The Proximity-Concentration Tradeoff in a Risky Environment*

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Abstract

This paper introduces the firm's choice between serving a foreign market through exports or affiliates sales in a risky environment characterized by country specific shocks. We find that country pairs with less correlated business cycles trade more, relative to affiliate sales, and that countries with more volatile fluctuations are served relatively more by exports rather than multinational production. Using detailed U.S. data on trade and affiliate sales from the Bureau of Economic Analysis, we find strong empirical support for these predictions of the model. Our estimates suggest that an increase in one standard deviation in the co-movement between the United States and a trading partner reduces the ratio of exports to sales from the United States to that country by more than one third of a standard deviation, while an increase of one standard deviation in the distance between both countries decreases such ratio by less than one tenth of standard deviation.

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1 Introduction

The increasing importance of multinational firms in world gross output drove the focus of the new trade literature on the firms choice between different ways of serving a foreign market. In particular, firms are modeled to choose between exporting and setting up foreign subsidiaries. This paper concentrates on the effect of uncertainty on this firm's decision, derives empirical predictions, and takes them to the data.[1]

We present a simple multi-country, general equilibrium model, with heterogeneous firms. Financial markets are integrated and frictionless, allowing firms and consumers to perfectly share country specific shocks. Still, we show that risk characteristics across countries play an important role in explaining the pattern of exports and affiliate sales. Our results follow from a crucial distinction between these two ways of serving a foreign market. Exported goods are produced in the source country and, thus, their unit cost of production fluctuates with *home country* shocks; whereas affiliate sales entails production located in the destination country, and therefore, bears the *host country* shock. This difference implies that demand and cost of production co-move differently for exports and affiliate sales of multinational firms.

The difference in the location of production for exported goods and affiliate sales in the context of country shocks results in new predictions. First, country pairs with less correlated business cycles have larger bilateral trade flows, relative to affiliate sales. Second, exports, rather than affiliate sales, flow towards countries with more volatile output. We find strong empirical support for these two predictions of the model. The scatter plots in figures 1 and 2 preview our main empirical findings for a cross section of countries paired with the United States. While figure 1 shows the positive relationship between volatility of the destination country and the ratio of trade to affiliate sales, figure 2 illustrates the negative relationship between that ratio and the co-movement of output across country pairs.

These facts are novel in the literature. In particular, regarding the relationship in figure 2, the empirical literature has documented a positive relationship between bilateral trade and the

[1] We focus on the firm's choice between exporting and horizontal foreign direct investment (FDI), that is, investments in production facilities abroad that are designed to serve foreign customers. We exclude vertical FDI that involves fragmentation of production across countries.

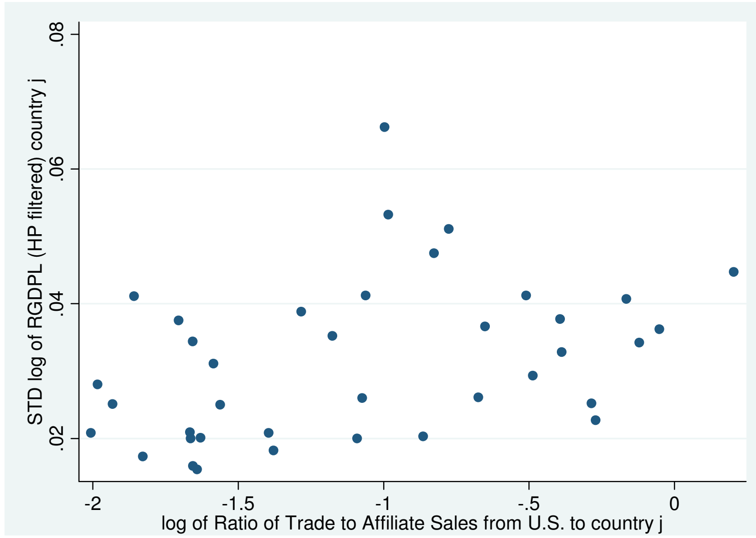

Figure 1: Volatility, Trade, and Affiliate Sales.

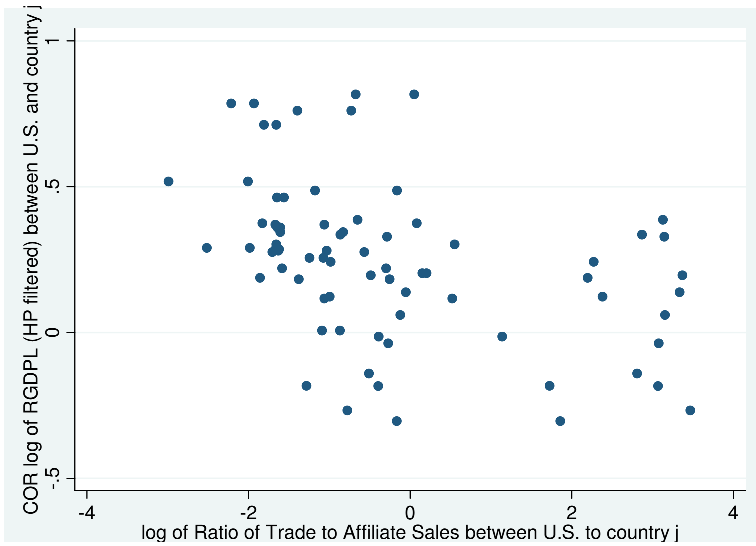

Figure 2: Cross country output correlations, Trade, and Affiliate Sales.

correlation of output fluctuations between trading partners; we show that once we control for bilateral affiliate sales, that relationship is reversed.[2]

Our model builds on the existing literature on the "proximity-concentration" tradeoff. When choosing the mode in which to serve a foreign market, firms evaluate the tradeoff between taking advantage of economies of scale (by exporting) and saving in transport costs (through FDI).[3] We

[2]The positive link between bilateral trade flows and correlation of GDP's fluctuations of trading partners has been documented by Frankel and Rose (1998), Clark and van Wincoop (2001), and Baxter and Kouparitsas (2005).

[3]See Markusen (1984), Brainard (1997), and Helpman, Melitz and Yeaple (2004).

extend the "proximity-concentration" tradeoff to an environment with uncertainty. The predictions derived by Helpman et al. (2004) in a deterministic environment with heterogenous firms are also present in our model. To their findings, we add predictions that link a firm's choice of serving a foreign market through trade or opening affiliates to the stochastic properties of the partner country business cycles.

First, country specific risk implies fluctuations in the pattern of comparative advantage across countries, which create potential gains from trade. The expected gains from trade are large for country pairs with very dissimilar (expected) relative cost of production. Hence, firms have more incentives to invest in export networks, rather than to open affiliates, in more volatile economies, and in economies that are least correlated with their own country's fluctuations, as suggested by Figure 1 and 2, respectively.

Second, the presence of aggregate risk delivers some additional predictions. Aggregate risk also affects the firm's decision between exporting and opening affiliates in different destination markets. Firms are risk neutral but, with complete financial markets, they internalize consumer's preferences for a smooth pattern of consumption. That is, a stream of profits is more valuable when it is concentrated in states of nature in which the final good is scarce. This creates incentives to locate production in countries that have low production costs in states with low aggregate output. Hence, countries whose output is more correlated with world output serve foreign markets relatively more through exports, and are served by other countries relatively more through affiliate sales.

We test the predictions of our model on U.S. trade and affiliate sales data that cover 52 manufacturing industries and 34 countries, from the Bureau of Economic Analysis (BEA). Our tests support the model's implications: Output volatility and cross country output correlations are significant predictors of the ratio of trade to affiliate sales across countries. We find that countries which closely co-move with the United States are characterized by a smaller volume of trade relative to affiliate sales with the United States. Conversely, highly volatile markets, in terms of aggregate output, are characterized by a larger volume of trade relative to affiliate sales with the United States. These results are robust across different specifications.

The magnitudes of these effects on the ratio of trade to affiliate sales across countries are comparable to those of geographic distance. For instance, a decrease of one standard deviation in the output correlation between country j and the United States, is associated with an increase of more than one third of a standard deviation of the (log of) ratio of exports relative to affiliates sales from the United States to country j. In comparison, an increase of one standard deviation in the (log of) distance between country j and the United States decreases the (log of) ratio of exports to affiliate sales from the United States by less than one tenth of a standard deviation.

The empirical evidence on the effect of aggregate risk on the cross country patterns of trade flows to affiliate sales is inconclusive: we find that such effect goes in the direction predicted by the theory, but its significance depends on the specification used.

Although the analysis of the joint pattern of trade and multinational activity under uncertainty is novel, there is an extensive literature on investment under uncertainty and, in particular, the impact of risk on FDI flows.[4] Moreover, the literature has focused on the effect of international risk on the pattern of FDI under imperfect financial markets: Opening foreign affiliates may improve diversification when financial markets are segmented.[5] In contrast, our paper considers well-functioning world financial markets that allow consumers and firms to perfectly share country specific risk. Still, the endogenous reallocation of production occurring through the activity of multinational firms improves the scope for risk diversification.[6]

Finally, there is an extensive literature explaining why country pairs with high output correlation tend to have larger trade flows. These explanations include vertical specialization, off-shoring, and similarities in the industrial structure across countries.[7] The model in this paper abstracts from many of these important considerations. Instead, we focus on trade and horizontal FDI. Our emphasis is placed on the importance of considering the effect of international risk on the *relative* flows of trade and affiliates'sales. Considering this ratio better isolates the effects of risk as it controls for industry and country factors that equally affect both flows.

[4]Aizenman and Marion (2004) analyze the impact of uncertainty on vertical versus horizontal FDI. They find that output volatility has a greater negative impact on vertical than on horizontal FDI. In Goldberg and Kolstad (1995), volatility affects FDI flows only if firms are risk averse.

[5]See for example Rowland and Tesar (2004).

[6]Moreover, we think that the case of complete financial markets is a relevant benchmark, particularly for developed economies, which concentrate most of multinational activities. In that line, Alburqueque et al (2005) find, using a large cross-country time-series data set, that FDI flows are increasingly explained by world factors, consistent with integrated and well functioning world financial markets.

[7]For potential explanations on the positive co-movement between bilateral trade and output fluctuations, see Frankel and Rose (1998), Kose and Yi (2001), Burstein, Kurz and Tesar (2008), Di Giovanni and Levchenko (2009), Calderon, Chong and Stein (2007), and Bergin, Feenstra and Hanson (2009).

2 The Model

We develop a multi-country, general equilibrium model in which the source of uncertainty is variation in country specific productivity, in the spirit of Backus, Kehoe and Kydland (1992). Risk averse households have access to a full set of contingent claims. With a freely tradable final consumption good, there is perfect risk sharing: Consumption in each country fluctuates only with world output.

Trade and multinational production are alternative ways in which firms can serve foreign markets in the intermediate goods sector. The firms face the proximity-concentration tradeoff: As in Helpman et al. (2004), exporting firms pay smaller sunk costs (relative to building an affiliate), but are subject to per-unit transportation costs. Opening a foreign affiliate bypasses the transportation cost of shipping goods, but the firm is faced with a larger fixed cost of entering the foreign market. In our stochastic model, country shocks affect the unit cost of production of all plants located in a country, both nationally owned and foreign affiliates. Thus, a firm deciding to serve a foreign market by exporting or by opening an affiliate must consider the joint distribution of source and host country shocks. For exports, production is affected by shocks in the home market, for multinational producers, the relevant production shock is the one to the host country.

2.1 Set Up

There are I countries, each of size L_i, $i = 1, \ldots, I$, and two periods. In the first period, *before* country shocks are realized, households make their portfolio decisions and firms set up foreign affiliates (i.e. foreign direct investment) and create export relationships. In the second period, *after* uncertainty is realized, production occurs. Households consume in both periods.

Let the vector $s \in S = \{s_1, s_2, \ldots, s_n\}$ denote the (finite number of) states of nature in the second period, each occurring with probability $\Pr(s)$. Each state of nature is characterized by the vector of realizations of country specific productivity shocks, $A = [A_1(s), ..., A_I(s)]$. Without loss of generality, we normalize the expected productivity in each country to one: for $i = 1, ..., I$, $E_s[A_i] = 1$.[8]

[8] In this economy, all asymmetries in $E_s[A_i]$ across countries can be equivalently expressed as differences in the

Final good production

Each country produces a final good and a continuum of intermediates. The final consumption good is produced under perfect competition with a constant returns to scale technology that combines labor and intermediate goods. The final good is freely tradable and, provided that it is produced everywhere, its price is equalized across countries and normalized to one. Production of the final good in country i is affected by a country specific productivity shock, $A_i(s)$. The production function for the final good in country i is given by

$$Y_i(s) = A_i(s) L_i^f(s)^{\alpha} Q_i(s)^{1-\alpha},$$

with $0 < \alpha < 1$. The index $Q_i(s)$ aggregates intermediate goods with a constant elasticity of substitution $\eta > 1$,

$$Q_i(s) = \left[\int_{\omega \in \Omega_i} q_i(\omega, s)^{\frac{\eta-1}{\eta}} d\omega \right]^{\frac{\eta}{\eta-1}},$$

where Ω_i is the mass of available goods in country i. The associated price index is given by

$$P_i(s) = \left[\int_{\omega \in \Omega_i} p_i(\omega, s)^{1-\eta} d\omega \right]^{\frac{1}{1-\eta}}. \tag{1}$$

Demand for each intermediate good ω is

$$q_i(\omega, s) = \left[\frac{p_i(\omega, s)}{P_i(s)} \right]^{-\eta} Q_i(s). \tag{2}$$

Intermediate good production

Each intermediate good, ω, is produced using only labor, with a constant returns to scale technology and a firm specific productivity $z(\omega) \in [z_i^{\min}, \infty)$. Each country is endowed with a continuum of firms, which we refer to as the *domestically owned* firms, or, as firms *from* a country. The nationality of these firms determines from which distribution, $G_i(z)$, the firm draws its productivity parameter. This parameter is independently distributed across countries and firms.

Definition. *A firm is said to be domestically owned by country i—or from country i—if the firm's*

size of the labor endowment, L_i.

productivity parameter, z, is drawn from country i's distribution, $G_i(z)$.

The domestically owned firms have the option of serving a foreign country by exporting or by opening a foreign affiliate. A key assumption in our model is that foreign affiliates inherit the productivity parameter, $z(\omega)$, of their parent firm. Foreign direct investment and exporting have different cost structures. A domestically owned firm in i that chooses to export to j must pay an *ad valorem* transportation cost, $\tau_{ij} \geq 1$, as well as a fixed cost, f_{ij}^x, to do so. If, rather than export, the firm decides to open an affiliate in country j, it avoids the transportation cost, but pays a larger fixed cost, $f_{ij}^m > f_{ij}^x$. We discuss the firm's export versus FDI choice in the next section.

We characterize the production of firms owned by the household in country i according to the location of production and the destination market. We denote by $q_{ii}(\omega, s)$ output for the domestic market produced by domestically owned firms, by $q_{ij}^x(\omega, s)$ output produced in i and exported to j, and by $q_{ij}^m(\omega, s)$ output of country i affiliates producing in (and selling to) country j. The production function of a firm with productivity $z(\omega)$ who produces for the domestic market is

$$q_{ii}(\omega, s) = z(\omega) l_{ii}(\omega, s),$$

where $l_{ii}(\omega, s)$ are units of labor input. Production functions for the other two types of producers are analogous.

Given the linearity of the production function (gross of fixed costs), the firm's problem in each market can be solved independently. The choice problem of a firm owned in country i and selling in country i is

$$\begin{aligned} \max_{p_{ii},\, l_{ii}} \ \pi_{ii}(\omega, s) &= p_{ii}(\omega, s)\, q_{ii}(\omega, s) - W_i(s)\, l_{ii}(\omega, s) \\ \text{s.t. } q_{ii}(\omega, s) &= z(\omega) l_{ii}(\omega, s). \end{aligned}$$

Substituting the demand function—the appropriate version of equation (2)—into the firm's maximization problem, and solving, yields the familiar pricing rule

$$p_{ii}(\omega, s) = \frac{\eta}{\eta - 1} W_i(s) \frac{1}{z(\omega)}. \tag{3}$$

Note that the only parameter that varies across intermediate goods is the firm specific productivity, $z(\omega)$. Since intermediate goods are symmetric in demand, each firm with productivity z will choose identical quantities and prices. For convenience, we will rename each good ω by its productivity, z, and track the measure of firms of type z.

If a firm with productivity z, from country i, opens an affiliate in country j, it chooses its price and labor demanded to maximize

$$\begin{aligned} \pi_{ij}^m(z,s) &= p_{ij}^m(z,s)\, q_{ij}^m(z,s) - W_j(s)\, l_{ij}^m(z,s) \\ \text{s.t. } q_{ij}^m(z,s) &= z l_{ij}^m(z,s), \end{aligned}$$

and has the associated price

$$p_{ij}^m(z,s) = \frac{\eta}{\eta-1} W_j(s) \frac{1}{z}. \tag{4}$$

If, instead, the firm decides to serve country j with exports produced in i, the firm maximizes profits that now depend on iceberg transportation costs,

$$\begin{aligned} \max_{p_{ij}^x,\, l_{ij}^x} \pi_{ij}^x(z,s) &= p_{ij}^x(z,s)\, q_{ij}^x(z,s) - W_i(s)\, l_{ij}^x(z,s) \\ \text{s.t. } \tau_{ij}\, q_{ij}^x(z,s) &= z l_{ij}^x(z,s), \end{aligned}$$

and the price in country j is

$$p_{ij}^x(z,s) = \tau_{ij}\, p_{ii}(z,s) = \tau_{ij} \frac{\eta}{\eta-1} W_i(s) \frac{1}{z}. \tag{5}$$

Besides τ_{ij}, the prices in (4) and (5) differ in the price of labor. When producing in i and selling to j the firm pays $W_i(s)$, while producing in—and selling to j—requires paying $W_j(s)$. In section 3 we characterize how differences in the stochastic processes governing W_i and W_j affect the mode in which a firm serves a foreign market.

Lastly, we define total profits for an i country firm with productivity z as

$$\pi_i(z,s) = \pi_{ii}(z,s) + \sum_{j=1}^{I} \iota_{ij}^x(z)\pi_{ij}^x(z,s) + \sum_{j=1}^{I} \iota_{ij}^m(z)\pi_{ij}^m(z,s),$$

where $\iota_{ij}^{x}(z)$ and $\iota_{ij}^{m}(z)$ are, respectively, one if the firm exports or owns an affiliate in country j and zero otherwise.

Households

The representative household in country i inelastically supplies L_i units of labor and maximizes the expected utility from final consumption. The household in country i holds two types of assets: shares of firms and contingent claims, $B_i(s)$. Without loss of generality, firms are assumed to be owned by the households, and thus, households receive all of the profits earned by domestically owned firms.[9] The representative consumer in country i maximizes expected utility from consumption in both periods,

$$U = \frac{C_i(0)^{1-\sigma}}{1-\sigma} + \beta \sum_{s \in S} \Pr(s) \frac{C_i(s)^{1-\sigma}}{1-\sigma},$$

subject to the budget constraint,

$$C_i(0) + \sum_{s \in S} \varphi(s) C_i(s) = B_i(0) + \sum_{s \in S} \varphi(s) \left[L_i W_i(s) + \int_z \pi_i(z,s)\, dG_i(z) \right]. \tag{6}$$

The elasticity of intertemporal substitution is $\sigma \geq 0$ and $0 < \beta < 1$ is the subjective discount factor. $\varphi(s)$ is the time-zero price of a security that pays one unit of the final good in state s, and $B_i(0)$ is initial net wealth for country i.

The first order condition from the household's optimization problem is

$$\varphi(s) = \beta \Pr(s) \left[\frac{C_i(s)}{C_i(0)} \right]^{-\sigma} \qquad s = 1, \ldots, n. \tag{7}$$

With a complete set of contingent claims, consumption of the final good in each country is a constant share of the world supply. Defining world output as $Y_W(s) = \sum_{i=1}^{I} Y_i(s)$, we have $C_i(s) = \mu_i Y_W(s)$, where μ_i is a constant that depends on country i's share of total world wealth. The stochastic discount factor can be written as

$$\varphi(s) = \phi_3 \Pr(s) Y_W(s)^{-\sigma}, \tag{8}$$

[9] The results are not affected if firms from country i are initially owned by the households in i and then are sold in the international market.

where ϕ_3 is a positive constant.

2.2 Trade and Affiliate Sales

Intermediate good firms choose to become multinationals, to become exporters, or to only serve the domestic market before the realization of country shocks. A firm from country i that decides to open an affiliate in country j pays a fixed cost, f_{ij}^m. If it decides to export to country j, it pays a fixed cost given by f_{ij}^x. We assume that exporting requires a lower fixed cost than setting up an affiliate and that "export platforms" are ruled out.

Countries are endowed with a stock of the final good, $Y_i(0)$. Multinational production and export costs are paid at time zero in units of this good. The value (gross of fixed costs) of becoming an exporter to country j for a firm with productivity z from country i is given by the discounted expected profit,

$$V_{ij}^x(z) = \sum_{s \in S} \varphi(s) \pi_{ij}^x(z, s), \tag{9}$$

while the value of opening an affiliate is given by

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

where $\varphi(s)$ is the price of a security that pays a unit of the consumption good in state s, as defined in (7).

In the appendix we show that the optimal multinational production and export decisions of firms from country i are characterized by cutoff productivity levels, z_{ij}^m and z_{ij}^x, such that firms with these productivity levels earn zero expected profits from entry,

$$V_{ij}^x\left(z_{ij}^x\right) = f_{ij}^x \tag{11}$$

$$V_{ij}^m\left(z_{ij}^m\right) - V_{ij}^x\left(z_{ij}^m\right) = f_{ij}^m - f_{ij}^x. \tag{12}$$

Firms from country i with $z \geq z_{ij}^m$ open affiliates in country j, firms with productivity z with $z_{ij}^x \leq z < z_{ij}^m$ become exporters, and firms with $z < z_{ij}^x$ do not engage in international activities, although these firms still sell to their domestic market.

Finally, net wealth in the budget constraint (6) of the household in country i is given by

$$B_i(0) = Y_i(0) - \sum_{j=1}^{I} f_{ij}^x \left[G_i\left(z_{ij}^m\right) - G_i\left(z_{ij}^x\right)\right] - \sum_{j=1}^{I} f_{ij}^m \left[1 - G_i\left(z_{ij}^m\right)\right],$$

that is, the value of the endowment net of the entry cost of setting up foreign affiliates and export networks.

2.3 Equilibrium

Given initial endowments, $\{Y_i(0)\}_{i=1}^I$*, an equilibrium is country-pair cutoff rules,* $\{z_{ij}^m, z_{ij}^x\}_{i,j=1}^I$*, and, for each* $s \in S$*, quantities,* $\{C_i(0), C_i(s), B_i(s)\}_{i=1}^I$*,* $\left\{\langle q_{ij}(z,s), l_{ij}(z,s)\rangle_{z\in Z}\right\}_{i,j=1}^I$*,* $\{Y_i(s), L_i^f(s)\}_{i=1}^I$ *and prices,* $\left\{\langle p_{ij}(z,s)\rangle_{z\in Z}, W_i(s)\right\}_{i,j=1}^I$*,* $\varphi(s)$*,such that:*

1. *Given prices and profits, the quantities* $\{C_i(0), C_i(s), l_{ij}(z,s), L_i^f(s)\}$ *solve the utility maximization problem of household* $i = 1, \ldots, I$.

2. *Prices,* $p_{ij}(z,s)$*, and quantities* $\{q_{ij}(z,s), l_{ij}(z,s)\}$ *solve the profit maximization problem of intermediate good firm* z *in country* $i = 1, \ldots, I$.

3. *The productivity cutoffs,* $\{z_{ij}^x, z_{ij}^m\}$*, satisfy the zero profit conditions for trade and multinational production in equations (11), and (12) for each* $i = 1 \ldots, I$.

4. *Arrow securities are in zero net supply, for each* $s \in S$*,*

$$\sum_{i=1}^{I} B_i(s) = 0.$$

5. *The world resource constraint for the final good is satisfied for each period and each* $s \in S$

$$\begin{aligned}\sum_{i=1}^{I} Y_i(s) &= \sum_{i=1}^{I} C_i(s)\\ \sum_{i=1}^{I} Y_i(0) &= \sum_{i=1}^{I} C_i(0) + \sum_{i=1}^{I}\sum_{j=1}^{I}\left[1 - G_i(z_{ij}^m)\right] f_{ij}^m + \sum_{i=1}^{I}\sum_{j=1}^{I}\left[G_i(z_{ij}^m) - G_i(z_{ij}^x)\right] f_{ij}^x.\end{aligned}$$

6. *The market for each type of variety,* z*, clears.*

7. *The labor market clears,*

$$L_i = L_i^f(s) + \int_{z_{min}^i}^{\infty} l_{ii}(z,s)dG_i(s) + \sum_{j=1}^{I}\int_{z_{ij}^x}^{z_{ij}^m} l_{ij}^x(z,s)dG_i(s) + \sum_{j=1}^{I}\int_{z_{ji}^m}^{\infty} l_{ji}^m(z,s)dG_j(s).$$

8. *The law of one price holds for the final good.*

3 Trade and Affiliate Sales under Uncertainty

In this section we analyze the effect of cross-country risk on the choice a firm faces between serving a market through exporting or opening an affiliate. To such end, we need to compare the expected stream of profits of doing trade versus multinational production.

It is useful to define the following aggregate productivity indices for domestic firms, exporters, and multinationals supplying country i,

$$Z_{ii}^d \equiv \int_{z_{min}^i}^{\infty} z^{\eta-1}dG_i(z) \qquad Z_{ji}^x \equiv \int_{z_{ji}^x}^{z_{ji}^m} z^{\eta-1}dG_j(z) \qquad Z_{ji}^m \equiv \int_{z_{ji}^m}^{\infty} z^{\eta-1}dG_j(z). \tag{13}$$

Since investment decisions are made before uncertainty is resolved, the productivity of the marginal exporter and multinational firm, z_{ij}^x and z_{ij}^m, do not vary across states. Thus, Z_{ii}^d, Z_{ji}^x and Z_{ji}^m are constant across states. Using the intermediate good price index in (1) and substituting the pricing rules in (3)-(5), it is straightforward to show that

$$P_i(s) = \left(\frac{\eta}{\eta-1}\right) W_i(s) \left[Z_{ii}^d + \sum_{j=1}^{I}\left(\tau_{ji}\frac{W_j(s)}{W_i(s)}\right)^{1-\eta} Z_{ji}^x + \sum_{j=1}^{I} Z_{ji}^m\right]^{\frac{1}{1-\eta}}. \tag{14}$$

Comparing (14) to (3), it is clear that the price of intermediate goods in country i is equivalent to that of a country with a unit mass of producers who all have productivity $Z_i(s)^{\frac{1}{\eta-1}}$, where

$$Z_i(s) = Z_{ii}^d + \sum_{j=1}^{I}\left(\tau_{ji}\frac{W_j(s)}{W_i(s)}\right)^{1-\eta} Z_{ji}^x + \sum_{j=1}^{I} Z_{ji}^m. \tag{15}$$

We refer to Z_i as the aggregate productivity in the economy. Note that, although the productivity indices Z_{ii}^d, Z_{ji}^x, and Z_{ji}^m are constant across states of nature, aggregate productivity, $Z_i(s)$, is state dependent. This is because foreign productivity shocks are transmitted to the domestic market through the price of imported intermediate goods. The index $Z_i(s)$ increases when imported goods are produced with relatively cheaper labor costs.

The firm's choice between exporting and opening an affiliate is characterized by two productivity thresholds, z_{ij}^x and z_{ij}^m, that satisfy the zero profit conditions in (11) and (12). To understand how these productivity thresholds are affected by country risk, we analyze the stochastic properties of the stream of profits earned by affiliates and exporters in country j. But, first, it is important to present the co-movement properties of equilibrium wages, prices, and final output.

The law of one price in the final good sector implies that the unit costs of production are equalized across countries, which, combined with the equilibrium prices in (4) and (5), results in the following expressions for wages and the price index,

$$W_i(s) = \phi_1 A_i(s) Z_i(s)^{\frac{1-\alpha}{\eta-1}} \tag{16}$$

$$P_i(s) = \phi_2 A_i(s) Z_i(s)^{-\frac{\alpha}{\eta-1}}, \tag{17}$$

where ϕ_1 and ϕ_2 are positive constants.[10] Wages in country i depend positively on realizations of country shocks, $A_i(s)$: higher productivity in the final good sector directly increases the wage in the economy, and higher productivity in the final goods sector also leads to higher aggregate productivity in the intermediate goods sector —a higher $Z_i(s)$. Aggregate productivity in the intermediate goods sector increases with $A_i(s)$ because a good realization of $A_i(s)$ increases $w_i(s)$, making imported intermediate goods relatively cheaper than local goods. This effect can be seen in equation (15). The presence of imported intermediate goods also explains why the price index, $P_i(s)$, increases less than proportionally with local wages. A good realization of $A_i(s)$ increases wages, but also makes imported goods relatively cheap: The net effect is that the real wage $W_i(s)/P_i(s)$ increases with $A_i(s)$.

Combining the market clearing conditions for intermediate goods and labor, and solving for

[10] $\phi_1 \equiv \alpha^\alpha (1-\alpha)^{1-\alpha} \left(\frac{\eta-1}{\eta}\right)^\alpha$ and $\phi_2 \equiv \frac{\eta}{\eta-1}\phi_1$.

labor requirements, output in country i can be expressed as

$$Y_i(s) = \frac{\eta}{(\eta-1)+\alpha} W_i(s) L_i - \frac{(\eta-1)}{(\eta-1)+\alpha} NX_i(s), \tag{18}$$

where net exports are defined as $NX_i(s) = \sum_{j=1}^{I} \left[X_{ij}^x(s) - X_{ji}^x(s) \right]$. In an open economy, total output in the final good is more elastic to country shocks: First, as explained above, wages are more responsive to $A_i(s)$ (through $Z_i(s)$), and second, in states when i has a high realization of final good productivity, net exports of intermediate goods are lower. In these states, foreign countries are relatively less productive in assembling final goods, so they allocate more labor to the production of intermediate goods. Correspondingly, the home country imports more intermediates and allocates more labor to the production of the final good.

With shocks to productivity in the final good sector, the co-movement between final output and (real) wages in a country is positive. This relationship is key for the co-movements derived below.[11]

Combining the demand function in (2) with the pricing rule in (4), the profits of an affiliate of a firm with productivity z from country i located in country j are

$$\pi_{ij}^m(z,s) = \frac{1-\alpha}{\eta} z^{\eta-1} \cdot w_j(s)^{1-\eta} Y_j(s),$$

where the term $w_j(s) \equiv W_j(s)/P_j(s)$ is the *real wage* in country j. Analogously, a firm with productivity z from country i that exports to j has profits

$$\pi_{ij}^x(z,s) = \frac{1-\alpha}{\eta} z^{\eta-1} \cdot \left[\tau_{ij} w_i(s) e_{ij}(s)\right]^{1-\eta} Y_j(s),$$

where the *real exchange rate* between i and j is $e_{ij}(s) \equiv P_i(s)/P_j(s)$.

The profits of affiliates and exporters fluctuate with two state dependent objects: the demand for intermediate goods in the host country, which is determined by the output of final goods $Y_j(s)$;

[11] Our assumption on productivity shocks to the final good sector is motivated by the data. An alternative specification with only country specific shocks to the productivity in the intermediate good sector results in negative co-movement of real wages (and the implicit real exchange rate) and final output. The corresponding empirical predictions of this alternative specification are not supported by the data, as explained in section 4.

and market shares, $w_j(s)$ and $w_i(s)e_{ij}(s)$, respectively. A good realization of country j's shock increases final output, $Y_j(s)$, raising the demand for intermediate goods: Profits for both exporters and multinational producers increase. However, since exporters and affiliates serving country j differ in their location of production, realizations of country shocks affect their market shares differently. The relatively high value of $A_j(s)$ implies that for exporters—located in country i—the term $W_i(s)/P_j(s)$ is relatively low, which has a positive effect on exporter profits. Conversely, the real wage faced by affiliates located in country j is relatively high. The increase in the real wage in j has a negative effect on affiliate profits.

Combining equations (9), (10), and (8), the value of opening an affiliate in country j for a firm with productivity z from country i is

$$V_{ij}^{m}(z) = \sum_{s\in S} \varphi(s)\pi_{ij}^{m}(z,s) = \phi_4 z^{\eta-1} E_s\left[Y_W^{-\sigma} Y_j w_j^{1-\eta}\right], \tag{19}$$

with $\phi_4 \equiv \phi_3(1-\alpha)/\eta$. The value of becoming an exporter in country j for a firm with productivity z from country i is

$$V_{ij}^{x}(z) = \sum_{s\in S} \varphi(s)\pi_{ij}^{x}(z,s) = \phi_4 z^{\eta-1} E_s\left[Y_W^{-\sigma} Y_j \left(\tau_{ij} w_i e_{ij}\right)^{1-\eta}\right]. \tag{20}$$

In deciding between opening an affiliate or exporting to a foreign market, the firm compares the value of such options net of their entry costs.

In an environment with uncertainty, the co-movement between the demand for intermediate goods, the cost of production, and the stochastic discount factor determines the expected flow of profits. The demand level in the destination market is given by $Y_j(s)$, while the impact of the cost of production on profits is summarized by $w_j(s)$ for affiliates and $w_i(s)e_{ij}(s)$ for exporters. The impact of aggregate risk is given by the term $Y_W(s)^{-\sigma}$.

We decompose the effect of risk on the location decision of a firm into two effects: 1) a *comparative advantage* effect that refers to the co-movement between demand and costs of production (or market shares); and 2) an *aggregate risk* effect that refers to the co-movement between profits and the stochastic discount factor.

3.1 The comparative advantage effect

Here, we shut down fluctuations in the stochastic discount factor. This can be done either by assuming risk-neutral investors, $\sigma = 0$, or alternatively, no aggregate risk, $Y_W(s) = Y_W$. The values of opening an affiliate in and exporting to market j, for a firm from country i with productivity z in equations (19) and (20), respectively, collapse to

$$\begin{aligned} V_{ij}^{m}(z) &= \phi_4 z^{\eta-1} E_s \left[Y_j w_j^{1-\eta} \right], \\ V_{ij}^{x}(z) &= \phi_4 z^{\eta-1} \tau_{ij} E_s \left[Y_j \left(w_i e_{ij} \right)^{1-\eta} \right]. \end{aligned}$$

The co-movement between the demand for intermediate goods and the cost of production is crucial in determining $V_{ij}^{m}(z)$ and $V_{ij}^{x}(z)$. In particular, firms would prefer to produce intermediate goods in countries with relatively low realizations of shocks, and hence low costs, and sell their output in markets with relatively high shocks, and hence a high demand of the final good. Low correlation between partner countries' shocks (or more volatile shocks in the destination market) means that demand in the destination country is relatively large in those states of nature where the unit cost of production (wages) in the source market is relatively low. That is, demand and the relative unit cost of exports to affiliate sales are negatively correlated. The convexity of the firms' profit function explains why trade, rather than affiliate sales, is a more attractive alternative the lower this correlation.

In other words, this is the principle of comparative advantage at work in a stochastic environment. Relative productivity between the intermediate and final good sector changes according to the shock realizations across countries. Intuitively, the country with the relatively low realization of productivity in the final good sector reallocates labor to the production of intermediate goods, and exports them to the country with high productivity in the final good sector. The high productivity country does the opposite: It reallocates labor to final good production, imports intermediate goods, and exports the final good. Hence, trade *relative* to affiliate sales has to be large between country pairs with a low correlation of their country shocks, or towards highly volatile economies.

3.2 The aggregate risk effect

With aggregate risk and risk averse consumers, the co-movement between the stochastic discount factor and profits plays an important role in valuing the two modes of serving a foreign market. A firm from i with productivity z chooses to serve market j by locating production in i (exports) or in j (affiliate sales) by comparing the expected discounted profits from exporting, $\sum_s \varphi(s)\pi_{ij}^x(z,s)$, against those from opening an affiliate, $\sum_s \varphi(s)\pi_{ij}^m(z,s)$. The additional relevant co-movement in this calculation is that between $Y_W^{-\sigma}(s)$ and profits from the respective activities.

The firm maximizes its value when it chooses the activity that concentrates profits in states of world where the final good is scarce, that is, states where the stochastic discount factor, which fluctuates with $Y_W^{-\sigma}(s)$, is high. This implies that they choose production locations in which profits negatively co-move with aggregate risk. That is, they prefer to locate the production of intermediate goods in countries with shocks most correlated with world output. In this way, labor costs are lower (and market shares larger) in states where world output is scarce. As a result, economies that closely co-move with aggregate risk are served relatively more through affiliate sales than imports.

At the macro level, the possibility of doing trade and multinational production under the presence of aggregate risk has the following effect. This effect goes beyond the efficiency gains due to the fact that allowing for these two flows permits to better adjust to the fluctuating pattern of comparative advantages. Note that with complete financial markets (and frictionless trade in the final good), households attain perfect risk sharing, $C_i(s) = \mu_i Y_W(s)$, but, consumption still fluctuates with aggregate output. In a world where firms can reallocate production through trade and multinational activities, consumption volatility is reduced relative to a world in which these international activities are not allowed. Intuitively, aggregate fluctuations are reduced when countries with shocks least correlated with world risk allocate more resources to the production of the final good. Although labor is immobile across countries, this is attained by locating the production of intermediate goods in countries with shocks more correlated with world fluctuations. Correspondingly, economies with productivity shocks least correlated with world output specialize more in the production of the final good and, for that purpose, they import a larger share of intermediate goods.[12] This endogenous location of production improves consumption smoothness in each country by reducing world output volatility.[13]

4 Empirical Results

In this section, we first derive the model's predictions regarding the effect of risk on the aggregate bilateral ratio of exports to multinational sales across country pairs. We then look for these effects in the United States using data from the Bureau of Economic Analysis.

4.1 Aggregate Implications

We start by deriving the aggregate ratio of exports to affiliate sales from country i in j. Using (2) and the first order condition from the final good producer's problem, $(1-\alpha)Y_i(s) = P_i(s)Q_i(s)$, exports of intermediate goods from i to j are

$$X_{ij}^{x}(s) = \left(\tau_{ij}\frac{W_i(s)}{W_j(s)}\right)^{1-\eta}\frac{Z_{ij}^{x}}{Z_j(s)}(1-\alpha)Y_j(s). \tag{21}$$

Similarly, we can express sales of affiliates owned by i operating in j as

$$X_{ij}^{m}(s) = \frac{Z_{ij}^{m}}{Z_j(s)}(1-\alpha)Y_j(s). \tag{22}$$

The ratio of trade to affiliate sales to country j from i is then

$$R_{ij}(s) = \frac{X_{ij}^{x}(s)}{X_{ij}^{m}(s)} = \left(\tau_{ij}\frac{W_i(s)}{W_j(s)}\right)^{1-\eta}\frac{Z_{ij}^{x}}{Z_{ij}^{m}}. \tag{23}$$

Assume that the distribution of firm productivities is Pareto, $G_i(z) = 1-\left(z_{min}^{i}/z\right)^{\kappa}$, which allows us to express the productivity indices as

$$\frac{Z_{ij}^{x}}{Z_{ij}^{m}} = \left(\frac{z_{ij}^{m}}{z_{ij}^{x}}\right)^{\kappa-\eta+1} - 1.$$

[12] Of course, in countries with bad shocks, demand for the final good is lower. Our statements are about satisfying this (lower) demand *relatively* more through trade or affiliate sales.

[13] See also Ramondo and Rappoport (2008) for a more detailed treatment of this mechanism.

where $\kappa + 1 > \eta$ so that an increase in the number of exporting firms, relative to multinationals, results in a larger flow of exports relative to affiliate sales.

From the free entry conditions in (11) and (12), and using (19) and (20), the ratio of the productivity cutoffs is

$$\left(\frac{z_{ij}^x}{z_{ij}^m}\right)^{\eta-1} = \left(\frac{f_{ij}^x}{f_{ij}^m - f_{ij}^x}\right)\left[\frac{E_s\left(Y_W^{-\sigma} Y_j w_j^{1-\eta}\right)}{\tau_{ij}^{1-\eta} E_s\left(Y_W^{-\sigma} Y_j \left(w_i e_{ij}\right)^{1-\eta}\right)} - 1\right]. \tag{24}$$

As the previous literature has pointed out in a deterministic environment, more firms prefer to export, rather than open an affiliate, to serve a foreign market if the cost of production in the home country i is lower relative to the one in the host country j (given by W_i/W_j, τ_{ij}, and f_{ij}^m/f_{ij}^x). It is easy to see this by computing (24) for a deterministic model,

$$\left(\frac{\overline{z}_{ij}^x}{\overline{z}_{ij}^m}\right)^{\eta-1} = \frac{f_{ij}^x}{f_{ij}^m - f_{ij}^x}\left[\left(\tau_{ij}\frac{\overline{W}_i}{\overline{W}_j}\right)^{\eta-1} - 1\right], \tag{25}$$

where over-lined variables denote equilibrium outcomes in the deterministic case. Lower costs of exporting result in a lower ratio $\overline{z}_{ij}^x/\overline{z}_{ij}^m$, meaning that a larger fraction of firms from i opt for exporting rather than opening affiliates to serve country j.

Of course, as it is clear from (24), under uncertainty, not only do the average costs of production affect the decision to export relative to opening an affiliate, but also the stochastic properties of country shocks matter as well, through the comparative advantage and aggregate risk effects described in the previous section.

It is shown in appendix A that combining equations (16) and (17), a linear approximation of (24) around the deterministic equilibrium values in (25) is given by

$$\widehat{\left(\frac{z_{ij}^x}{z_{ij}^m}\right)} \propto \mathbf{cov}\left[\widetilde{y}_j\widetilde{w}_j\right] - \mathbf{cov}\left[\widetilde{y}_j\widetilde{w}_i\right] + \mathbf{cov}\left[\widetilde{y}_j\widetilde{e}_{ij}\right] - \sigma\left\{\mathbf{cov}\left(\widetilde{y}_W\widetilde{w}_j\right) - \mathbf{cov}\left(\widetilde{y}_W\widetilde{w}_i\right) - \mathbf{cov}\left(\widetilde{y}_W\widetilde{e}_{ij}\right)\right\}, \tag{26}$$

where $\widehat{x}$ denotes percentage deviations from deterministic values, $\widehat{x} \equiv (X(s) - \overline{X})/\overline{X}$, and $\widetilde{x}$ refers to percentage deviation from mean values, $\widetilde{x} \equiv \left(X\left(s\right) - E_s(X)\right)/E_s(X)$.

An increase in the left-hand side of (26) implies a decrease in the number of exporting firms relative to multinational firms (expressed as deviations from deterministic values). The right hand side of (26) shows the effect of risk on the location decision of a firm. The *comparative advantage* effect is captured by the first term in (26): More firms opt for exporting rather then opening affiliates if the correlation of demand with cost of production in the destination country is higher than the correlation with the cost of production in the source country. The *aggregate risk* effect is indicated by the second bracket in (26): economies with a stronger covariance of costs of production with world output export more intermediate goods relative to affiliate sales, while they are served relatively more through affiliate sales than imports.

Linearizing equation (23) around the deterministic equilibrium yields

$$\widehat{R_{ij}} = (\kappa + 1 - \eta)\left[1 + \left(\frac{\overline{Z}^x_{ij}}{\overline{Z}^m_{ij}}\right)\right]\widehat{\left(\frac{z^x_{ij}}{z^m_{ij}}\right)}. \tag{27}$$

We can further substitute (26) into (27) and get $\widehat{R_{ij}}$ in terms of output and costs co-movements, as in (26). As it is shown in appendix A, around balanced trade, we can restate such co-movements in terms of output fluctuations. Taking logs, we arrive at

$$\log R_{ij} \approx \log \overline{R}_{ij} + \Phi_{ij}\left[\mathbf{var}\left(\widetilde{y}_j\right) - \mathbf{cov}\left(\widetilde{y}_i, \widetilde{y}_j\right)\right] - \Phi_{ij}\sigma\left[\mathbf{cov}\left(\widetilde{y}_W, \widetilde{y}_j\right) - \mathbf{cov}\left(\widetilde{y}_W, \widetilde{y}_i\right)\right]. \tag{28}$$

where $\Phi_{ij} > 0$ This equation forms the basis for our estimating equations. The factors affecting the ratio of exports to affiliate sales in the deterministic case are also present here, imbedded in the variable $\log \overline{R}_{ij}$. For example, the bilateral ratio of exports to affiliate sales decreases in the relative average cost of labor in the home country, and in the transport cost between country pairs. The effects coming from the risky environment are summarized by the stochastic properties of country's output fluctuations. The comparative advantage effect is captured by the first term in brackets in (28), while the aggregate risk effect is reflected by the second term in brackets.

We take the relationship in (28) to U.S. data. Our data cover both foreign affiliates of U.S. multinationals and affiliates of foreign multinationals that operate in the United States. We separately specify (28) as either the ratio of trade to affiliate sales from the United States to country

j, or from country j to the United States. That is, we separately test the predictions of the model on outflows from the United States and inflows into the United States, as specified below. We first present results on the comparative advantage effect and then we consider the full specification that includes aggregate risk. First, we turn to the description of the data.

Finally, the BEA only collects affiliate sales data when the United States is one of the trading partners. To increase the number of observations in our data set, we extend the model to include many industries. Additionally, this allows us to control for important industry characteristics.[14] In appendix B we present the complete description of the multi-industry model. We allow for H tradable intermediate good sectors, with each sector h producing a CES-composite intermediate good Q^h that aggregates a continuum of varieties $\omega \in \Omega^h$. Our estimating equations are then at the industry-country level.

4.2 Data

We use a sample of thirty-four countries that trade and engage in multinational production with the United States in the year 1994 (the baseline sample). For comparability with Helpman et al. (2004) we also report our findings for their sample of countries (referred to as the "HMY" sample). The countries included, and summary statistics, are presented in appendix C. Our variable of interest is the ratio of exports to affiliate sales from the United States to country j, in industry h, denoted R^h_{uj}, and the one from country j into the United States, denoted by R^h_{ju}.

The affiliate sales data are collected by the Bureau of Economic Analysis for use in constructing the international investment position of the United States. Our affiliate sales measure is the sum of affiliate sales to other affiliates of the same parent and to unaffiliated firms: we exclude affiliate sales back to the parent firm. The BEA uses the International Surveys Industry (ISI) system to classify the operations of multinationals and their affiliates. This classification system is based on the 1987 Standard Industrial Classification (SIC): a three digit ISI industry is roughly equivalent to a three digit SIC industry. For each country in the sample, we aggregate the firm level affiliate sales data to the three digit ISI level, so that our fundamental observation is a country-industry

[14]For example, Helpman et al. (2004) show that industries with more heterogenous firms do more multinational production relative to trade.

pair. We drop any observation in which affiliate sales are less than one thousand dollars.

Our data on exports and imports are from Feenstra, Schott and Romalis (2002), who construct SIC based measures of trade flows from Harmonized System data. To match the affiliate sales data, we create a concordance between the SIC and the ISI, based on Mataloni (1995). The concordance is listed in table 10. We measure output as (log) real GDP per capita at constant prices, PPP adjusted, from the Penn World Tables ("RGDPL"), de-trended using the Hodrick-Prescott filter with smoothing parameter 250. We compute the standard deviation of output for all countries in the sample, as well as their correlation coefficient with respect to U.S. output, for the period 1970-2004.

We proxy the ratio of exports to affiliate sales to (and from) country j in the deterministic environment, $\overline{R}_{uj}^{h}$ and $\overline{R}_{ju}^{h}$, using variables from the gravity literature. We use the distance between countries, a common language indicator, and, as a measure of size, the real income per capita of the source country relative to the destination country.[15] As an additional robustness check, when the United States is the source country, we also include country-level variables such as years of schooling, the capital-labor ratio, and the degree of rule of law in country j. Summary statistics are reported in appendix C.

4.3 Specifications and Results

4.3.1 Comparative Advantage Effect

We first concentrate on testing the comparative advantage effect, ignoring the terms involving aggregate risk in equation (28).[16] For each industry h and country of destination j, we estimate the following equation for flows from the United States:

$$\log\left(R_{uj}^{h}\right) \approx \log\left(\overline{R}_{uj}^{h}\right) + \beta_1 \text{std}\left[\widetilde{y}_j\right] + \beta_2 \text{cor}\left[\widetilde{y}_u, \widetilde{y}_j\right] + \varepsilon_{uj}^{h}. \tag{29}$$

[15] Bilateral distance is the distance in kilometers between the largest cities in the two countries. Common language is a dummy equal to one if both countries have the same official language or more than 20 percent of the population share the same language (even if it is not the official one). Both variables are from the Centre d'Etudes Prospectives et Informations Internationales (CEPII). Average real income per capita is from Penn World Tables 6.2 ("RGDPL"), an average over the period 1990-2000.

[16] We also replace covariances by correlations, and variances by standard deviations.

Our model predicts β_1 to be positive, and β_2 to be negative. For flows into the United States, we estimate the following specification based on equation (28), for each industry h and country of origin j:

$$\log\left(R^h_{ju}\right) \approx \log\left(\overline{R}^h_{ju}\right) + \alpha_1 \text{cor}\left[\widetilde{y}_u, \widetilde{y}_j\right] + \varepsilon^h_{ju}. \tag{30}$$

Our model predicts α_1 to be negative.

We use ordinary least squares to estimate equations (29) and (30). Table 1 presents results for the flows from the United States to country j, while table 3 presents analogous results for flows into the United States from country j. The dependent variable is the ratio of exports to affiliate sales in industry h. Results are presented for fifty two industries (3-digit), and two samples of countries, our baseline sample and the "HMY" sample. Appendix D reports results, similar to those in tables 1 and 3, aggregating to nineteen 2-digit industries.

Table 1 reports our estimation of equation (29). The results support the predictions of the theory regarding the relationship between flows from the United States and the stochastic properties of country j's business cycle.

The United States serves more volatile destinations relatively more through exports than affiliate sales: The coefficient on std$(\widetilde{y}_j)$ is positive and significant across different specifications. Additionally, consistent with the predictions of the model, the United States has more affiliate sales relative to exports in markets that are more correlated with the U.S. business cycle: The OLS coefficient on cor$(\widetilde{y}_u, \widetilde{y}_j)$ is -2.52 in our preferred specification (column 3).

Results are robust to the inclusion of other country variables (i.e., capital/labor ratios, average years of schooling, and the degree of rule of law in the partner country), as well as different sample of countries, and industry aggregations (shown in the appendix).

To see the economic significance of the estimated coefficients on our two variables of interest, table 2 presents the beta coefficients associated with the OLS coefficients in table 1 (for estimates in column 3 and 6).[17]

The beta coefficient on volatility implies that an increase of one standard deviation in the

[17] A beta-coefficient converts the regression coefficients into units of sample standard deviations. It is calculated as the product of the estimated coefficient times the standard deviation of the corresponding independent variable, divided by the standard deviation of the dependent variable.

Dependent variable:	$\log R^h_{uj} = \log(X^{xh}_{uj}/X^{mh}_{uj})$					
	Baseline Sample			HMY Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{std}(\widetilde{y}_j)$	26.71**	18.95*	17.03*	17.03	17.20*	13.55*
	(12.96)	(10.27)	(9.52)	(10.75)	(9.15)	(6.74)
$\text{cor}(\widetilde{y}_u, \widetilde{y}_j)$	−0.67	−2.01***	−2.52***	−0.70	−1.55*	−1.75*
	(0.62)	(0.71)	(0.77)	(0.64)	(0.87)	(0.91)
$\log(dist_{uj})$		−0.40***	−0.48***		−0.24	−0.39**
		(0.14)	(0.15)		(0.22)	(0.18)
$\log(\overline{y}_u/\overline{y}_j)$		0.42**	0.54		0.38*	0.94**
		(0.19)	(0.43)		(0.21)	(0.46)
language		0.58**	0.31		0.51**	0.12
		(0.23)	(0.26)		(0.24)	(0.29)
$\log(K_j/L_j)$			−0.44			−1.01**
			(0.40)			(0.47)
$\log(school_j)$			1.47***			1.38***
			(0.50)			(0.47)
law_j			−0.0053			0.0026
			(0.092)			(0.09)
Industry FE	yes	yes	yes	yes	yes	yes
Observations	1032	1032	1032	1177	1177	1177
R^2	0.47	0.49	0.51	0.46	0.48	0.51

OLS estimates of (29). The dependent variable is the ratio of U.S. exports to sales by U.S. affiliates in country j and industry h. Industries are defined as 3-digit ISI codes. Robust standard errors in parentheses, clustered by country. ***, **, and * denote statistical significance at 1%, 5%, and 10% respectively

Table 1: The Comparative Advantage Effect: U.S. Outward Flows.

	Baseline sample			HMY sample		
	S.D.	OLS coef.	Beta coef.	S.D.	OLS coef.	Beta coef.
$\log R_{uj}^h$	2.20			2.21		
$\text{std}(\widetilde{y}_j)$	0.013	17.03*	0.10	0.014	13.55*	0.088
$\text{cor}(\widetilde{y}_u, \widetilde{y}_j)$	0.31	−2.52***	−0.35	0.30	−1.75*	−0.24
$\log(dist_{uj})$	0.26	−0.48***	−0.058	0.27	−0.39**	−0.047
$\log(\overline{y}_u/\overline{y}_j)$	0.36	0.54	0.088	0.28	0.94**	0.12
language	0.49	0.31	0.069	0.46	0.12	0.026
$\log(K_j/L_j)$	1.03	−0.44	−0.21	0.75	−1.013**	−0.34
$\log(school_j)$	0.41	1.47***	0.27	0.34	1.38***	0.21
law_j	2.25	−0.0053	−0.005	2.30	0.0026	0.003

Beta coefficients associated with the OLS coefficients in table 1 (columns 3 and 6). A beta coefficient converts the regression coefficients into units of sample standard deviations. ***, **, and * denote statistical significance at 1%, 5%, and 10% respectively

Table 2: Beta Coefficients: U.S. Outward Flows.

volatility of country j's output is associated with an increase of 0.10 standard deviations in the (log of) ratio of exports to affiliate sales from the United States. This effect is significant compared to traditional gravity variables. For instance, an increase of one standard deviation in the (log of) distance between country j and United States decreases the (log of) ratio of exports to affiliates sales from the United States by 0.058 of standard deviation. Moreover, our beta coefficient implies that an increase in one standard deviation in the co-movement between country j and the United States reduces the ratio of exports to sales from the United States to country j by 0.31 standard deviations, even larger in magnitude than the effect of country j's volatility.

Table 3 presents results from the OLS estimation of equation (30). The estimation based on inflow data is not as robust as the results based on outflow data. One problem with this specification is that there are few observations in this case: Fewer countries have flows of exports and, particularly, affiliate sales into the United States.

Results for the inward flows are in line with the model's predictions, particularly when we use our baseline sample of countries. The correlation between the United States and the source country business cycles is negatively related to the import-sales ratio and significant: The point estimate on $\text{cor}(\widetilde{y}_u, \widetilde{y}_j)$ is -2.47 (column 3). Additionally, consistent with the theory, output volatility on country j is statistically not different from zero in all specifications. Similar results are found when

Dependent variable:	$\log R^h_{ju} = \log(X^{xh}_{ju}/X^{mh}_{ju})$					
	Baseline Sample			HMY Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{cor}(\widetilde{y}_u, \widetilde{y}_j)$	−1.23	-2.32^{***}	-2.47^{**}	−1.08	−1.43	−1.40
	(1.11)	(0.66)	(0.91)	(1.07)	(0.89)	(1.08)
$\text{std}(\widetilde{y}_j)$			−5.66			1.34
			(25.57)			(25.73)
$\log(dist_{uj})$		-0.86^{***}	-0.87^{***}		-0.69^{***}	-0.69^{***}
		(0.10)	(0.14)		(0.18)	(0.20)
$\log(\overline{y}_j/\overline{y}_u)$		−0.48	−0.51		-0.92^{*}	−0.91
		(0.47)	(0.50)		(0.51)	(0.56)
language		0.29	0.34		0.10	0.09
		(0.38)	(0.39)		(0.40)	(0.42)
Industry FE	yes	yes	yes	yes	yes	yes
Observations	600	600	600	628	628	628
R^2	0.30	0.36	0.36	0.30	0.35	0.35

OLS estimates of (30). The dependent variable is the ratio of U.S. imports to sales by foreign owned affiliates in the U.S., in industry h. Industries are defined as three-digit ISI codes. Robust standard errors in parentheses, clustered by country. ***, **, and * denote statistical significance at 1%, 5%, and 10% respectively

Table 3: The Comparative Advantage Effect: U.S. Inward Flows.

we use a different industry aggregation (shown in appendix D).

The beta coefficients in table 4, associated with the OLS coefficients in table 3 (columns 2 and 5) give a better idea of the magnitude of the effects of cross country fluctuations on the ratio of trade to affiliate sales to the United States. Particularly, decreasing the output correlation between the United States and country j by one standard deviation increases (the log of) trade by more than one fourth of a standard deviation relative to (the log of) affiliate sales from the same origin. Again, for the baseline sample, this effect is larger than the effect of bilateral distance: decreasing the (log of) distance between the United States and country j by one standard deviation increases (the log of) trade by almost one tenth of a standard deviation relative to (the log of) affiliate sales from the same origin.

	Baseline sample			HMY sample		
	S.D.	OLS coef.	Beta coef.	S.D.	OLS coef.	Beta coef.
$\log R^h_{ju}$	2.50			2.54		
$\text{cor}(\widetilde{y}_u, \widetilde{y}_j)$	0.29	-2.32^{***}	-0.27	0.28	-1.43	-0.16
$\log(dist_{uj})$	0.26	-0.86^{***}	-0.09	0.27	-0.69^{***}	-0.07
$\log(\overline{y}_j/\overline{y}_u)$	0.36	-0.48	-0.07	0.27	-0.92^{**}	-0.10
language	0.49	0.29	0.06	0.47	0.10	0.02

Beta coefficients associated with the OLS coefficients in table 3 (columns 2 and 5). A beta coefficient converts the regression coefficients into units of sample standard deviations. ***, **, and * denote statistical significance at 1%, 5%, and 10% respectively

Table 4: Beta Coefficients: U.S. Inward Flows.

4.3.2 Aggregate Risk Effect

In this section we present results regarding the aggregate risk effect. We assess whether fluctuations in the stochastic discount factor are relevant in determining the bilateral ratio of trade to affiliate sales to and from the United States, in industry h. We add to the specifications in equations (29) and (30) the correlation coefficient between world output fluctuations and partner country's output, $\text{cor}\,(\widetilde{y}_W, \widetilde{y}_j)$.

For these estimates, we construct a measure of world output fluctuations, $\widetilde{y}_w$, as the weighted average of output fluctuations of the individual countries in our sample, $\widetilde{y}_w(s) = \sum_{j=1}^{I} \theta_j \widetilde{y}_j(s)$ where θ_j is the (deterministic) weight given to country j.[18] The United States is the largest country in our sample, driving most of the fluctuations in $\widetilde{y}_w(s)$. This implies that the two regressors $\text{cor}\,(\widetilde{y}_u, \widetilde{y}_j)$ and $\text{cor}\,(\widetilde{y}_w, \widetilde{y}_j)$ are highly correlated. To avoid this multi-collinearity problem, we decompose world fluctuations into a U.S. component, with sensitivity Ψ, and a "pure" international component, $\widetilde{\xi}_w$, by running the following linear regression:

$$\widetilde{y}_w = \Psi \widetilde{y}_u + \widetilde{\xi}_w.$$

[18]The weight θ_j is constructed as the sample share of country j's GDP at current prices from Penn World Tables 6.2 (GDP per capita at current prices PPP adjusted,"CGDP", times population), averaged over the period 1990-2000. Using real GDP per capita at constant prices PPP adjusted ("RGDPL") to construct the θ-weights does not change the results.

Our estimate is $\Psi = 0.61$ (s.d. 0.05) for our baseline sample.[19]

Replacing $\widetilde{y}_w$ by $\widetilde{\xi}_W$ in $\text{cor}\left(\widetilde{y}_w, \widetilde{y}_j\right)$, we arrive at the following specifications. For U.S. outward flows we have

$$\log R^h_{uj} \approx \log \overline{R}^h_{uj} + \beta_1 \text{std}\left[\widetilde{y}_j\right] + \beta_2 \text{cor}\left[\widetilde{y}_u, \widetilde{y}_j\right] + \beta_3 \text{cor}\left[\widetilde{\xi}_W, \widetilde{y}_j\right] + \varepsilon^h_{uj}. \tag{31}$$

As in section 4.3.1, our model predicts $\beta_1 > 0$. Moreover, $\beta_2 = -(1+\sigma\Psi)\Phi^h_{uj} < 0$, and $\beta_3 = -\sigma\Psi\Phi^h_{uj} < 0$.

For inflows from country j into the United States, the empirical specification is

$$\log R^h_{ju} \approx \log \overline{R}^h_{ju} + \alpha_1 \text{cor}\left[\widetilde{y}_u, \widetilde{y}_j\right] + \alpha_2 \text{cor}\left[\widetilde{\xi}_w, \widetilde{y}_j\right] + \varepsilon^h_{ju}. \tag{32}$$

where the sign of α_1 is given by the sign of $(\sigma\Psi - 1)$. With $\Psi = 0.62$, $\alpha_1 \geq 0$ when $\sigma \geq 1.6$. The coefficient $\alpha_2 = \sigma\Phi^h_{ju} > 0$ as long as $\sigma > 0$.

We use ordinary least squares to estimate equations (31) and (32). Table 5 presents results for the flows from the United States to country j, while table 6 presents analogous results for flows into the United States from country j. The dependent variable is the ratio of exports to affiliate sales in industry h. Results are presented for fifty two industries (3-digit), and two samples of countries, our baseline sample and the "HMY" sample. Appendix D reports results, similar to those in tables 5 and 6, aggregating to nineteen industries (2-digit).

Table 5 (column 2 and 4) shows that even though the effect of $\text{cor}(\widetilde{\xi}_w, \widetilde{y}_j)$ on the ratio of exports to affiliate sales in country j has the negative sign predicted by the theory, it is not significant across the different specifications. Only when we use the baseline sample at two-digit industry aggregation, do we find significance. See table 13 in the appendix. The negative significant effect of $\text{cor}(\widetilde{y}_u, \widetilde{y}_j)$ on $\log R^h_{uj}$ is preserved.

Turning to U.S. inward flows, Table 6 shows that the coefficient on $\text{cor}(\widetilde{\xi}_W, \widetilde{y}_j)$ has a positive sign, indicating a positive effect on the ratio of imports to affiliate sales into the United States from country j. The significance of such effect depends on the specification: when we use the

[19] Using the HMY sample, our estimate is $\Psi = 0.61$ (s.d. 0.05).

Dependent variable:	$\log R_{uj}^h = \log(X_{uj}^{xh}/X_{uj}^{mh})$			
	Baseline Sample		HMY Sample	
	(1)	(2)	(3)	(4)
$\text{std}(\widetilde{y}_j)$	17.03*	11.90	13.55**	9.87
	(9.52)	(10.07)	(6.74)	(7.35)
$\text{cor}(\widetilde{y}_u, \widetilde{y}_j)$	−2.52***	−2.74***	−1.75*	−1.92*
	(0.77)	(0.73)	(0.91)	(0.93)
$\text{cor}(\widetilde{\xi}_w, \widetilde{y}_j)$		−0.64		−0.45
		(0.39)		(0.42)
$\log(dist_{uj})$	−0.48***	−0.53	−0.39**	−0.43**
	(0.15)	(0.13)	(0.18)	(0.17)
$\log(\overline{y}_u/\overline{y}_j)$	0.54	0.96*	0.94**	1.21**
	(0.43)	(0.49)	(0.46)	(0.49)
language	0.31	0.13	0.12	0.01
	(0.26)	(0.26)	(0.29)	(0.29)
$\log(K_j/L_j)$	−0.44	−0.64	−1.01**	−1.15**
	(0.40)	(0.39)	(0.47)	(0.47)
$\log(school_j)$	1.47***	1.32***	1.38***	1.22**
	(0.50)	(0.48)	(0.47)	(0.48)
law_j	−0.0053	−0.04	−0.0026	−0.0077
	(0.09)	(0.10)	(0.09)	(0.10)
Industry FE	yes	yes	yes	yes
Observations	1032	1032	1177	1177
R^2	0.51	0.52	0.51	0.51

OLS estimates of (31). The dependent variable is the ratio of U.S. exports to sales by U.S. affiliates in country j. Robust standard errors in parenthesis, clustered by country. ***, **, and * denote statistical significance at 1%, 5%, and 10% respectively

Table 5: The Aggregate Risk Effect: U.S. Outward Flows.

sample of countries as in Helpman et al. (2004), column 5 and 6, the effect is significant at 10%. In these two specifications, the effect of $\text{cor}(\widetilde{y}_u, \widetilde{y}_j)$ becomes insignificant. Recall that in this case, the comparative advantage and aggregate risk effect have opposite effects on $\log R_{ju}^h$.

In summary, we find strong support for the comparative advantage effect. First, the positive co-movement between output across countries is a relevant variable in explaining why some country-pairs trade less with each other relative to affiliate sales. Second, the higher volatility of output in the destination market is also an important variable to explain why some countries are served relatively more through exports than affiliate sales. But, we have non-conclusive support for the aggregate risk effect: even though the co-movement between a country's output and aggregate fluctuations seems to affect the joint pattern of trade and affiliate sales in the direction suggested

Dependent variable:	$\log R^h_{ju} = \log(X^{xh}_{ju}/X^{mh}_{ju})$					
	Baseline Sample			HMY Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{std}(\widetilde{y}_j)$	−5.66		8.06	1.34		15.83
	(25.57)		(27.95)	(25.73)		(26.12)
$\text{cor}(\widetilde{y}_u, \widetilde{y}_j)$	−2.47**	−1.88**	−1.62	−1.40	−0.98	−0.54
	(0.91)	(0.75)	(1.13)	(1.08)	(1.01)	(1.28)
$\text{cor}(\widetilde{\xi}_w, \widetilde{y}_j)$		0.76	0.85		0.90*	1.08*
		(0.50)	(0.60)		(0.50)	(0.59)
$\log(dist_{uj})$	−0.87***	−0.83***	−0.80***	−0.69***	−0.67***	−0.62**
	(0.14)	(0.14)	(0.18)	(0.20)	(0.20)	(0.23)
$\log(\overline{y}_j/\overline{y}_u)$	−0.51	−0.67	−0.65	−0.91	−1.10**	−1.00*
	(0.50)	(0.50)	(0.50)	(0.56)	(0.53)	(0.54)
language	0.34	0.46	0.41	0.09	0.31	0.25
	(0.39)	(0.44)	(0.42)	(0.42)	(0.45)	(0.44)
Industry FE	yes	yes	yes	yes	yes	yes
Observations	600	600	600	628	628	628
R^2	0.36	0.37	0.37	0.35	0.36	0.36

OLS estimates of (32). The dependent variable is the ratio of U.S. imports to sales by U.S. affiliates in country j. Robust standard errors in parenthesis, clustered by country. ***, **, and * denote statistical significance at 1%, 5%, and 10% respectively

Table 6: The Aggregate Risk Effect: U.S. Inward Flows.

by the theory, we do not find robust evidence on the significance of such effect.

5 Conclusions

This paper analyzes how a firm's choice of serving a foreign market by exporting or opening a foreign affiliate is affected by the existence of country specific risk. We analyze this question in an environment where consumers and firms have access to frictionless financial markets. Still, we find that cross country risk patterns affect the firm's decision on the location of production, and thus, the patterns of trade flows and affiliate sales across countries. The predictions of the model build on the assumption that affiliates of multinational firms bear shocks to the country where they carry out production. This assumption is quite natural since the country shock directly impacts the cost of locally hired labor. One can imagine a host of other shocks affecting multinational production activities, such as firm and industry shocks that would also affect the activities of the firm, irrespective of its location. More research on the nature of shocks to multinational activities is needed. Yet, as long as there are shocks that affect local production in a country, the results presented in this paper go through. Moreover, the empirical evidence presented here suggests that the stochastic properties of country shocks are important in explaining the joint pattern of the location of affiliates and the direction of trade flows.

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A Proofs and Derivations

Theorem 1. *For each country pair, i, j, firm choices between exporting and creating an affiliate can be characterized by two cutoff productivity values, z_{ij}^{x}, z_{ij}^{m}.*

Proof: From (5) and (4), prices $p_{ij}^{x}(z,s)$ and $p_{ij}^{m}(z,s)$ are inversely related to the firm's productivity z. With elastic demand ($\eta > 1$), profits increase in z.

$$\sum_{s \in S} \varphi(s) \frac{\partial}{\partial z} \pi_{ij}^{x}(z,s) > 0$$

Thus, for $\tau_{ij} > 1$, multinational profits increase with z relatively more than export profits

$$\sum_{s \in S} \varphi(s) \left[\frac{\partial}{\partial z} \pi_{ij}^{m}(z,s) - \frac{\partial}{\partial z} \pi_{ij}^{x}(z,s) \right] > 0.$$

Hence, there exists a productivity level z_{ij}^{x} such that $V_{ij}^{x}\left(z_{ij}^{x}\right) - f_{ij} = 0$ and for all firms with productivity $z > z_{ij}^{x}$, the condition $V_{ij}^{x}(z) > f_{ij}$ holds. Equivalently there is a productivity level z_{ij}^{m} such that $V_{ij}^{m}\left(z_{ij}^{m}\right) - V_{ij}^{x}\left(z_{ij}^{m}\right) = \left(f_{ij}^{m} - f_{ij}^{x}\right)$ and for all $z > z_{ij}^{m}$, the condition $V_{ij}^{m}(z) - V_{ij}^{x}(z) > \left(f_{ij}^{m} - f_{ij}^{x}\right)$ holds. Therefore, the optimal entry rule is characterized by those two cutoff productivity levels. □

Derivation of Equation 26

Define $\widehat{X} \equiv (X - \overline{X})/\overline{X}$, where $\overline{X}$ denotes the value under certainty. The ratio of the productivity cutoffs can be approximated by:

$$\widehat{\left(\frac{z_{ij}^{x}}{z_{ij}^{m}}\right)} = \frac{1}{(\eta - 1)} \frac{\overline{V}_{ij}^{m}}{\overline{V}_{ij}^{m} - \overline{V}_{ij}^{x}} \left(\widehat{V}_{ij}^{m} - \widehat{V}_{ij}^{x}\right).$$

Similarly, from equations (20) and (19), the value functions can be approximated by

$$\begin{aligned} \widehat{V}_{ij}^{m} &= (1-\eta) E_s \left[\widetilde{y}_j \widetilde{w}_j\right] - \sigma \left[E_s \left(\widetilde{y}_W \widetilde{y}_j\right) + E_s \left(\widetilde{y}_W \widetilde{w}_j\right)\right] \\ \widetilde{V}_{ij}^{x} &= (1-\eta) E_s \left[\widetilde{y}_j \left(\widetilde{w}_i + \widetilde{e}_{ij}\right)\right] - \sigma E_s \left[\widetilde{y}_W \left(\widetilde{y}_j + \widetilde{w}_i + \widetilde{e}_{ij}\right)\right] \end{aligned}$$

Replacing, we obtain

$$\widehat{\left(\frac{z_{ij}^{x}}{z_{ij}^{m}}\right)} = \frac{\overline{V}_{ij}^{m}}{\overline{V}_{ij}^{m} - \overline{V}_{ij}^{x}} \left\{E_s \left[\widetilde{y}_j \widetilde{w}_j\right] - E_s \left[\widetilde{y}_j \widetilde{w}_i\right] + E_s \left[\widetilde{y}_j \widetilde{e}_{ij}\right] - \sigma \left\{E_s \left(\widetilde{y}_W \widetilde{w}_j\right) - E_s \left(\widetilde{y}_W \widetilde{w}_i\right) - E_s \left(\widetilde{y}_W \widetilde{e}_{ij}\right)\right\}\right\}.$$

From the equilibrium wages and prices in equations (16) and (17), we obtain the following equilibrium fluctuations:

$$\begin{aligned}\widetilde{W}_i &= \widetilde{A}_i + \frac{1-\alpha}{\eta-1}\widetilde{Z}_i \\ \widetilde{P}_i &= \widetilde{A}_i - \frac{\alpha}{\eta-1}\widetilde{Z}_i\end{aligned}$$

Moreover, from equation (18), we approximate around $NX_i/Y_i \approx 0$ the following co-movement:

$$\frac{dY_i(s)}{\overline{Y}_i} - \frac{dY_j(s)}{\overline{Y}_j} \approx \Phi\left(\frac{dW_i(s)}{\overline{W}_i} - \frac{dW_j(s)}{\overline{W}_j}\right),$$

Then, the ratio of exports to affiliate sales from country i to country j can be expressed as:

$$\log R_{ij} \approx \log \overline{R}_{ij} + \Phi_{ij}\left[E\left(\widetilde{y}_j^2\right) - E\left(\widetilde{y}_i, \widetilde{y}_j\right)\right] - \Phi_{ij}\sigma\left[E\left(\widetilde{y}_W, \widetilde{y}_j\right) - E\left(\widetilde{y}_W, \widetilde{y}_i\right)\right].$$

B The Multi-industry model

There are $H+1$ sectors: a tradable final good sector, and H tradable intermediate goods sectors. Each industry, h, produces a CES composite intermediate good Q^h that aggregates a continuum of varieties z,

$$Q_i^h(s) = \left(\int_z q_i^h(z)^{\frac{\eta^h}{\eta^h-1}} dG_i(z)\right)^{\frac{\eta^h-1}{\eta^h}}.$$

The parameter η^h is the elasticity of substitution among varieties in a given industry h. Total expenditure on each individual good, ω, in industry h, in country i, is

$$x_i^h(\omega, s) = \left[\frac{p_i^h(\omega, s)}{P_i^h(s)}\right]^{1-\eta^h} Q_i^h(s) P_i^h(s).$$

where P_i^h is the price index associated with $Q_i^h(s)$. Industries are aggregated as,

$$Q_i(s) = \prod_{h=1}^{H} Q_i^h(s)^{\beta^h},$$

with $\sum_{h=1}^{H}\beta_h = 1$. The composite intermediate good $Q_i(s)$ has associated price index

$$P_i(s) = \prod_{h=1}^{H}(P_i^h(s))^{\beta_h}.$$

The aggregate intermediate good is combined with labor to produce the final good, as in the basic model,

$$Y_i(s) = A_i(s) L_i^f(s)^{\alpha} Q_i(s)^{1-\alpha}.$$

Wages and the aggregate price index are analogous to the ones in the basic model,

$$\begin{aligned} W_i(s) &= \Lambda_1 A_i(s) \prod_{h=1}^{H} Z_i^h(s)^{(1-\alpha)\frac{\beta^h}{\eta^h-1}} \\ P_i(s) &= \Lambda_2 A_i(s) \prod_{h=1}^{H} Z_i^h(s)^{-\alpha\frac{\beta^h}{\eta^h-1}}, \end{aligned}$$

where Λ_1 and Λ_2 are constants and Z_i^h is the aggregate productivity index for industry h, in country i.[20] The realization of the country productivity $A_i(s)$ qualitatively affects the wage and price index as in the basic set up. Finally, the ratio of exports to affiliate sales from country i to country j, in industry h, is

$$\frac{X_{ij}^{x,h}(s)}{X_{ij}^{m,h}(s)} = (\tau_{ij})^{1-\eta^h} \left(\frac{W_i(s)}{W_j(s)}\right)^{1-\eta^h} \frac{Z_{ij}^{x,h}}{Z_{ij}^{m,h}}.$$

In contrast to the basic model, $Z_{ij}^{x,h}$ and $Z_{ij}^{m,h}$ now differ across industries.

[20] $\Lambda_2 \equiv \Lambda_1 \prod_{h=1}^{H} (\frac{\eta^h}{\eta^h-1})^{\beta_h}$ where $\Lambda_1 \equiv \alpha^\alpha (1-\alpha)^(1-\alpha)$.

C Summary Statistics

	$R^h_{uj} = X^{xh}_{uj}/X^{mh}_{uj}$			$R^h_{ju} = X^{xh}_{ju}/X^{mh}_{ju}$		
	obs	mean	std	obs	mean	std
ARG*	35	11.56	47.13	1	–	–
AUS	45	3.34	9.51	13	4.03	13.16
AUT	28	14.99	64.64	10	1.54	1.38
BEL	41	9.18	28.10	12	21.07	41.85
BRA*	42	1.41	2.82	6	14.01	13.37
CAN	50	3.66	4.55	18	6.59	8.59
CHE	33	18.63	82.73	17	0.56	1.12
CHL	20	4.82	15.38	1	–	–
COL	24	4.52	13.29	1	–	–
DNK	24	14.16	34.37	10	1.67	1.62
ESP	43	8.33	45.02	8	3.24	2.35
FIN	20	4.57	7.92	13	2.69	6.01
FRA	49	21.61	105.00	18	1.50	2.87
GBR	50	1.49	4.71	19	2.26	5.51
GER	47	1.80	7.72	19	1.88	4.99
GRC	15	0.78	0.98	1	–	–
HKG	28	13.22	33.81	7	39.62	48.83
IDN	19	8.89	18.64	2	0.30	0.34
IRL	35	67.28	298.03	9	2.65	4.38
ISR	15	13.63	22.40	7	17.03	38.97
ITA	48	4.03	12.23	13	3.78	6.50
JPN	37	16.40	77.28	18	1.22	1.81
KOR	27	24.98	55.22	12	264.83	551.47
MEX	47	23.11	63.93	14	111.31	210.21
MYS	24	5.89	11.95	4	346.71	681.92
NLD	45	4.18	10.70	15	36.46	131.02
NOR	20	2.21	3.64	9	12.40	32.56
NZL	24	2.35	3.81	6	2.02	3.74
PER*	11	2.67	6.85	–	–	–
PHL	22	2.57	2.95	3	46.57	65.44
PRT	20	3.51	8.88	–	–	–
SGP	29	17.11	32.09	9	9.68	13.98
SWE	34	4.35	7.64	13	0.61	0.46
THA	28	31.39	92.99	3	1.90	1.44
TUR	15	1.28	1.86	2	23.52	25.46
TWN	26	35.84	104.80	9	23.16	28.89
VEN*	31	9.27	25.66	4	17.50	29.14
ZAF	26	1.85	2.84	3	0.31	0.17

Affiliate sales data from from the Bureau of Economic Analysis. Trade data from Feenstra et al. (2002). Industries at the 3-digit level. Year 1994. Countries marked with * are included only in the HMY sample. Countries with only one observation have been suppressed to respect confidentiality.

Table 7: Summary Statistics: Affiliate Sales and Trade.

	$\text{std}(\widetilde{y}_j)$	$\text{cor}(\widetilde{y}_j, \widetilde{y}_u)$	$\text{cor}(\widetilde{y}_j, \widetilde{\xi}_w)$	$\overline{y}_j$
ARG*	0.051	0.11	−0.13	11798
AUS	0.021	0.69	−0.27	27937
AUT	0.020	0.38	0.66	29211
BEL	0.023	0.36	0.79	27436
BRA*	0.044	0.35	0.36	8184
CAN	0.030	0.79	0.10	28374
CHE	0.028	0.41	0.41	33011
CHL	0.070	0.09	0.34	12779
COL	0.025	0.05	0.41	6561
DNK	0.026	0.74	−0.22	27656
ESP	0.039	0.28	0.64	22503
FIN	0.054	0.35	0.08	23487
FRA	0.022	0.41	0.71	25426
GBR	0.026	0.75	0.29	24882
GER	0.021	0.40	0.68	27360
GRC	0.037	0.40	0.44	19362
HKG	0.038	0.08	0.53	30928
IDN	0.048	−0.11	0.46	4098
IRL	0.046	0.37	0.30	25481
ISR	0.038	0.00	0.33	20387
ITA	0.020	0.36	0.72	25434
JPN	0.028	0.16	0.86	27909
KOR	0.053	0.10	0.52	16832
MEX	0.048	−0.17	0.19	9429
MYS	0.049	−0.13	0.26	12414
NLD	0.024	0.59	0.39	28649
NOR	0.028	0.44	−0.39	37622
NZL	0.034	0.20	−0.19	20153
PER*	0.067	0.08	−0.23	4708
PHL	0.041	−0.11	0.33	3575
PRT	0.053	0.26	0.74	17561
SGP	0.053	−0.08	0.25	30052
SWE	0.029	0.39	0.15	25021
THA	0.059	−0.33	0.42	7075
TUR	0.043	0.27	0.01	5939
TWN*	0.032	0.59	0.47	18356
VEN*	0.063	0.15	0.46	10593
ZAF	0.022	−0.06	−0.01	8119

Standard deviation and output correlation with US computed using (log of) real GDP per capita at constant prices, PPP adjusted, from Penn World Table 6.2 (RGDPL), period 1970-2004, de-trended using a Hodrick-Prescott filter. The variable $\widehat{\xi}_w$ is the residual from running $\widehat{y}_w = \Psi\widehat{y}_u + \widehat{\xi}_w$, where $\widehat{y}_w$ is constructed as explained in section 4.3.2. The variable $\overline{y}_j$ is RGDPL from PWT (6.2), an average over the nineties. Countries marked with * are included only in the HMY sample.

Table 8: Summary statistics: Moments of Real GDP per Capita.

	Distance	Language	law_j	$school_j$	$\log(K_j/L_j)$
ARG*	8543	0	5.77	6.68	10.41
AUS	16009	1	10.00	10.24	11.39
AUT	6799	0	10.00	6.64	11.18
BEL	5892	0	9.90	9.15	11.24
BRA*	7694	0	6.14	3.49	9.96
CAN	548	1	10.00	10.37	11.32
CHE	6272	0	10.00	9.09	11.59
CHL	8271	0	7.17	6.45	10.02
COL	4021	0	2.29	4.53	9.64
DNK	6192	0	10.00	10.33	11.16
ESP	5770	0	8.07	5.58	11.03
FIN	6626	0	10.00	9.49	11.40
FRA	5838	0	8.99	6.52	11.35
GBR	5570	1	8.83	8.65	10.83
GER	6035	0	9.35	8.54	11.40
GRC	7929	0	6.66	6.73	10.66
HKG	12970	1	8.43	7.51	10.28
IDN	16180	0	4.50	3.75	9.00
IRL	5118	1	8.05	8.01	10.93
ISR	9120	1	5.21	9.41	10.85
ITA	6895	0	8.59	6.28	11.32
JPN	10856	0	9.11	8.46	11.07
KOR	11066	1	5.58	7.85	10.11
MEX	3369	0	5.32	4.42	10.26
MYS	15130	0	7.03	5.36	10.07
NLD	5866	0	10.00	8.57	11.28
NOR	5917	0	10.00	10.38	11.46
NZL	14546	1	9.97	12.04	11.27
PER*	5891	0	2.84	5.79	9.80
PHL	13681	1	3.26	6.48	8.99
PRT	5425	0	8.76	3.83	10.29
SGP	15351	1	8.80	4.55	10.94
SWE	6323	0	10.00	9.45	11.20
THA	13943	0	6.58	5.08	8.92
TUR	8071	0	5.52	3.29	9.70
TWN*	12533	0	8.39	7.00	10.18
VEN*	3429	0	6.42	5.37	10.66
ZAF	12582	1	4.41	4.95	9.91

Countries marked with * are included only in the HMY sample. Distance is the geographical distance in km between country j and U.S. Language is equal to one is country j has a common language with U.S., and zero otherwise. The variable law_j refers to the degree of rule of law in country j with 10 being the maximum. the variable $school_j$ refers to the average years of schooling in country j. The (log of) capital-labor ratio in country j is $\log K_j/L_j$.

Table 9: Summary Statistics: Other Country Variables.

	International Surveys Industry	1987 Standard Industrial Classification
201	Meat Products	201
202	Dairy Products	202
203	Vegetables and Preserves	203
204	Grain Mill Products	204
205	Bakery Products	205
208	Beverages	208
209	Other Food	209, 206, 207
210	Tobacco	210
220	Textiles	22
230	Apparel	23
240	Wood and Lumber	24
250	Furniture	25
262	Pulp and Paper	261, 262, 263
265	Processed Paper	265, 267
271	Newsprint	271
272	Other publishing	272, 273, 274
275	Commercial Printing	275, 276, 277, 278, 279
281	Industrial Chemicals	281, 282, 286
283	Drugs	283
284	Soap and Cleansing Products	284
287	Agricultural Chemicals	287
289	Other Industrial Chemicals	285, 289
305	Rubber	301, 302, 305, 306
308	Miscellaneous Plastics	308
310	Leather	31
321	Glass	321, 322, 323
329	Stone, Minerals, and Ceramics	324, 325, 326, 327, 328, 329
331	Ferrous metals	331, 332, 339
335	Non-Ferrous metals	333, 334, 335, 336
341	Metal Cans, Fabricated Metal	341
342	Cutlery	342
343	Heating and Plumbing Equipment	343
349	Metal Services	344, 345, 346, 347, 348, 349
351	Engines and Turbines	351
352	Farm Machinery	352
353	Construction Machinery	353
354	Metalworking Machinery	354
355	Special Industrial Machinery	355
356	General Industrial Machinery	356
357	Computers	357
358	Refrigeration Equipment	358
359	Other Industrial Equipment	359
363	Household Appliances	363
366	Audio, Video, Communications Equipment	365, 366
367	Electronic Components	367
369	Other Electronics	361, 362, 364, 369
371	Motor Vehicles	371
379	Other Transport Equipment	372, 373, 374, 375, 376, 379
381	Scientific and Measuring Equipment	381, 382
384	Medical Equipment	384
386	Optical and Photographic Equipment	385, 386
390	Miscellaneous Manufacturers	39

Table 10: Industry Concordance: SIC 1987 to ISI.

D Estimates for 2 Digit Industries

Dependent variable:	$\log R^h_{uj} = \log(X^{xh}_{uj}/X^{mh}_{uj})$					
	Baseline Sample			HMY Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
$std(\widetilde{y}_j)$	26.09**	22.30**	16.12*	17.27*	19.68**	14.59**
	(10.95)	(9.43)	(9.47)	(9.37)	(8.84)	(7.20)
$\text{cor}(\widetilde{y}_u, \widetilde{y}_j)$	−1.43**	−2.30***	−2.46***	−1.37	−1.77*	−1.78*
	(0.53)	(0.67)	(0.78)	(0.58)	(0.97)	(0.95)
$\log(dist_{uj})$		−0.25	−0.34**		−0.035	−0.24
		(0.15)	(0.16)		(0.28)	(0.21)
$\log(\overline{y}_u/\overline{y}_j)$		0.29	0.91***		0.28	1.33***
		(0.19)	(0.33)		(0.24)	(0.40)
language		0.49**	0.20		0.43	0.00086
		(0.23)	(0.29)		(0.26)	(0.32)
$\log(K_j/L_j)$			−0.85*			−1.36***
			(0.422)			(0.485)
$\log(school_j)$			1.05*			1.21*
			(0.59)			(0.60)
law_j			−0.019			−0.044
			(0.10)			(0.10)
Industry FE	yes	yes	yes	yes	yes	yes
Observations	450	450	450	515	515	515
R^2	0.41	0.43	0.45	0.39	0.40	0.45

Estimation results of OLS specification (29). The dependent variable is the ratio of U.S. exports to sales by U.S. affiliates in country j, industry h at the 2-digit industry level. Robust standard errors in parenthesis, clustered by country. ***, **, and * denote statistical significance at 1%, 5%, and 10%.

Table 11: The Comparative Advantage Effect: U.S. Outward Flows. Two-Digit Industries.

Dependent variable:	$\log R^h_{ju} = \log(X^{xh}_{ju}/X^{mh}_{ju})$					
	Baseline Sample			HMY Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{cor}(\widetilde{y}_u, \widetilde{y}_j)$	-2.55^{**}	-3.35^{***}	-2.86^{**}	-2.38^{**}	-2.18^{**}	-1.50
	(0.95)	(0.80)	(1.09)	(0.91)	(0.98)	(1.15)
$\text{std}(\widetilde{y}_j)$			17.59			28.88
			(25.35)			(25.74)
$\log(dist_{uj})$		-0.81^{***}	-0.76^{***}		-0.57^{**}	-0.50^{**}
		(0.15)	(0.17)		(0.23)	(0.23)
$\log(\overline{y}_j/\overline{y}_u)$		-0.35	-0.30		-1.00^{*}	-0.79
		(0.53)	(0.53)		(0.55)	(0.53)
language		0.51	0.39		0.28	0.11
		(0.38)	(0.40)		(0.42)	(0.42)
Industry FE	yes	yes	yes	yes	yes	yes
Observations	309	309	309	329	329	329
R^2	0.25	0.32	0.33	0.23	29	0.33

OLS estimates of (30). The dependent variable is the ratio of U.S. imports to sales by foreign owned affiliates in the U.S., industry h at the 2-digit industry level. Robust standard errors in parenthesis, clustered by country. ***, **, and * denote statistical significance at 1%, 5%, and 10%.

Table 12: The Comparative Advantage Effect: U.S. Inward Flows. Two-Digit Industries.

Dependent variable:	$\log R^h_{uj} = \log(X^{xh}_{uj}/X^{mh}_{uj})$			
	Baseline Sample		HMY Sample	
	(1)	(2)	(3)	(4)
$\text{std}(\widetilde{y}_j)$	16.12$*$	10.34	14.59 $**$	10.08
	(9.47)	(10.40)	(7.20)	(7.75)
$\text{cor}(\widetilde{y}_u, \widetilde{y}_j)$	-2.46^{***}	-2.73^{***}	-1.78^{*}	-2.00^{**}
	(0.78)	(0.69)	(0.95)	(0.95)
$\text{cor}(\widetilde{\xi}_w, \widetilde{y}_j)$		-0.88^{*}		-0.67
		(0.45)		(0.40)
$\log(dist_{uj})$	-0.34^{**}	-0.40^{***}	-0.24	-0.30
	(0.16)	(0.14)	(0.21)	(0.20)
$\log(\overline{y}_u/\overline{y}_j)$	0.91^{***}	1.44^{***}	1.33^{***}	1.70^{***}
	(0.33)	(0.44)	(0.40)	(0.46)
language	0.20	-0.03	0.00086	-0.15
	(0.29)	(0.28)	(0.32)	(0.31)
$\log(K_j/L_j)$	-0.85^{*}	-1.11^{**}	-1.36^{***}	-1.54^{***}
	(0.42)	(0.43)	(0.49)	(0.50)
$\log(school_j)$	1.05$*$	0.82	1.21^{*}	0.98
	(0.59)	(0.54)	(0.60)	(0.59)
law_j	-0.019	-0.06	-0.044	-0.06
	(0.10)	(0.11)	(0.10)	(0.11)
Industry FE	yes	yes	yes	yes
Observations	450	450	515	515
R^2	0.45	0.46	0.45	0.45

OLS estimates of (31). The dependent variable is the ratio of U.S. exports to sales by foreign affiliates in country j. Robust standard errors in parenthesis, clustered by country. ***, **, and * denote statistical significance at 1%, 5%, and 10% respectively

Table 13: The Aggregate Risk Effect: U.S. Outward Flows. Two-Digit Industries.

Dependent variable:	$\log R^h_{ju} = \log(X^{xh}_{ju}/X^{mh}_{ju})$					
	Baseline Sample			HMY Sample		
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathrm{std}(\widetilde{y}_j)$	17.59		24.40	28.88		38.07
	(25.35)		(26.86)	(25.74)		(24.70)
$\mathrm{cor}(\widetilde{y}_u, \widetilde{y}_j)$	-2.86^{**}	-3.22^{***}	-2.40^{*}	-1.50	-1.96^{*}	-0.90
	(1.09)	(0.75)	(1.22)	(1.15)	(1.05)	(1.30)
$\mathrm{cor}(\widetilde{\xi}_w, \widetilde{y}_j)$		0.24	0.51		0.50	0.88
		(0.59)	(0.68)		(0.62)	(0.69)
$\log(dist_{uj})$	-0.76^{***}	-0.80^{***}	-0.72^{***}	-0.50^{**}	-0.56^{**}	-0.46^{*}
	(0.17)	(0.16)	(0.20)	(0.23)	(0.23)	(0.25)
$\log(\overline{y}_j/\overline{y}_u)$	-0.30	-0.40	-0.39	-0.79	-1.08^{*}	-0.88
	(0.53)	(0.53)	(0.54)	(0.53)	(0.57)	(0.54)
language	0.39	0.56	0.44	0.11	0.39	0.25
	(0.40)	(0.44)	(0.42)	(0.42)	(0.46)	(0.45)
Industry FE	yes	yes	yes	yes	yes	yes
Observations	309	309	309	329	329	329
R^2	0.33	0.32	0.33	0.30	0.30	0.31

OLS estimates of (32). The dependent variable is the ratio of U.S. imports to sales by foreign owned affiliates in the U.S. Robust standard errors in parenthesis, clustered by country. ***, **, and * denote statistical significance at 1%, 5%, and 10% respectively

Table 14: The Aggregate Risk Effect: U.S. Inward Flows. Two-Digit Industries.