z) = 1 - \varphi^{-l}$, where l is the shape parameter, and $z\epsilon[1,\infty)$. I further make two standard assumptions regarding the shape of the distribution to ensure that the distribution is finite and has finite mean; $l>2$, and $l + 1 - \sigma > 0$.

With Pareto assumption, the relative productivity indices defined as $z_{ij} = \frac{z_{ij}^{k,x}}{z_{ij}^{k,m}}$ and $Z_{ij} = \frac{Z_{ij}^{k,x}}{Z_{ij}^{k,m}}$ will satisfy:

$$Z_{ij} = z_{ij}^{-(l+1-\sigma)} - 1 \tag{28}$$

From (12), (13), and (23), (24), the ratio of productivities of marginal exporter relative to marginal foreign affiliate can be expressed as:

$$z^{\sigma^k-1}{}_{ij} = \left(\frac{f_{ij}}{1-f_{ij}}\right)\left(\frac{E_S\left[Q_j^k\left(\frac{W_j}{P_j^k}\right)^{1-\sigma^k}\right]}{\tau_{ij}{}^{1-\sigma^k}\left[Q_j^k\left(\frac{W_j}{P_j^k}\right)^{1-\sigma^k}\right]} - 1\right) \tag{29}$$

where $f_{ij}{}^k = f_{ij}{}^{k,x}/f_{ij}{}^{k,m}$ and $E_s(X) = \sum_S \Pr(s)X(s)$

Replacing (31) and (30) back into (29), the ratio of exports to affiliates in state s can be shown as:

$$logR_{ij}^k(s) \approx log\bar{R}_{ij}^k + (\sigma^k - 1)\left[m_j^k\widetilde{Y_j^k}(s) - m_i^k\widetilde{Y_j^k}(s)\right]$$
$$-\bar{\Phi}_{ij}^1 cov\left(\tilde{Y}_i, \tilde{Y}_j\right) + \bar{\Phi}_{ij}^2 var\left(\tilde{Y}_j\right) + \bar{\Phi}_{ij}^3 var\left(\widetilde{Y_j^k}\right) \tag{30}$$

where $\bar{\Phi}_{ij}^1, \bar{\Phi}_{ij}^3$, are all positive constants, *and* $\bar{\Phi}_{ij}^2$ is positive as long as the deterministic share of imported varieties in the domestic tradable price index, $m_j^k$is less than one half. Expression (32) will be used as basis for my empirical analysis in the next chapter. $\bar{R}_{ij}^k$ is the ratio of exports to affiliate sales from i to j in the deterministic equilibrium expressed as:

$$\bar{R}_{ij}^k = \left(\tau_{ij}\frac{W_i(s)}{W_j(s)}\right)^{1-\sigma^k}\left(\left(\frac{f_{ij}}{1-f_{ij}}\left[\left(\tau_{ij}\frac{W_i(s)}{W_j(s)}\right)^{1-\sigma^k} - 1\right]\right)^{-\frac{l}{\sigma^k-1}+1} - 1\right) \tag{31}$$

This expression represents the proximity concentration tradeoff at deterministic environment. Ratio of exports to affiliate sales is decreasing in trade cost and relative average labor costs. Lower values of trade cost and relative fixed cost have similar impacts on marginal exporter and marginal multinational firm.

4. EMPIRICAL FRAMEWORK

4.1. Estimation framework

I analyze the effect of industry level uncertainty and its' interaction with the economy wide uncertainty on the choice between exports and FDI. As such, I estimate the following equation for flows of industry k from the home i to destination j in the year t = {2008 to 2015}:

$$logR_{ijt}^k = log\bar{R}_{ijt}^k + \beta_1 Cov\left(Y_i, Y_j\right) + \beta_2 Var\left(Y_j\right) + \beta_3 Var\left(Y_j^k\right) + \beta_4 Var\left(Y_j\right) * Var\left(Y_j^k\right) + \varepsilon_{ijt}^k \tag{32}$$

where $log\bar{R}_{ijt}^k$ is the ratio of exports to affiliate sales in the deterministic environment, $Cov\left(Y_i, Y_j\right)$ is the covariance of output for home and destination countries (i and j), $Var\left(Y_j\right)$

is the variance of the output in destination country j, and $Var(Y_j^k)$ is the variance of the output of industry k in the destination j.

The theoretical model predicts β_1 to be negative and β_2 to be positive, and β_3 to be positive and behave in similar manner to economy-wide uncertainty.

The ratio of exports to affiliate sales under certainty is specified as:

$$log\bar{R}_{ijt}^{k} = \alpha_0 D_{kt} + \alpha_1 Y_j/Y_i + \alpha_2 \tau_{ijt} \quad (33)$$

where Y_j/Y_i is GDP per capita in country j relative to the country i, and the transport cost, τ_{ijt}, is proxied by distance to country j, tariffs, and freight costs applied to goods coming from the country i to country j at time t.

To control for industry characteristics, I also include a set of time-industry fixed effects, D_{kt}. The baseline specification includes as explanatory variables all those factors that, according to the model, determine the ratio of exports to affiliate sales under certainty. Note that the industry fixed effects fully account for industry characteristics typically found to influence the proximity-concentration tradeoff, such as the heterogeneity of firm-level productivity within an industry, as studied in Helpman et al. (2004).

4.2. Data description

To construct a new dataset that captures exports, affiliate sales, and uncertainty proxies at aggregate and industry level, I make use of data from a number of different sources. I use data from OECD AMNE database to construct affiliate sales by industry and country pairs covering a period from 2008 to 2015. The country-industry measure of affiliate sales is constructed from the firm-level data surveys by respective OECD countries. OECD AMNE database uses ISIC Rev.4 classification to classify the industries. Data on exports is from the UN Comtrade database, on 4-digit level, according to HS-07 classification for years 2008-2011 and HS-12 classification for years 2012-2015. Data on exports and affiliate sales covers period from year 2008 to year 2015.

I then construct necessary correspondence tables between HS-07 and ISIC Rev.4, and HS-12 and ISIC Rev.4 to match the 4-digit exports with the respective industry affiliate sales for each year, industry and country pair. This matched and merged data covers exports and affiliate sales of multinational firms from 26 OECD countries to the rest of the world at industry level. There are 72 destination countries in the dataset.

Data on gravity variables, excluding all GDP variables, is from CEPII Gravity Database. Data on all GDP variables is from Penn World Tables 9.1. I use the data on trade costs from the World Bank database. The World Bank Trade Costs Dataset provides estimates of bilateral trade costs in agriculture and manufactured goods for the 1995-2018 period. It is built on trade and production data collected in 208 countries. Trade costs are available for two sectors: trade in manufactured goods, and agriculture. In my estimations, I use bilateral trade costs for manufacturing goods covering the period from 2008 to 2015.

The novel and matched database from OECD AMNE, UN Comtrade, CEPII Gravity Database, Penn World Tables 9.1, and World Bank Trade Cost covers affiliate sales and exports of 11 manufacturing industries disaggregated as per ISIC Rev. 4 classification.

To capture industry level uncertainty, I use industry level gross output (GO), taken from UNIDO INDSTAT4 database, covering 132 destination countries, in 11 industries of interest for the period of 1985-2017. I construct necessary concordance tables between ISIC Rev. 3 and ISIC Rev.4 and apply it to the data from UNIDO INDSTAT4. I then further aggregate this date to 2-digit ISIC Rev. 4 system to match the data for affiliate sales and exports for each industry country pair.

I measure output as real GDP per capita at constant prices, PPP adjusted, from the Penn World Tables 9.1. I compute the variance of output for all destination countries in the sample, as well as the covariance of home and destination country pairs, for the period 1970–2015. As a measure of industry level uncertainty, I compute the variance of GO variable for each industry-country pair for the period of 1985-2017. In some specifications, I also include other gravity variables such as common language and contiguity. Distance, tariff rates and fright charges are included in the trade-cost variable obtained from the World Bank database for the country pairs.

Descriptive Statistics

Table 1. Summary of key variables

Variable	Observations	Mean	Std.Dev.	Min	Max
Exports	24,818	9.34e+08	3.60e+09	13	6.75e+10
Affiliate Sales	24,818	1.10e+09	5.99e+09	0	1.54e+11
Ratio	6,458	.445	1.771	-5.74	10.429
Share	24,818	.892	.240	.003	1

Table 2. Industries and their frequency used in the empirical analysis

ISIC Rev.4 Industry Code	Industry	Freq.
C10-12	Food products, beverages and tobacco	999
C19-22	Total petroleum, chemical, rubber and plastic products	5337
C20	Chemicals and chemical products	926
C22	Rubber and plastic products	915
C24-25	Basic metals and fabricated metal products	1151
C25	Fabricated metal products	509
C26	Computer, electronic and optical products	5960
C27	Electrical equipment	682
C28	Machinery and equipment n.e.c.	1240
C29	Motor vehicles, trailers and semi-trailers	1085
C29-30	Transport equipment	6014
Total		**24818**

5. EMPIRICAL RESULTS

Following Ramondo et al. (2013), I estimate my *restricted* sample by OLS. The results are shown on *table 1*. The results in *table 1.* correspond to the restricted sample of 26 OECD home countries and 72 destination countries, which includes both developed and developing economies. The dependent variable is the ratio of exports to affiliate sales, from country *i* to country *j*, in industry *k*, for the years 2008 to 2015. Industries are defined at the two-digit ISIC Rev. 4 classification, containing 11 industries. In all of the regressions, I use heteroskedasticity robust standard errors and add time-industry fixed effects.

Table 3.

Estimation of *restricted sample* by OLS

	Dependent variable: Exports/ Affiliate Sales					
	(1)	(2)	(3)	(4)	(5)	(6)
$\boldsymbol{Y_j/Y_i}$	0.502	0.524	0.625	0.651	0.617	0.639
	(0.064)***	(0.064)***	(0.066)***	(0.066)***	(0.063)***	(0.063)***
$\boldsymbol{\tau_{ij}}$	-1.059	-0.979	-1.081	-1.027	-1.079	-1.021
	(0.052)***	(0.071)***	(0.052)***	(0.072)***	(0.052)***	(0.071)***
$\boldsymbol{Cov}(\boldsymbol{Y_i}, \boldsymbol{Y_j})$	-3.161	-3.121	-4.047	-4.036	-4.071	-4.070
	(0.323)***	(0.318)***	(0.333)***	(0.318)***	(0.338)***	(0.319)***
$\boldsymbol{Var}(\boldsymbol{Y_j})$	0.704	0.699	0.896	0.960	0.757	0.750
	(0.158)***	(0.154)***	(0.312)***	(0.301)***	(0.170)***	(0.165)***
contig.		0.344		0.298		0.302
		(0.085)***		(0.085)***		(0.085)***
comlang_off		-0.412		-0.423		-0.418
		(0.062)***		(0.063)***		(0.063)***
$\boldsymbol{Var}(\boldsymbol{Y_j^k})$			0.168	0.182	0.105	0.087
			(0.106)	(0.105)*	(0.037)***	(0.036)**
$\boldsymbol{Var}(\boldsymbol{Y_j}) * \boldsymbol{Var}(\boldsymbol{Y_j^k})$			-0.424	-0.639		
			(0.684)	(0.675)		
Observations	5497	5497	5479	5479	5479	5479
Fixed effects	Ind-time	Ind-time	Ind-time	Ind-time	Ind-time	Ind-time
R^2	0.241	0.248	0.254	0.261	0.254	0.261

Notes: (a) All regressions are implemented in Stata's command regress. (b) Constant terms and year and industry fixed effects are included in the estimations. (c) Values in parentheses are robust standard errors. (d) "***", "**", and "*" indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Columns (1), and (2) replicate the estimation of Ramondo et al. (2013) for a larger, and more extensive sample in terms of home and destination country pairs, and number of years. The results are consistent with existing literature on proximity concentration trade-off and with the work of Ramondo et al. (2013), and the estimates support the predictions of the theory regarding the relationship between flows from the home country and the stochastic properties of destination country's business cycles. The firms in OECD countries serve more-volatile destinations more through exports than through affiliate sales: The coefficient on $\boldsymbol{Var}(\boldsymbol{Y_j})$ is positive and significant. Consistent with the model's predictions, the firms in OECD countries have more exports—relative to affiliate sales—to markets that are less correlated with their home business cycle: the coefficient on $\boldsymbol{Cov}(\boldsymbol{Y_i}, \boldsymbol{Y_j})$ is negative and statistically significant.

Columns (3) to (6) further extend the empirical estimation to cover for industry uncertainty and interaction of aggregate uncertainty and industry uncertainty. In addition to predictions #1 and #2, the results also support the prediction #3. The results show that the markets with higher industry uncertainty is less likely to be served by foreign affiliates, the coefficient on $\boldsymbol{Var}(\boldsymbol{Y_j^k})$ is positive and significant. Prediction number four does not get full support in the OLS regression of my restricted sample. Although the coefficient on $\boldsymbol{Var(Y_j) * Var(Y_j^k)}$ has the correct sign, it is insignificant.

One distinct feature of my novel database is that the presence of zero values for affiliate sales enables me to overcome a major selection bias, which is present in previous studies. Previous studies analyze proximity concentration tradeoff only by selecting positive values for both the affiliate sales and exports. I argue that such selection is biased in a sense that when selecting only positive values for either exports or affiliate sales, the universe of countries and industries not served by either exports or FDI is left out of the analysis. The information about the reasons for not engaging in exports or in affiliate sales in a set of industry-country pairs, and the characteristics of such industry-country pairs could provide useful information, especially for the case of foreign direct investment[10].

A such, I estimate my full sample including zero values for both exports and affiliate sales for each country pair. Due to presence of zeros in my sample, I follow Yeaple (2003a) and use Exports/ (Affiliate Sales + Exports)[11] (from here on referred to as SHARE) as my dependent variable.

Using SHARE variable as dependent variable presents additional challenge. A large number of zeros for affiliate sales result in SHARE variable taking large number of "1" values for the SHARE variable. To deal with this challenge I use Zero-One Inflated Beta Regression (ZOIB Regression) to estimate equation the following equation.

$$logR_{ijt}^k = log\bar{R}_{ijt}^k + \beta_1 Cov(Y_i, Y_j) + \beta_2 Var(Y_j) + \beta_3 Var(Y_j^k) + \beta_4 Var(Y_j) * Var(Y_j^k) + \varepsilon_{ijt}^k \quad (34)$$

where the dependent variable $logR_{ijt}^k$ is a proportion calculated as Exports/ (Affiliate Sales + Exports) for exports and affiliate sales from country i to country j in industry k at time t, and $log\bar{R}_{ijt}^k$ is the same proportion under certainty.

ZOIB fits by maximum likelihood a zero-one inflated beta distribution to a distribution of a dependent variable that ranges between 0 and 1: for example, it may be a proportion. ZOIB will estimate the probabilities of having the value 0 and/or 1 as separate processes. The logic is that we can often think of proportions of 0 or 1 as being qualitatively different and generated through a different process as the other proportions. This is useful is analyzing impact of uncertainty on the extensive and intensive margins of exports and affiliate sales.

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[10] The universe of country-industry pairs served by FDI is relatively smaller than that of served by exports.

[11] This dependent variable is more suitable to use in the presence of large numbers of zeros for exports and/or affiliate sales as demonstrated by Yeaple (2003a)

The results of ZOIB Regression on my full sample are presented in table 4. The results of ZOIB regression of my full sample support all four predictions of the model. In addition to the main four predictions of the model there are two interesting points to note regarding the results of ZOIB regression.

Table 4.

Estimation of full sample by Zero-One Inflated Beta Regression

Dependent Variable: Exports/(Affiliate Sales + Exports)		
	(1)	(2)
Proportion part		
Y_j/Y_i	0.443	0.452
	(0.042)***	(0.043)***
τ_{ij}	-0.746	-0.712
	(0.035)***	(0.045)***
$Cov(Y_i, Y_j)$	-3.220	-3.160
	(0.208)***	(0.210)***
$Var(Y_j)$	1.025	1.013
	(0.188)***	(0.188)***
$Var(Y_j^k)$	0.184	0.184
	(0.063)***	(0.063)***
$Var(Y_j) * Var(Y_j^k)$	-0.953	-1.004
	(0.404)**	(0.406)**
contiguity		0.184
		(0.052)***
comlang_off		-0.248
		(0.041)***
One-inflate part		
Y_j/Y_i	1.434	1.420
	(0.047)***	(0.047)***
τ_{ij}	2.646	2.740
	(0.059)***	(0.064)***
$Cov(Y_i, Y_j)$	-2.544	-2.452
	(0.264)***	(0.238)***
$Var(Y_j)$	0.405	0.306
	(0.216)*	(0.210)
$Var(Y_j^k)$	0.360	0.342
	(0.079)***	(0.078)***
$Var(Y_j) * Var(Y_j^k)$	-1.595	-1.620
	(0.495)***	(0.485)***
contiguity		0.614
		(0.107)***
comlang_off		-0.723
		(0.071)***
Observations	18000	18000

Notes: (a) All regressions are implemented in Stata's command zoib. (b) Constant terms and year and industry fixed effects are included in the estimations. (c) Values in parentheses are robust standard errors. (d) "***", "**", and "*" indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

First, one could notice that the coefficient for trade-cost $\boldsymbol{\tau_{ij}}$ is positive in the one-inflate part of the ZOIB regression, implying that higher trade cost result in more exports – relative to affiliate sales, which is an opposite result to the proximity concentration trade-off. This result might indicate that in my data, the SHARE being equal to one is more likely as $\boldsymbol{\tau_{ij}}$ is higher. This seems to be counter-intuitive, because a higher trade cost must result in smaller exports. However, actually, the share being equal to one is not related with the size of exports at all in this case. It does not matter whether the export values are high or low. The share being equal to one, in this case, just means that affiliate sales are zero. So, the correct interpretation of this result is that affiliate sales are more likely to be zero as trade costs get higher.

To check this, I compare the average trade costs for observations with the SHARE=1 and those for observations with *0<SHARE<1*. I find out that the average trade costs are almost twice higher for observations with the *SHARE=1* than for those observations with SHARE variable being *0<SHARE<1*.

There is some existing literature that derive similar results. In the Helpman, Melitz, Rubinstein (2008) model with truncated Pareto distribution, no firm engages in FDI if fixed costs of FDI are too high, in relative to gross profits that firms can earn from the foreign market, from the viewpoint of the most productive firms in the home country. Thus, if the fixed costs of FDI are higher as the destination country is more remote from the home country, then this result can be consistent with the theory. Keller and Yeaple (2013 AER) show that foreign affiliate sales are actually decreasing in distance from the home country. So, there may be a threshold distance (or trade costs) above which foreign affiliate sales become zero (which means no FDI from the home country). Another research by Irac (2006) finds that the impact of distance on flows and stocks of FDI, controlling for exports, is negative and strongly significant, in line with gravity models, whereas in a standard proximity-concentration framework the impact should be positive.

Second, and perhaps more interesting result of *table 4* is the differential effects of economy wide uncertainty and industry wide uncertainty on extensive and intensive margins. The results of the table 4. show that aggregate uncertainty has more effect on intensive margin than on the extensive margin, the coefficient on $\boldsymbol{Var(Y_j)}$ is larger in magnitude for the proportion part compared to the one-inflate part. On the other hand, the industry wide uncertainty affects more the extensive margin rather than the intensive margin, the coefficient on $\boldsymbol{Var(Y_j^k)}$ is almost twice as large in magnitude in the one-inflate part compared to the proportion part. In addition, the interaction of the two uncertainty terms seems to have more effect on the extensive margin compared to intensive margin, the coefficient on $\boldsymbol{Var(Y_j) * Var(Y_j^k)}$ is larger in magnitude in the one-inflate part.

This result is interesting because it suggests that uncertainty might have effect not only on the proximity-concentration trade-off but also on the choice of entry, i.e. the extensive margin. Further, this result implies that both levels of uncertainty, that is country-level uncertainty and industry-level uncertainty matter for the entry of firms into FDI in a given industry-destination pair, and that these two levels of uncertainties have differential effect on the entry of firms into an industry-destination pair.

6. ROBUSTNESS

To explore the robustness of our results, I add additional controls to my OLS and ZOIB regressions and check the sensitivity of the findings to different time periods:

- *Additional country-specific and country-pair determinants of FDI and trade used in the gravity equation* – continuity, and common language.
- *Different time periods* - The sample covers 8 consecutive years. To check if the results hold for different time periods, I divide my sample into two 4-year periods (from 2008 to 2011, and from 2012 to 2015), and check the sensitivity of findings for these two periods.

6.1. *Additional country-pair determinants of FDI and trade*

In this section, we add two country-pair characteristics that have been shown to be important in deterministic models of international trade. Contiguity and common language are two commonly used country-pair variables in the gravity literature, and I check the robustness of my results by including these two additional variables. The results in the columns (2), (4), and (6) of table 3 show that adding these two determinants of FDI and trade improves the results in the OLS regression of the restricted sample.

Additionally, the results of column (2) of table 4 show that the results of ZOIB regression of the full sample are robust to the inclusion of additional country-pair determinants of FDI and trade.

6.2. Different time periods

I estimate the coefficients of equation (1) for two different time periods. My full sample covers affiliate sales and trade for eight consecutive years from 2008 to 2015. I separate this into two 4-year time periods, and check the sensitivity of the results. The estimates reported in table 5 confirm that the results are similar over time and are not driven by an outlier year. The invariance of my results to time period is not surprising; the cross-country patterns of trade and affiliate sales are very persistent. Columns (1), (2) show the results of the estimation for years 2008 to 2011, whereas columns (3), (4) show the results for the years 2012 to 2015.

Table 5.

Estimation of different time periods by ZOIB

	Dependent Variable: Exports / (Affiliate Sales + Exports)			
	(1)	(2)	(3)	(4)
proportion				
Y_j/Y_i	0.556	0.560	0.358	0.367
	(0.068)***	(0.069)***	(0.053)***	(0.054)***
τ_{ij}	-0.698	-0.664	-0.798	-0.765
	(0.050)***	(0.065)***	(0.048)***	(0.063)***
$Cov(Y_i, Y_j)$	-3.714	-3.645	-2.869	-2.815
	(0.344)***	(0.346)***	(0.257)***	(0.260)***
$Var(Y_j)$	1.259	1.242	0.821	0.808
	(0.270)***	(0.268)***	(0.262)***	(0.262)***
$Var(Y_j^k)$	0.222	0.221	0.147	0.146
	(0.090)**	(0.090)**	(0.085)*	(0.085)*
$Var(Y_j) * Var(Y_j^k)$	-1.219	-1.294	-0.657	-0.682
	(0.556)**	(0.558)**	(0.582)	(0.585)
contiguity		0.215		0.153
		(0.078)***		(0.069)**
comlang_off		-0.298		-0.196
		(0.060)***		(0.057)***
One-inflate				
Y_j/Y_i	1.536	1.501	1.356	1.349
	(0.075)***	(0.075)***	(0.060)***	(0.061)***
τ_{ij}	3.160	3.465	2.351	2.341
	(0.097)***	(0.106)***	(0.073)***	(0.078)***
$Cov(Y_i, Y_j)$	-2.678	-2.552	-2.388	-2.319
	(0.387)***	(0.341)***	(0.354)***	(0.325)***
$Var(Y_j)$	0.375	0.262	0.470	0.395
	(0.334)	(0.324)	(0.285)*	(0.279)
$Var(Y_j^k)$	0.318	0.300	0.391	0.375
	(0.129)**	(0.127)**	(0.100)***	(0.100)***
$Var(Y_j) * Var(Y_j^k)$	-1.378	-1.488	-1.760	-1.756
	(0.816)*	(0.795)*	(0.625)***	(0.616)***
contiguity		1.375		0.169
		(0.170)***		(0.134)
comlang_off		-0.907		-0.578
		(0.111)***		(0.094)***
Time period	2008-2011	2008-2011	2012-2015	2012-2015
Observations	7625	7625	10375	10375

Notes: (a) All regressions are implemented in Stata's command zoib. (b) Constant terms and year and industry fixed effects are included in the estimations. (c) Values in parentheses are robust standard errors.. (d) "***", "**", and "*" indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

7. CONCLUSION

In this study, I investigate how country-specific and industry-specific uncertainties affect the proximity-concentration trade-off. I find that cross-country uncertainties affect the firm's decision about the location of production and, thus, the patterns of trade flows and affiliate sales across countries. Everything else equal, firms prefer to face a lower cost of production in those states of nature in which demand for their goods is relatively high. This profit-maximizing behavior results in a sharp empirical prediction: country pairs with less-correlated business cycles have larger bilateral trade flows, relative to affiliate sales. Moreover, exporters can better exploit the volatility of the relative cost of production between the source and the host country. This implies that exports, rather than affiliate sales, flow towards countries with more-volatile output.

In addition, I find that the market with higher industry uncertainty is less likely to be served by foreign affiliates, and that an industry with a higher demand in a country with higher unit cost shock will be attracting less exports. This means that although the market with higher unit cost shock gives a good business chance for exporters, the degree of attractiveness is lower for exporters if the particular industry is characterized by higher demand shock.

Further, I derive some new implication regarding differential effects of economy wide uncertainty and industry wide uncertainty on extensive and intensive margins. The results of this article show that both levels of uncertainty matter for the decisions of the firms regarding entry into a foreign market. Economy wide uncertainty has more effect on intensive margin than on the extensive margin. On the other hand, the industry wide uncertainty affects more the extensive margin rather than the intensive margin. In addition, the interaction of the two uncertainty terms seems to have more effect on the extensive margin compared to intensive margin.

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Appendix A.

List of home and destination countries and their frequency used in the research

Home	Freq.	Percent
Austria	830	3.34
Belgium	818	3.3
Czech Republic	1,105	4.45
Germany	1,088	4.38
Denmark	305	1.23
Spain	868	3.5
Estonia	950	3.83
Finland	753	3.03
France	850	3.42
United Kingdom	759	3.06
Greece	1,227	4.94
Hungary	1,257	5.06
Ireland	1,130	4.55
Israel	80	0.32
Italy	971	3.91
South Korea	538	2.17
Luxembourg	1,231	4.96
Latvia	1,281	5.16
Netherlands	292	1.18
Norway	689	2.78
Poland	1,025	4.13
Portugal	1,184	4.77
Slovakia	1,255	5.06
Slovenia	1,711	6.89
Sweden	803	3.24
United States	1,818	7.33
Total	**24,818**	**100**

Destination	Freq.	Percent
United Arab Emirates	29	0.12
Argentine	373	1.5
Australia	369	1.49
Austria	339	1.37
Belgium	354	1.43
Bulgaria	317	1.28
Belarus	11	0.04
BMU	17	0.07
Brazil	1,050	4.23
Canada	1,107	4.46
Switzerland	1,037	4.18
Chile	365	1.47
China	1,112	4.48
Colombia	26	0.1
Cyprus	374	1.51
Czech Republic	339	1.37
Germany	382	1.54
Denmark	349	1.41
DZA	17	0.07
Ecuador	23	0.09
Egypt	368	1.48
Spain	349	1.41
Estonia	324	1.31
Finland	333	1.34
France	395	1.59
United Kingdom	377	1.52
Greece	332	1.34
Hungary	306	1.23
Indonesia	387	1.56
India	1,004	4.05
Ireland	356	1.43
Iceland	414	1.67
Israel	375	1.51
Italy	328	1.32
Japan	1,067	4.3

Destination	Freq.	Percent
KHM	11	0.04
South Korea	351	1.41
Lithuania	319	1.29
Luxembourg	357	1.44
Latvia	323	1.3
MAR	327	1.32
MDA	11	0.04
MDV	3	0.01
Mexico	412	1.66
MKD	11	0.04
Malta	353	1.42
MYS	354	1.43
NER	6	0.02
NGA	385	1.55
Netherlands	362	1.46
Norway	344	1.39
NPL	4	0.02
New Zealand	401	1.62
PAK	5	0.02
PAN	27	0.11
PER	35	0.14
Philippines	372	1.5
Poland	316	1.27
Portugal	347	1.4
Russia	934	3.76
Saudi Arabia	22	0.09
Singapore	358	1.44
Slovakia	292	1.18
Slovenia	306	1.23
Sweden	341	1.37
Thailand	352	1.42
Turkmenistan	5	0.02
Turkey	363	1.46
Ukraine	11	0.04
Uruguay	344	1.39
United States	997	4.02
ZAF	352	1.42
Total	**24,818**	**100**