Diversification, Cost Structure, and the Risk Premium of Multinational Corporations*

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Abstract

We investigate theoretically and empirically the relationship between the geographic structure of a multinational corporation and its risk premium. Our structural model suggests two channels. On the one hand, multinational activity offers diversification benefits: risk premia should be higher for firms operating in countries where shocks co-vary more with the domestic ones. Second, hysteresis and operating leverage induced by fixed and sunk costs of production imply that risk premia should be higher for firms operating in countries where it is costlier to enter and produce. Our empirical analysis confirms these predictions and delivers a decomposition of firm-level risk premia into individual countries' contributions.

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1 Introduction

A large literature on foreign direct investment has studied how firms decide whether to become multinational corporations (henceforth, MNCs) and which countries to enter. Still, little is known about the consequences of these decisions for firm-level risk. Do firms' activities in foreign countries reduce the risk that investors bear through diversification? Or are there characteristics of MNCs that increase their risk relative to purely domestic firms? How does firm risk-exposure depend on the countries in which a firm operates? To address these questions, we analyze how the geographic structure of a multinational corporation impacts its risk premium in the stock market.[1] The answer is complex, as firms' foreign activities can be both a source of diversification and a source of risk to their investors.

MNCs are the largest players in the world economy. Understanding their risk exposure sheds light on the global allocation of risk across countries. This is especially important in consideration of recent economic events like the crisis, whose global aspect puts at the forefront of economic analysis the map of economic linkages across countries.

Theoretically, a firm's decisions about which countries to enter affects the risk premium via two channels. On the one hand, operating an affiliate in a foreign country induces diversification and reduces risk exposure. On the other hand, sunk entry costs and fixed operating costs generate hysteresis and leverage that increase risk exposure. Under the assumptions that agents are rational and markets are efficient, in equilibrium, risk averse agents require a risk premium that is higher the higher the risk exposure of the firms they invest into.

Empirically, we focus on differences in risk premia across firms that differ in the set of countries in which they operate. To do so, we exploit a rich firm-level dataset on MNCs with detailed information about firms' foreign operations by country, accounting, and financial market data. Consistent with the predictions of the model, we find that firms operating in countries whose GDP shocks co-move more with those of the US and in countries with higher fixed and sunk entry costs exhibit systematically higher risk premia.

The theoretical underpinning of our analysis is a streamlined, multi-country version of the model developed by Fillat and Garetto (2014), which links firms' interna-

[1] Stock returns in excess of the risk-free rate define the risk premium of a firm.

tional activities with their stock market returns.[2] This approach to the multinational firm problem is, essentially, an asset pricing problem in which the generating process for consumption and cash flows are needed to price the firm. In the model, multinational activity offers diversification potential: if the business cycles of two countries are not perfectly correlated, multinational sales diversify away the risk arising from country-specific fluctuations and reduce firms' returns in equilibrium. This mechanism, referred to as the "diversification channel", implies that, in equilibrium, MNCs should exhibit lower expected returns than non-multinational firms – all else equal. Within multinationals, returns should be higher for those firms operating in countries whose business cycles co-vary more with the one of the US. Moreover, the model introduces another channel of risk, arising from hysteresis and potential losses induced by sunk entry costs and fixed operating costs, which make firms leveraged. Firms open affiliates abroad when prospects of growth make foreign operations profitable, but they must bear sunk entry costs to open an affiliate, and fixed costs of production. If the host country is hit by a negative shock, the affiliate may incur losses. The parent may find optimal not to exit the foreign market and bear those losses for a while, in order not to forego the sunk cost it paid to enter. The higher the fixed and sunk costs of production, the higher the potential losses and the longer the time for which a firm is willing to bear them. These potential losses are perceived as a cash flow risk by the investors. This second mechanism, which we refer to as the "fixed and sunk cost channel", implies that MNCs with affiliates in countries where entry is more costly and fixed operating costs are higher should exhibit higher stock returns than MNCs with affiliates located in countries that are more easily and cheaply accessible. To our knowledge, our paper is the first one to study the relationship between the endogenous location choices of a MNC and its risk exposure. Given that MNCs are the largest players in the global economy, understanding this relationship is key to evaluating the allocation of aggregate risk across countries.

Our empirical analysis exploits a novel dataset obtained by merging accounting and financial data from Compustat/CRSP with the US Bureau of Economic Analysis (BEA) data on the operations of multinational corporations. The data display a

[2]Our model builds on the literature on investment under uncertainty, particularly on the real option value framework developed by Dixit (1989) and Dixit and Pindyck (1994) as applied to an economy with heterogeneous firms by Fillat and Garetto (2014).

large amount of variation across MNCs in terms of number, characteristics, and location of foreign affiliates, allowing us to study the cross-section of returns of MNCs and to relate it to firm- and country-level characteristics.

We start with a reduced form specification whose goal is to explore the statistical relationship between measures of diversification, entry costs, and returns. The results of our regression analysis are consistent with the predictions of the model: GDP growth covariances and entry costs in the countries in which firms have affiliates are positively correlated with the returns that firms offer in the stock market. These results are robust to controlling for the impact that potential activities in countries other than the ones currently served have on the returns of the firm (the option value).

The model at the heart of our analysis delivers a structural equation linking expected returns to firm- and country-level characteristics. By estimating this equation we are able to quantify the effect of the geographic choices of a MNC on its risk premium. This specification allows us to decompose firm-level risk premia along two dimensions. First, we compute the contribution of each host country to the firms' risk premium. Second, we separate the contribution of option value versus assets in place in explaining stock returns.

By aggregating our estimates, we show that the aggregate risk premium from multinational sales is large: a firm with affiliates in every country in our sample has, on average, expected annual returns that are about 3% higher than those of a purely domestic firm. The countries that are associated with the highest risk premia are Greece, Malaysia, Singapore, Denmark, India and China, while most European countries and Canada are associated with relatively low risk premia. The aggregate risk premium coming from the option value of foreign sales is smaller but also significant, at 0.65 %, indicating that the mere possibility of entering foreign markets is a source of risk to the firm.

The question of understanding why and how average stock returns vary across firms based on certain characteristics is central to the asset pricing literature.[3] Nonetheless, very little empirical work has been done on the returns of multinational

[3] An extensive literature in finance has been investigating cross-sectional differences in stock returns across firms, assets, or portfolios, identifying several variables driving returns differentials. Fama and French (1996) provide comprehensive evidence about returns differentials across portfolios formed according to particular characteristics like size and book-to-market.

corporations. Early research examined the returns of MNCs to assess whether firms' foreign activities provide diversification benefits to their stockholders. Support for this "diversification hypothesis" is scarce: Jacquillat and Solnik (1978) regressed the returns of multinationals from nine countries on a set of market indices and found that multinational returns tended to covary most with the firm's home market, hence not providing any evidence in support of diversification. Senchack and Beedles (1980) compared the risk, returns and betas of portfolios of multinationals with portfolios of domestic and international equities and found that multinationals did not deliver diversification benefits. Using a different methodology based on mean-variance spanning tests, Rowland and Tesar (2004) also found limited evidence of diversification benefits for MNCs. More recently, using a sample of manufacturing firms from Compustat, Fillat and Garetto (2014) have shown that the stock market returns of multinational corporations are systematically higher than the stock market returns of non-multinational firms, also against what would be predicted by the diversification hypothesis. The structural model in Fillat and Garetto (2014) sheds light on this "puzzle" by introducing another channel, the fixed and sunk cost channel, that increases the risk to which MNCs are exposed compared to non-multinational firms and can potentially explain MNCs' higher returns and the lack of evidence of diversification.

Our analysis is related to an extensive literature on foreign direct investment, which has documented important differences across firms in their choice of geographic locations, and to empirical research using the BEA data on the operations of multinational corporations, starting with Kravis and Lipsey (1982) and Brainard (1997), and more recently Yeaple (2003), Helpman, Melitz, and Yeaple (2004), and Yeaple (2009).[4] In a model with similar ingredients but different assumptions, Ramondo, Rappoport, and Ruhl (2013) study selection into export and FDI in the presence of aggregate uncertainty. We see our analysis as complementary to theirs, as we emphasize the relationship between firms' global decisions and financial variables rather than the role of uncertainty for selection.

To our knowledge, this is the first paper to link the geographic information contained in the BEA data to stock market data from CRSP.[5] By their nature, stock

[4]See also Chen and Moore (2010) and Alfaro and Chen (2013).

[5]Branstetter, Fisman, and Foley (2006) merge the BEA data on the operations of US multinationals with accounting data from Compustat to examine the effect of IPR reforms on technology

market data are forward-looking, and incorporate information about agents' expectations that can be informative about the long-run outcomes of these firms. While bringing novel data into the analysis, we contribute to the literature by providing new insights on the operations of MNCs from a financial markets, forward-looking perspective.

Our work is also related to a strand of literature in corporate finance that studies the linkages between international activity and stock market variables.[6] Our analysis departs from these contributions by taking into account the full geographic structure of the firm as a determinant of stock returns, and by starting from the predictions of a structural model to identify the economic forces that link MNCs' structure and stock returns in the data.

The rest of the paper is organized as follows. Section 2 lays out the theoretical model at the basis of our empirical specification. Section 3 describes the financial data and the data on the operations of multinational corporations. Section 4 presents our baseline empirical specifications and results, and Section 5 concludes. The derivation of the model and several robustness exercises are relegated to the appendix.

2 The Returns of Multinational Corporations

The model we develop in this section is designed to illustrate how the stock returns of multinational corporations depend on a set of variables related to their international activities across countries. At the aggregate level, the model is specified as an endowment economy, consistent with consumption-based asset pricing models. We take aggregate consumption as given, and focus on modeling the production side of the economy, where firms' valuations are affected by firm-level and country-level characteristics. Firms' valuations and the covariance of their profits with the agents' marginal utility drive the returns.

The model is a multi-country extension of the framework developed in Fillat and Garetto (2014).[7] The economy is composed by $N+1$ countries: a Home country, that

transfer within multinational corporations.

[6]See Denis, Denis, and Yost (2002) and Baker, Foley, and Wurgler (2009).

[7]While Fillat and Garetto (2014) distinguish entry in foreign markets according to whether it happens via export or FDI, due to data availability in this paper we disregard the decision to

we denote by h, and N potentially asymmetric foreign countries, that we denote by $j = 1, ...N$. Time is continuous. Each country is hit by aggregate shocks to its GDP growth rate, which are described by the following geometric Brownian motions:[8]

$$\frac{dY_i}{Y_i} = \mu_i dt + \sigma_i dz_i, \text{ for } i = h, j \text{ and } j = 1, ...N \quad (1)$$

where $\mu_i \geq 0$, $\sigma_i > 0$. Y_i denotes the GDP level in country i and dz_i is the increment of a standard Wiener process. GDP growth processes may be correlated across countries: let $\rho_j \in [-1, 1]$ denote the correlation between the GDP growth of the Home country and the one of country j.

International markets are incomplete: changes in aggregate consumption in each country are equal to changes in GDP, and there is no possibility of consumption smoothing over time or across countries. We assume complete home bias in the asset markets, in the sense that firms are owned by agents in country h, who discount cash flows with the following discount factor M_h:[9]

$$\frac{dM_h}{M_h} = -r_h dt - \gamma \sigma_h dz_h \quad (2)$$

where r_h denotes the risk-free rate in the Home country and γ denotes risk-aversion.[10] This is a partial equilibrium model where aggregate quantities are taken as given.

export and focus on the choice of becoming a multinational corporation.

[8]It is well accepted that equilibrium consumption growth follows a random walk since Hall (1978). The unit root process is necessary to generate an option value component in the value of the firm. We take standard deviations and correlations of consumption growth as exogenous parameters, and model firm's decisions depending on those parameters. In general equilibrium, firms' international activities could have an impact on host country-level variables, hence the GDP growth correlations ρ_j would be endogenous. In our data, total MNCs' sales to a host country are typically a very small fraction of the host country's GDP (3.3% on average), hence we argue that it is acceptable to take the GDP growth correlations as exogenous. For a different approach where country-specific volatility is endogenous and affected by international activity, see Caselli et al. (2014).

[9]The model does not allow for any possibility of international portfolio diversification, but features perfect home bias in equity portfolios. This assumption is not at odds with the data: Tesar and Werner (1998) provide evidence of an extreme home bias in equity portfolios: about 90% of US equity was invested in the US stock market in the mid-1990s. Atkeson and Bayoumi (1993), Sorensen and Yosha (1998), and Crucini (1999) present evidence supporting the assumption of international market incompleteness.

[10]The process for the stochastic discount factor or intertemporal marginal rate of substitution, M_h, is an equilibrium object that can be derived from agents maximizing CRRA utility over aggregate consumption.

Therefore, equilibrium in the goods and asset markets is determined by adjustment in prices.

Aggregate output in each country Y_i is produced by domestic firms and by the affiliates of multinational firms located in country i. Each firm chooses its optimal production level in each country as a share of total output Y_i.

Let $\mathcal{V}$ denote the value of a firm. $\mathcal{V}$ depends on firm-specific characteristics, like productivity, size, employment, etc., and on country-specific characteristics, like the GDP growth processes of the countries where the firm operates, entry costs, and other operating costs. For this reason, we write $\mathcal{V} = \mathcal{V}(a, \bar{Y}, \bar{X})$, where a denotes firm-specific characteristics, $\bar{Y} = (Y_h, Y_1, ...Y_N)$ denotes a vector whose entries are the realizations of GDP described by Eq. (1), and $\bar{X} = (X_h, X_1, ...X_N)$ denotes a vector whose entries are other country-specific characteristics affecting firm value. Consistent with the literature on selection into multinational activity and with the empirical evidence on firms' international dynamics, fixed operating costs of production and sunk costs of entry into a market are particularly relevant among the variables entering the vector $\bar{X}$.[11] Depending on its characteristics a, each firm self-selects into the set of countries where its operations are profitable. Given demand for each firm's product in each country, a drives both the intensive margin of production in each country and the extensive margin of entry in different countries.

We assume that firms' activities are independent across countries, *i.e.* each firm makes entry and production decisions country-by-country.[12] Since the decision of setting up a foreign affiliate is endogenous and affected by uncertainty through the country-specific GDP growth shocks, we must consider the fact that a firm's valuation is affected both by its assets currently in place in various countries, and by the possibility of entering new countries (its option value).[13] For these reasons

[11] Helpman, Melitz, and Yeaple (2004) model selection into multinational activity as motivated by the interaction of high productivity and fixed costs. The importance of fixed costs for multinational production is documented in the empirical work of Brainard (1997). Roberts and Tybout (1997) and Das, Roberts, and Tybout (2007) show the empirical relevance of sunk costs for entry in foreign markets.

[12] The model does not accommodate the possibility of export platforms, whereby foreign affiliates of a multinational corporation export to third countries. As a result, a multinational firm is essentially a "portfolio" of assets in different countries, linked only by the fact that each segment of the firm operates with the same firm-level characteristics a.

[13] To understand why the option value enters the value of a firm, it is useful to recall that the value of a firm is the present discounted value of its profits over an infinite time horizon. If a firm is not selling in a market today but maybe it will be in the future, this possibility has a value and

we write the value of the firm as:

$$\mathcal{V}(a,\bar{Y},\bar{X}) = V_h(a,Y_h,X_h) + \sum_{j\in\mathcal{A}} V_j(a,Y_j,X_j) + \sum_{j\notin\mathcal{A}} V_j^o(a,Y_j,X_j) \tag{3}$$

where $V_h(a,Y_h,X_h)$ denotes the firm's value of domestic sales, $V_j(a,Y_j,X_j)$ denotes the value of the firm's affiliate sales in country j if the firm has an affiliate there, and $V_j^o(a,Y_j,X_j)$ denotes the option value of the firm's affiliate sales in country j if the firm does not have an affiliate there. $\mathcal{A}$ denotes the endogenous set of countries where the firm has affiliates ($\mathcal{A} \subseteq \{1,2,...N\}$).

We assume that all firms sell in the Home country. Conversely, firms' entry and exit into foreign markets are endogenous. For these reasons, over a generic time interval Δt we can express the components of a firm's value function as:

$$\begin{aligned}
V_h(a,Y_h,X_h) &= \pi_h(a,Y_h,X_h)M\Delta t + E[M\Delta t\cdot V_h(a,Y_h',X_h|Y_h)] && (4)\\
V_j(a,Y_j,X_j) &= \max\left\{\pi_j(a,Y_j,X_j)M\Delta t + E[M\Delta t\cdot V_j(a,Y_j',X_j|Y_j)]\ ;...\right.\\
&\quad \left. ...\ V_j^o(a,Y_j,X_j)\right\} && (5)\\
V_j^o(a,Y_j,X_j) &= \max\left\{E[M\Delta t\cdot V_j^o(a,Y_j',X_j|Y_j)]\ ;\ V_j(a,Y_j,X_j) - F_j\right\} && (6)
\end{aligned}$$

where $\pi_i(a,Y_i,X_i)$ denotes the flow profits of the firm in country i (for $i = h, j$ and $j = 1,...N$), F_j denotes the sunk entry cost that a firm has to cover to open an affiliate in country j, and the terms in expectations indicate the firm's continuation value in the event in which its status in a country does not change (*i.e.* it does not enter or exit the country).

We show in Appendix A that, in the continuation regions, the three components of the value functions above satisfy the following no-arbitrage conditions:

$$\begin{aligned}
\pi_h - r_h V_h + (\mu_h - \gamma\sigma_h^2)Y_h V_{hY}' dt + \frac{1}{2}\sigma_h^2 Y_h^2 V_{hY}'' &= 0 && (7)\\
\pi_j - r_h V_j + (\mu_j - \gamma\rho_j\sigma_h\sigma_j)Y_j V_{jY}' dt + \frac{1}{2}\sigma_j^2 Y_j^2 V_{jY}'' &= 0 && (8)\\
-r_h V_j^o + (\mu_j - \gamma\rho_j\sigma_h\sigma_j)Y_j V_{j\,Y}^{o\prime} dt + \frac{1}{2}\sigma_j^2 Y_j^2 V_{j\,Y}^{o\prime\prime} &= 0 && (9)
\end{aligned}$$

where the dependence of profits and values on $(a,\bar{Y},\bar{X})$ has been suppressed to ease

must be reflected in the value function. Dixit (1989) provides a seminal treatment of the option value of entry in a model of investment under uncertainty and sunk costs.

the notation. Given functional forms for each firm's demand in each market, one can solve explicitly for the value functions using a system of value-matching and smooth-pasting conditions. This system also delivers the country- and firm-specific thresholds in the realizations of the shocks that induce entry into a country or exit from it. The explicit solution of this problem is beside the scope of this paper, but we illustrate it in Appendix A, as it helps to link the model to the empirical analysis.[14]

By combining Eqs. (7)-(9) one can obtain the following expression for a multinational's expected returns:[15]

$$E(ret) \equiv \frac{\pi_h + \sum_{j \in \mathcal{A}} \pi_j + E(d\mathcal{V})}{\mathcal{V}} = r_h + \gamma \left(\frac{\sigma_h^2 Y_h V_{hY}'}{\mathcal{V}} + \sum_{j \in \mathcal{A}} \sigma_h \sigma_j \rho_j \frac{Y_j V_{jY}'}{\mathcal{V}} + ... \right.$$
$$\left. ... \sum_{j \notin \mathcal{A}} \sigma_h \sigma_j \rho_j \frac{Y_j V_{j\;Y}^{o\prime}}{\mathcal{V}} \right). \tag{10}$$

Eq. (10) summarizes the implications of the model for the dependence of firm level returns (and hence of the risk premium $E(ret) - r_h$) on country-specific variables, and is the theoretical foundation of our empirical specifications. The risk aversion, γ, captures the price of risk for the representative agent, or how much does he need to be rewarded for additional exposure to risk incurred by the firms. The terms in the parentheses capture the three sources of risk that a firm is exposed to: domestic risk, risk from the countries where the firm has an affiliate, and risk from the countries where the firm has the option of opening an affiliate, respectively. The first term of the expression describes the contribution of domestic activities to the returns. The last term captures the option value of entry in new countries, which we will approximate in our empirical analysis. We now focus on the second term, which we refer to as "assets in place". This term captures the exposure of multinational firms to the risk that arises from having affiliates in foreign countries, and generates two testable implications.

First, Eq. (10) indicates that expected returns should be higher the higher the covariances $\sigma_h \sigma_j \rho_j$ between the Home country's GDP growth rate and the GDP

[14]See Fillat and Garetto (2014) for more details.

[15]Details of the calculations are relegated to Appendix A.

growth rates of the host countries. This prediction summarizes the effect of diversification on returns in the model: the more the GDP growth rates of two countries co-vary, the smaller the amount of diversification that foreign activities provide. As a result, MNCs with affiliates in countries whose GDP growth rates co-move more with the US GDP growth rate are less diversified (and more risky) than MNCs with affiliates in countries whose GDP growth rates co-move less with that of the US. Riskier firms command higher expected returns in equilibrium.

Second, the fact that a firm has activities in a foreign country indicates that the firm paid an entry cost to establish an affiliate there and is bearing fixed operating costs.[16] These costs, which are independent of firm size, affect a firm's value but not its derivative V'. In other words, the elasticity of the value function in host country j (the term $Y_j V'_{jY}/\mathcal{V}$) is increasing in the fixed and sunk costs of production, and Eq. (10) indicates that expected returns should be higher the higher the fixed and sunk costs of production in the host countries where the firm operates. The economic intuition behind this prediction is the following: due to sunk entry costs and fixed costs of production, if a host country is hit by a negative shock, the foreign affiliate of a multinational firm may incur losses. The parent may find optimal not to exit the foreign market and bear those losses for a while, in order not to forego the sunk cost it paid to enter. The extent and duration of these losses are positively correlated with the size of fixed and sunk costs. Investors perceive as a risk the possibility of losses, and this cash flow risk must be rewarded by higher expected returns in equilibrium. The analysis in Section 4 tests the empirical validity of these predictions.[17]

It is important to notice that, even if Eq. (10) is derived from a simple power-utility i.i.d. framework, the qualitative predictions of the model are robust to alternative, more sophisticated specifications, namely the inclusion of permanent shocks

[16]Due to data availability, we consider a firm to be operating in country j only if it has an affiliate there. If a firm only exports to a country, we have no information about its activities there, hence we cannot include the country in the set $\mathcal{A}$. This leads us to underestimate the contribution of assets in place to the risk premium of the firm, and to interpret our results as a lower bound of the amount of riskiness that operating in foreign markets generates.

[17]Our empirical analysis focuses on the relationship between the extensive margin of entry by country and the returns. If one had to parameterize the model using CES demand functions and linear cost functions (like in most of the new trade literature), the model would also imply that – keeping the extensive margin of countries constant – returns should be increasing in the unit cost of the firm. For the purpose of this paper we don't test this prediction but we limit our analysis to test the extensive margin predictions of the model.

to GDP growth rates ("long-run risk"), disaster risk, recursive preferences, and the addition of firm-specific productivity shocks. These alternative specifications affect the solution of the value functions, but not the general dependence of returns on covariances and fixed and sunk costs.

3 Data

To test the predictions of the model, we need information on multinational companies' operations across countries and on their stock returns. We also need country-level data on the covariance of GDP growth rates and on fixed and sunk costs of production.

The Bureau of Economic Analysis collects firm-level data on US multinational companies' operations in its annual surveys of US direct investment abroad. All US headquartered firms that have at least one foreign affiliate and meet a minimum size threshold are required by law to respond to these surveys. The data include detailed information on the firms' operations both in the US and at their foreign affiliates. Our empirical analysis uses information from the BEA data on the countries in which each firm has operations. We also use data on the sales by each foreign affiliate, as well as total global sales by the MNCs to control for the scale of operations in each location and by each firm. The BEA surveys cover both manufacturing and nonmanufacturing industries, classified according to BEA versions of 3-digit SIC codes. We include firms in all industries and use data from 1987 through 2009.

Stock market returns data are obtained from the Center for Research in Security Prices (CRSP), which includes information on all firms that are publicly traded in the US stock market.[18] We match the firm level stock return data from CRSP with the firm level data on multinational operations from the BEA to obtain a set of publicly traded US-headquartered multinational firms. To ensure that outlier firms are not biasing our results, we drop observations that fall into the highest or lowest 5% in terms of their annual stock market returns. The result is a sample of more than 3200 multinational firms operating in 118 countries and 148 industries over the 23 year period.

[18] The CRSP population includes NYSE, AMEX, and NASDAQ. We identify firm-level returns with the returns of the firm's common equity. Stock market expected returns in excess of the risk free rate are the empirical counterpart of the risk premium.

The model emphasizes two channels that link firms' foreign activities with their stock market returns. To measure the diversification channel, we construct a firm-level measure, Cov_{ft}, of the extent to which GDP growth in each host country of firm f co-varies with GDP growth in the home country (the US). We begin with data on real GDP growth rates by country from the IMF. We assume that expected GDP growth is constant. We then compute the covariance between annual US GDP growth and annual GDP growth in each country over our sample period, resulting in a time-invariant GDP growth covariance measure for each country, Cov_j. We use these covariances together with information on firm f's affiliate sales to construct our firm-level measure as a weighted average of the GDP growth covariances for the countries in which the firm has foreign affiliates, where the share of sales by the affiliates in each country are used as weights:

$$Cov_{ft} = \sum_{j \in \mathcal{A}_f} s_{fjt} Cov_j \tag{11}$$

where Cov_j is the country-level GDP growth covariance and s_{fjt} is the share of total sales by foreign affiliates of firm f that were produced in country j in year t.[19]

To measure the fixed and sunk cost channel, we use country level data on the cost of starting a business from the World Bank's Doing Business database. Doing Business records the costs and procedures officially required, or commonly done in practice, for an entrepreneur to start up and formally operate an industrial or commercial business. The information used to construct these data comes from official laws, regulations and publicly available information on business entry, and the data are verified in consultation with local incorporation lawyers, notaries and government officials. The database includes information on various aspects of the cost of starting a business, including initial capital requirements, license and registration fees, number of startup procedures that must be undertaken, and the amount of time these procedures usually require. Our primary specification uses the paid in

[19]Weighting the covariances by sales shares is the simplest and most intuitive way to obtain firm-level measures of covariances with host countries. In Eq. (10) the covariances enter in a different way, where the "weights" that the model generates are the country-specific elasticities of the value function. The model-based estimation we perform in Section 4.3 mimics more closely the structure of Eq. (10). We use the measure defined in Eq. (11) in our baseline specifications, but for our robustness tests we also conduct the empirical analysis using GDP growth correlations rather than covariances. The results are reported in Appendix B.

minimum capital requirement. Doing Business defines this as "the amount that the entrepreneur needs to deposit in a bank or with a notary before registration and up to 3 months following incorporation, recorded as a percentage of the economy's income per capita." We convert this measure to a US dollar value by multiplying by income per capita. We use this variable to construct a firm-level measure of sunk costs. As with the GDP growth correlations, the firm-level sunk cost variable is a weighted average of the doing business measures for the countries in which the firm has foreign affiliates, where the share of sales by the affiliates in each country are used as weights:

$$F_{ft} = \sum_{j \in \mathcal{A}_f} s_{fjt} F_j \tag{12}$$

where F_j is a measure of cost to start a business in country j. For robustness, we also construct a firm-level measure of sunk costs that uses the share of affiliates the firm has in each country, rather than the sales share, as weights.[20] We also use alternative measures of entry costs, including the number of procedures required to start a business, and the number of days these procedures take to complete.

Table 1 provides summary statistics for the firms in our dataset. We will be using data on the entire sample of firms, as well as data on only the subset of firms that can be classified as purely horizontal multinationals. In our model FDI sales are only of the horizontal type, so by restricting our sample to purely horizontal firms we prevent the possibility that our results are biased by different motives for FDI, which could have different implications for risk. We define purely horizontal firms as those firms for which at least 99% of sales by foreign affiliates are to the local market in which the affiliate resides. Using this definition, about 26% of the firms in our sample can be classified as purely horizontal MNCs.[21] Most MNCs exhibit some combination of horizontal, vertical, and export platform FDI. In our merged dataset, about 94% of the firms have at least some horizontal sales, 66% have some sales back to the US, and 65% have some sales to third countries. In terms of total volumes of sales, about 64% of all sales by foreign affiliates are horizontal, about

[20] If a MNC needs to pay a sunk cost every time it opens a new affiliate (even in countries where it already operates other affiliates), weighting by the number of affiliates may be the appropriate choice. Results of the robustness checks using alternative definitions of Cov_{ft} and F_{ft} are reported in Appendix B.

[21] In Appendix B we report the results of a robustness test using an alternative, looser definition of horizontal MNCs.

Table 1: Summary Statistics.

	N. Obs	Mean	Std. Dev.	Min	Max
ALL FIRMS					
Tot. firm sales ($b)	21809	4.952	18.3	(confidential)	
Tot. affiliate sales by firm ($b)	21809	1.82	10.3	(confidential)	
No. of affiliates	21809	19.385	52.661	(confidential)	
No. of host countries	21809	9.428	12.437	(confidential)	
Annual Returns (%)	21809	11.296	42.015	-98.986	1315.79
Covariance (Cov_{ft})	21809	2.718	1.099	-6.585	8.096
Min. paid in capital (F_{ft}, $)	21809	4007.04	5247.67	0	75531.34
HORIZONTAL FIRMS					
Tot. firm sales ($b)	5688	2.656	9.125	(confidential)	
Tot. affiliate sales by firm ($b))	5688	0.408	1.67	(confidential)	
No. of affiliates	5688	11.656	55.406	(confidential)	
No. of host countries	5688	4.12	6.025	(confidential)	
Annual Returns (%)	5688	11.771	49.69	-96.073	1315.79
Covariance (Cov_{ft})	5688	2.725	1.205	-2.105	8.096
Min. paid in capital (F_{ft}, $)	5688	2559.17	5139.04	0	60266.7

10% are vertical, and about 26% are export platform.

We report summary statistics for this subset of horizontal firms as well as for the full sample of firms in Table 1. The average firm in our sample has 19 foreign affiliates located in 9 different countries with total global sales of 5 billion and an 11.3% annual stock market return. Purely horizontal firms are on average smaller than firms in the full sample, but the summary statistics on returns are comparable. The average GDP growth covariances are similar for both sets of firms, while sunk costs are lower for the purely horizontal firms.[22] This is consistent with a proximity-concentration model of FDI, in which high entry costs are a deterrent to horizontal FDI.

[22]It has to be noted that our measures of sunk costs are surprisingly small compared to the size of the firms in the sample. For this reason, we are not emphasizing the quantitative interpretation of the correlations between returns and sunk costs that are the results of our reduced form estimates. We argue that these sunk costs measures provide reasonable proxies for the cross-country variation of sunk costs, even if the actual level of sunk costs may be orders of magnitude higher.

Table 2: Summary Statistics: Entry and Exit.

	Total	corr. with F_j	Cross-Country Summary Statistics			
			Mean	St. Dev.	Min	Max
ALL FIRMS						
Continuation of existing affiliate	131511		2630.22	2158.54	688	10044
Affiliate entry, all types	17056	-0.02	341.12	236.21	55	1167
Affiliate exit, all types	13759	-0.12	275.18	221.62	64	1034
Affiliate entry, pre-existing parent	9448	-0.02	188.96	76.88	33	360
Affiliate exit, continuing parent	4863	-0.14	97.26	48.48	24	207
HORIZONTAL FIRMS						
Continuation of existing affiliate	43436		868.72	950.59	165	4738
Affiliate entry, all types	7537	-0.06	150.74	133.51	24	660
Affiliate exit, all types	5719	-0.13	114.38	117.56	13	548
Affiliate entry, pre-existing parent	3898	-0.04	77.96	43.85	11	171
Affiliate exit, continuing parent	1908	-0.15	38.16	27.07	6	114

Table 2 provides summary statistics on the extent of affiliate entry and exit during our sample period. The lines labeled "Affiliate exit, all types" give the total number of affiliates that exit the sample throughout the sample period, regardless of whether or not their parent firm continues to operate affiliates in other countries. This includes both continuing parents who close one or more affiliates, as well as MNCs that cease to exist entirely. A parent firm may or may not choose to shut down an individual affiliate that is experiencing losses, and – if an affiliate shuts down – the entire multinational firm does not necessarily have to shut down. For this reason, we also report exit statistics for firms that continue to operate, but that close down one or more of their affiliates, denoted as "Affiliate exit, continuing parent". We present a similar breakdown for new affiliates, first summarizing all new affiliate observations, and then only new affiliates of parents that had existed in previous periods. The category labeled "continuation of existing affiliate" includes affiliates operating in year t that also existed in $t-1$. In our sample, we observe that 81% of observations are affiliates continuing to exist from one year to the next. In 9,448 instances (5.8 %), we observe a previously existing parent firm entering a country in which it did not previously have an affiliate. Affiliate exits are much less common that entries or continuations of existing affiliates. We observe 4,863 cases (about 3 %) in which a parent firm continues to operate, but shuts down its affiliates in one or more countries. The patterns are similar for horizontal firms. By all definitions, affiliate exit is very small when compared to both new entry and to the number of affiliates that continue to exist throughout the sample period.

There is also a substantial amount of heterogeneity across countries in the entry and exit rates. Each country in our sample experiences between 33 and 360 new affiliate entries over our sample period, with an average of 189 new affiliates. The average number of affiliate exits is 97. We have also computed the correlations between entry/exit rates by country and our country-level measure of sunk cost F_j. We find that firms are not only less likely to enter countries with higher entry costs, but they are also less likely to exit these countries once they have set up an affiliate there. This is consistent with the mechanics of the model, where the larger the sunk entry costs, the larger the "band of inaction", i.e. the set of realizations of the shocks such that firms do not change their entry/exit status in a country.

4 The Role of Diversification and Cost Structure: Empirical Results

4.1 Reduced-Form Estimates

We test here the predictions of the model described in Section 2. The goal of the reduced form specification is to establish a statistical relationship between firm-level stock returns and the relevant explanatory variables that are suggested by the model: GDP growth covariances across countries and fixed and sunk costs of production. Our baseline specification is given by:

$$ret_{ft} = \alpha + \beta_1 Cov_{ft} + \beta_2 F_{ft} + \beta_3 X_{ft} + \delta_k + \delta_t + \varepsilon_{ft} \tag{13}$$

where ret_{ft} is the annual stock return of firm f in year t, Cov_{ft} is the weighted covariance of GDP growth between the US and the countries in which firm f has affiliates, and F_{ft} is the weighted cost of capital required to start a business in the countries in which firm f has affiliates. X_{ft} is a vector of firm-level controls, including the total sales of the firm, the number of countries in which it has affiliates, the aggregate FDI/export ratio in each host country, the market *beta* of the individual firm (to capture its exposure to domestic risk), the firm's exposure to other types of host country-specific risk (exchange rate volatility, rule of law, property rights, and conflicts) and gravity variables like GDP and distance from the host countries.[23] Because the industry in which a firm operates is likely to impact returns, we also include fixed effects δ_k for each firm's primary industry.[24] Finally, we include year fixed effects δ_t to interpret our results as cross-sectional. ε_{ft} is an orthogonal error term.

In the model, GDP shocks in host countries impact US MNCs through local demand, which should have a greater effect on firms that rely more heavily on sales to the local market, rather than sales back to the US or to third countries (ours is primarily a model of horizontal, rather than vertical, FDI). For this reason, our baseline reduced form estimates focus on firms that are purely horizontal in structure.

Table 3 shows the results. Column I shows the result of regressing returns on Cov_{ft}, F_{ft}, and on the controls listed above. In the interest of space, the table only reports the coefficients on our measures of covariances and sunk costs, while the complete results of the regression are reported in Appendix B. As predicted, the coefficient on the variable measuring how much comovement there is between the US and the countries in which a firm operates, Cov_{ft}, is positive and significant. This implies that stock returns are higher (lower) for MNCs with affiliates in countries

[23]Total sales capture the scale of firm activity, and have also been shown to be highly correlated with other factors, such as productivity, that may affect returns. The market *beta* of the individual firm is obtained by regressing firm-level returns on the aggregate return on the market portfolio: one time-series regression for each firm delivers each firm's *beta*. Since the BEA data does not include information on exporting by domestic firms, our model does not directly address the decision to serve foreign markets through exports. Ramondo, Rappoport, and Ruhl (2013) show that the covariance of GDP shocks impacts the firm's decision to serve markets through exports or FDI, which could result in selection bias. To control for this potential bias, we include an aggregate country-level measure of the ratio of total US exports over total FDI sales by US firms in each country. The coefficient on this ratio captures country-level differences in the propensity for exports versus FDI at an aggregate level for the countries in our sample. Variables' definitions and data sources for all the controls used are reported in Appendix B.

[24]It is possible that the covariances of GDP growth shocks vary by industry, or that firms in certain industries are more likely to enter more or less risky countries. The industry fixed effects control for the time-invariant components of these industry differences. Addressing more complex components of industry level variation and decomposing risk by industry are topics that we plan to pursue in future work.

where GDP growth co-varies more (less) with growth in the US. The coefficient on the measure of sunk costs, F_{ft}, is also positive and significant as predicted by our model.[25]

Table 3: The relationship between annual stock returns, GDP growth covariances, and entry costs.

	I Horizontal Firms	II Single Industry	III Manufacturing Only	IV All Firms	V > 75% Horizontal
covariances (Cov_{ft})	2.492**	4.454***	3.059*	0.504	1.621**
	(0.985)	(1.661)	(1.651)	(0.343)	(0.683)
entry costs (F_{ft})	0.0005***	0.001***	0.0004*	0.0002***	0.0002**
	(0.0002)	(0.0003)	(0.0002)	(0.0001)	(0.0001)
N	5223	2853	2043	21204	9589
R-sq	0.0742	0.0728	0.0598	0.0855	0.0737

Notes: *,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively. Additional controls (non reported) include: firm total sales, host countries' GDP, distance from the host countries, firm market *beta*, the ratio of FDI to exports by all US firms in the host country, the total number of host countries, exchange rate volatility, property rights, quality of government, conflict, and industry and year fixed effects. Bootstrapped standard errors are in parentheses.

These results are robust to a number of other specifications and variable definitions. The remaining columns in the Table show the results of the same regression run for different subsamples of the data. Column II only includes firms for which 100% of sales fall in one 3-digit SIC industry. By this definition, about 55% of the firms in our sample are single-industry firms. If firms operate in many different industries, then some of the variation we observe across firms in different countries could actually reflect differences in product mixes rather than the cross-country differences described in Section 2. Running the regression using only single-industry firms alleviates this concern. The results for both Cov_{ft} and F_{ft} are positive and significant, and their coefficients are larger in magnitude than the coefficients using the

[25] Our measures of covariances and entry costs are composite variables which include both variation in the covariances and entry costs themselves as well as variation in the sales shares that we use as weights. Simply clustering the standard errors by country or firm would not address these multiple sources of variation. Instead, we report bootstrapped standard errors.

full sample. The same concern about multi-product firms may also apply to firms operating in different broad sectors, like wholesale, retail, or service firms. Thus the specification in Column III includes only manufacturing firms. The coefficients are positive for for both Cov_{ft} and F_{ft}, but they are only significant at the ten percent level.[26] Column IV includes all US MNCs, not just those that can be classified as purely horizontal. The coefficient on Cov_{ft} is not significant for this universe of firms. This result is not surprising, as GDP shocks work through local demand in our model and local demand is unlikely to impact vertical or export-platform FDI. However, the sunk cost measure remains positive and significant. Finally, Column V presents the results for a sample of "mostly horizontal" firms, where we use a looser criterium to define a firm as horizontal: we define mostly horizontal firms as those firms for which at least 75% of sales by foreign affiliates are to the local market in which the affiliate resides. Using this definition, about 44% of the firms in our sample can be classified as mostly horizontal MNCs. For this subsample, the coefficients on covariances and entry costs are positive and significant.[27]

Our results confirm the importance of cross-country GDP growth covariances and entry costs into the host countries for the stock returns of US multinationals. These results provide a first pass of a theory built on those fundamentals, but disregard the fact that – according to Eq. (10) – GDP growth correlations and entry costs in the countries in which the firm does not have affiliates also matter, through the option value term. In the next section we discuss our approach to controlling for the components of the option value term by building proxies based on the estimated probabilities that firms open affiliates in given countries.

4.2 Country Selection

Eq. (10) shows that GDP growth covariances and entry costs matter not only for the value of assets in place, in the countries in which firms have affiliates, but also for the option value of entering new countries. The difficulty in measuring the contribution of these variables to the returns through the option value is that we cannot construct firm-level measures like Eqs. (11) and (12) since firms do not have

[26]The full table of results broken down by sector is available upon request to the authors.

[27]We also run our specification for the subsample of firms for which at least 50% of sales by foreign affiliates are horizontal (70% of the firms in our sample). The results are qualitatively similar to the ones using all firms.

sales in these countries. However, we can estimate how likely it is that a firm will enter a given country and then use these predicted probabilities to construct proxy measures of the option value.

Our estimation of the likelihood of entering a country draws from the literature on the determinants of FDI. According to the knowledge capital model developed by Carr, Markusen, and Maskus (2001) and Markusen and Maskus (2002), the volume of FDI activity between two countries depends on the sum of the GDPs of the countries, the squared difference in their GDPs, the difference in skilled labor endowments, and trade costs. The proximity-concentration model developed by Brainard (1997) and Helpman, Melitz, and Yeaple (2004) suggests that a firm's decision to engage in FDI is a function of proximity, which we proxy with distance, and market size, measured by the sum of US GDP and the GDP of the host country. Data on these variables are compiled from several sources. Information regarding real GDP and trade barriers come from the Penn World Tables. Trade costs are measured using standard definitions of openness: 100 minus the trade share of total GDP. Skill differences are measured using estimates of average educational attainment by Barro and Lee (2010). We also include the sources of country risk mentioned in Section 4.1 and described in detail in the appendix.

Another factor that likely impacts the future probability of entering a country is the likelihood that the country will experience a large GDP shock in the future. We proxy this likelihood using the dispersion of the country's growth rate shocks.

When considering the likelihood of entering a new country, it is important to also consider where the firm already has foreign affiliates. Work by Ekholm, Forslid, and Markusen (2007) and Mrazova and Neary (2011) has demonstrated the importance of export platform FDI, that is, firms choosing to use one foreign affiliate to serve multiple countries rather than locating an affiliate in each country. This would suggest that, under certain conditions, already having an affiliate in the same region may reduce a firm's incentives to enter a neighboring country. On the other hand, Chen (2011) emphasizes the interdependence of location choices across affiliates of the same MNC. She finds that the impact of already having a nearby affiliate can be negative (in the case of export platform FDI) or positive, as is the case when firms ship components between affiliates and thus benefit from proximity.

Even if our structural model does not allow for export platforms or intrafirm trade in inputs, controlling for the presence of other affiliates in the region is important empirically. In our country selection regression we include a dummy variable that equals one if the firm had an affiliate in the region in year $t-1$. To avoid placing strong restrictions on what constitutes a region, we define regions broadly as either Europe, Asia, NAFTA, Central and South America, Africa, and the Middle East. The resulting estimating equation is:

$$A_{fjt} = \alpha + \beta_1 W_{jt} + \beta_2 Region_{fj,t-1} + \delta_t + \varepsilon_{fjt} \tag{14}$$

where A_{fjt} is a dummy variable that equals 1 if firm f has an affiliate in country j in time t. W_{jt} is a vector of the knowledge capital, proximity-concentration and country risk variables described above. $Region_{fj,t-1}$ is a dummy variable that equals one if firm f had an affiliate in the region in which country j is located at time $t-1$. We estimate Eq. (14) using both the full sample and the sample of purely horizontal firms.

When considering the possible countries in which a firm may operate, we limited the sample to the top 50 destination countries, which account for 96% of all foreign activity by US firms. Table 4 shows the results of this probit regression. The knowledge capital and proximity-concentration variables are significant predictors of whether or not a given firm will have an affiliate in a given country. Although none of the country risk measures are significantly related to the firm's risk premium, property rights protection and quality of government are positively and significantly related to a firm's decision to enter a given country. As expected, the coefficient on armed conflict is negative, though not significant. The ratio of FDI sales to exports at the country level is positive. As expected, GDP volatility is negatively related to the decision to enter.

For each firm, we use these first step results to compute the predicted probability of entering each country in which the firm does not currently have an affiliate. These predicted entry probabilities are positively correlated with the actual rates of entry that we observe in the sample, however there is still some noise at the firm level. The correlation between actual new entry and our predicted probabilities at the firm level is 0.10. The correlation is much higher at the country level: when we average the predicted entry rate over all firms in each country, we get a correlation of 0.62 for the average predicted probability that any firm will enter the country and that country's actual number of new affiliate entrants.

Table 4: Probit regression of selection into FDI.

	ALL FIRMS	HORIZONTAL FIRMS
ln(distance)	-0.126***	-0.159***
	(0.004)	(0.007)
ln(sumgdp)	7.315***	7.583***
	(0.179)	(0.284)
ln(gdpdif^2)	1.678***	1.745***
	(0.059)	(0.093)
ln(skilldif)	0.039***	0.037***
	(0.004)	(0.006)
ln(trade cost)	-0.011***	-0.008***
	(0.001)	(0.002)
st.dev.(GDP)	-0.023***	-0.023***
	(0.002)	(0.002)
st.dev.(exrate)	-0.00004***	-0.00005***
	(0.000003)	(0.000005)
property rights	0.004***	0 004***
	(0.0002)	(0.0004)
quality of gov.	0.100***	0.236***
	(0.025)	(0.039)
conflict	-0.004	-0.001
	(0.003)	(0.004)
FDI/export ratio	0.002***	0.005**
	(0.001)	(0.002)
Region$^f_{t-1}$	0.393***	0.289***
	(0.005)	(0.008)
Year FE	YES	YES
N	2769984	1355552
Pseudo R-sq	0.1083	0.1171

Notes: ** and *** indicate significance at the 5 and 1 percent levels, respectively. Standard errors clustered by country are in parentheses.

Using the results of the probit to proxy for the option value is consistent with the model we developed in Section 2. According to the theory, the option value of a firm in a foreign country is higher the likelier a firm is to enter a given country. In the language of the model, a firm enters a country when its expected profits in that country are above some threshold (that one can derive explicitly given functional forms for preferences and technologies, see Appendix A). The estimated probability of entering a country that results from the probit can then be interpreted as a measure of how close a firm is to the entry threshold and hence of how important the option value of entering that country is.

To understand the option value of entry, we next construct a weighted average of the GDP growth covariances between the US and the countries in which the firm does not have affiliates, using the predicted probabilities as weights:

$$Cov^o_{ft} = \frac{\sum_{j \notin \mathcal{A}} prob^f_{jt} Cov_j}{\sum_{j \notin \mathcal{A}} prob^f_{jt}} \tag{15}$$

where $prob^f_{jt}$ is the predicted probability that firm f has an affiliate in country j in time t from the first step estimation and Cov_j is the covariance of GDP growth between the US and country j. We construct a similar measure for the cost of capital required to start a business in the countries in which the firm does not currently have affiliates.

Table 5: Summary statistics by affiliate presence.

	Covariance	Entry cost ($)
ALL FIRMS		
Countries with affiliates	2.718	4007.04
Countries without affiliates	2.319	7057.54
HORIZONTAL FIRMS		
Countries with affiliates	2.725	2559.17
Countries without affiliates	2.384	6938.89

Table 5 shows the weighted average GDP growth covariances and cost of capital required to start a business for the countries in which a firm does and does not have affiliates. For the average horizontal firm in our sample, the GDP growth covariance for countries in which the firm has affiliates is 2.725. The weighted covariance of shocks for countries in which they do not have affiliates is 2.384. These numbers suggest that US MNCs don't choose their affiliates' host countries with the only purpose of to diversifying away risk. If this were the case, we would observe them self-selecting into countries whose GDP growth co-varies less with the US GDP growth. The weighted cost of capital required to start a business in the countries where the firms have affiliates is \$2,559. For countries in which they do not have affiliates, that cost is \$6,939. These numbers indicate that US MNCs privilege locations with lower entry costs. The same patterns hold for the full sample of firms.

Appendix B includes a table showing the reduced form results controlling for characteristics of the countries in which each firm does not have affiliates. The effects of GDP growth covariances and of the sunk cost measures are qualitatively and quantitatively similar to the results from Table 3. The effect of the GDP growth covariances and entry costs on the returns via the option value component should have the same sign as the effect of these forces through the component measuring assets in place. This is true for the covariances Cov^o_{ft}, which exhibit a positive, albeit non significant coefficient in the baseline specification, but not for the sunk costs, F^o_{ft}, whose coefficient is negative and significant. The robustness of our reduced form results to the inclusion of these option value proxies is reassuring. However, in order to get better estimates of the option values themselves, we now turn to specifications that are more closely related to the model presented in Section 2.

4.3 Model-Based Estimates

The reduced form regressions we presented above confirm the presence of a statistical relationship between GDP growth covariances, sunk and fixed costs of production and the stock returns of multinational corporations. We now move to a more structural approach, which is derived closely from the theoretical relationship that the model delivers, Eq. (10). The model-based analysis presented here allows us to accomplish two tasks. First, we are able to decompose the risk premium into the separate contributions of individual host countries. Second, we are able to quantify the contribution of assets in place versus option value to the risk premium.

We can re-write Eq. (10) as:

$$E(ret^f) - r_h = \gamma \left[\sigma_h^2 \varepsilon_h^f + \sum_{j \in \mathcal{A}} \sigma_h \sigma_j \rho_j \varepsilon_j^f + \sum_{j \notin \mathcal{A}} \sigma_h \sigma_j \rho_j \varepsilon_j^{of} \right] \tag{16}$$

where $\varepsilon_h^f \equiv Y_h V'_{hY} / \mathcal{V}$ is the elasticity of the firm's value with respect to GDP in the home country, $\varepsilon_j^f \equiv Y_j V'_{jY} / \mathcal{V}$ is the elasticity of the firm's value with respect to GDP in host country $j \in \mathcal{A}$, and $\varepsilon_j^{of} \equiv Y_j V^{o\prime}_{j\ Y} / \mathcal{V}$ is the elasticity of the firm's option value with respect to GDP in a potential host country $j \notin \mathcal{A}$. The term $\sigma_h^2 \varepsilon_h^f$ captures firm f's domestic risk exposure. The term $\sum_{j \in \mathcal{A}} \sigma_h \sigma_j \rho_j \varepsilon_j^f$ captures the risk exposure arising from the foreign countries where firm f has affiliates. The term $\sum_{j \notin \mathcal{A}} \sigma_h \sigma_j \rho_j \varepsilon_j^{of}$ captures the risk exposure arising from the countries where firm f does not currently operates (the option value).

In order to run a regression based on Eq. (16), we need to compute the elasticities ε_h^f, ε_j^f for $j \in \mathcal{A}$, and ε_j^{of} for $j \notin \mathcal{A}$. Since the value of the firm in the countries where it has affiliates is not observable, we proxy it with the firm's net income in country j, I_{jt}^f.[28] Net income exhibits a substantial amount of variation across countries and firms. Since income is an imperfect measure of the value of the firm, we assume that the true elasticity ε_j^f is given by the approximated elasticity $\tilde{\varepsilon}_j^f$ times a country-specific unobserved component ζ_j:

$$\varepsilon_j^f \equiv \zeta_j \tilde{\varepsilon}_j^f. \tag{17}$$

The approximated elasticity $\tilde{\varepsilon}_j^f$ is estimated by running one time series regression of log-income on log-GDP for each firm f and host country j:[29] $ln(I_{jt}^f) = \alpha +$

[28]Net income is given by the firm's income from sales and investment minus total costs and expenses, so it is a measure of the firm's affiliate profits in country j. This measure, like flow profits at the affiliate level (which are not available from the BEA data), is not a perfect measure of the value of the firm because it disregards the option value of assets in place. Alternatively, CRSP contains data on profits and market capitalization at the firm level. This measure is also problematic as we only have information on the firm total market capitalization and total profits, not by individual affiliate or country of operation, hence the variation of ε_j^f across countries only comes from variation in Y_{jt}. To construct ε_j^f, we also need to take a stand on the status of MNCs that enter or exit countries during the sample period. In our baseline specification, we consider the effect on the returns of those assets that are in place for at least two years of the sample period.

[29]When we regress log net income on log gdp, observations with negative net income are dropped,

$\tilde{\varepsilon}_j^f ln(GDP_{jt})$. We estimate $\tilde{\varepsilon}_h^f$ in the same way, regressing the log of each firm's domestic net income on the log of US GDP.

The terms ζ_h, ζ_j for $j \in \mathcal{A}$, account for country-specific factors that impact the value of firms in each country and are not captured by net income. Income changes are primarily driven by shocks to local demand, however value has much broader determinants, including the expectation about future cash-flows. For example, shocks to expectations about institutional quality, rule of law, taxes, or political factors may impact the valuation of firms in a country without necessarily being reflected in their income.

Estimating the elasticity $\tilde{\varepsilon}_j^f$ using actual data on the responsiveness of each firm's income to local GDP shocks also helps us avoid potential complications resulting from differences between horizontal, vertical, and export platform FDI. GDP growth shocks in host countries impact US MNCs through local demand, which should have a greater effect on firms that rely more heavily on sales to the local market. For our reduced form approach, we addressed the distinction between horizontal versus vertical sales by only including purely horizontal firms in our analysis. However, this distinction is not an issue in our model-based estimation. Here we are able to directly identify the responsiveness of the net income of each firm to fluctuations in the local market using the estimates of $\tilde{\varepsilon}_j^f$. By estimating this elasticity directly at the firm level, we pick up any differences in responsiveness to local GDP across firms that may result from being primarily horizontal or vertical in structure.

We also prefer to avoid making a strong distinction between horizontal versus vertical FDI in these estimates because most firms do not fall cleanly into one of those two categories. The majority of US MNCs engage in some combination of both horizontal and vertical FDI, but most of the sales by US MNCs are horizontal. For example, in our sample, 64% of sales by foreign affiliates of US firms are to the

generating selection bias in our estimates. An alternative would be to approximate the elasticities as:

$$\tilde{\varepsilon}_j^f \approx \sum_{t=1}^{T} \left[\frac{(I_{jt}^f - I_{j,t-1}^f)/I_{j,t-1}^f}{(GDP_{jt} - GDP_{j,t-1})/GDP_{j,t-1}} \right] \cdot \frac{1}{T}$$

where I_{jt}^f denotes the net income of firm f in country j in year t, and GDP_{jt} denotes the GDP of country j in year t. This method allows us to compute the elasticities for all the firm-country pair in the sample, but – as an approximation – is affected by measurement error. We run our model-based estimation also using the alternative specification above, and the results are qualitatively similar.

market in which the affiliate is located and 94% of the firms have at least some sales to the local markets in which their affiliates are located. Thus for our full sample of firms, almost all of them have at least some sales to the local market, and for most affiliates these local sales make up the majority of their total sales. The structural estimates that follow make use of the full sample of firms, rather than focusing on firms that only have horizontal sales.

Next, in order to estimate the full Eq. (16), we need to construct a proxy for the elasticity of the option value of the firm: $\varepsilon_j^{of} \equiv \frac{Y_j V_{j\,Y}^{o\prime}}{\mathcal{V}}$. We cannot proxy this elasticity using foreign income measures since firms don't have income in the countries where they don't have affiliates. We proxy it instead as $\varepsilon_j^{of} \approx \zeta_j^o prob_j^f \tilde{\varepsilon}_h^f$, where $\tilde{\varepsilon}_h^f$ is the firm's elasticity of domestic net income with respect to GDP fluctuations in the US. This measure captures the firm-specific component of elasticity, and does not suffer from bias due to selection into affiliate countries, as it is a purely domestic measure. $prob_j^f$ is the predicted probability that firm f will enter country j, as estimated in Section 4.2. By multiplying the domestic elasticity by the estimated probability, we assign higher responsiveness to shocks to those firms that are more likely to enter a foreign market, and for which the model predicts the option value to be more important. The term ζ_j^o accounts for other country-specific factors that may impact the value of firms in potential host country j.[30]

This leads to the following estimation equation:

$$E(ret^f) - r_h = \psi_h \sigma_h^2 \tilde{\varepsilon}_h^f + \sum_{j \in \mathcal{A}} \psi_j \sigma_h \sigma_j \rho_j \tilde{\varepsilon}_j^f + \sum_{j \notin \mathcal{A}} \psi_j^o \sigma_h \sigma_j \rho_j prob_j^f \tilde{\varepsilon}_h^f + \nu^f \tag{18}$$

where $\psi_h \equiv \gamma \zeta_h$, $\psi_j \equiv \gamma \zeta_j$, $\psi_j^o \equiv \gamma \zeta_j^o$.

We present the results in two parts. First, we decompose the risk premium of the firm into the contributions of each individual host country. Next, we aggregate the risk premia across countries to give an estimate of total MNCs' risk. Each of these sets of results is further decomposed into the contributions of assets in place and option value.

[30]Our approximation of the elasticity of the option value is justified by the theoretical model, which – under appropriate functional assumptions – implies that the elasticity of the option value is the product of a potential host country-specific component and of a firm-country-specific component that is increasing in firm productivity and in the likelihood that the firm will enter that specific country. See Appendix A for details about how to map the model into our approximation in the data.

4.3.1 Decomposition of Risk Premium by Country

In this section we use the entire sample of firms having affiliates in the top 50 countries to estimate Eq. (18). We begin by estimating Eq. (18) without controlling for the option value. We do this by introducing a separate variable for each host country j which takes value $\sigma_h \sigma_j \rho_j \tilde{\varepsilon}_j^f$ if firm f has an affiliate in country j and equals zero if firm f does not have an affiliate in country j. It is worth noting that we do not identify the estimated coefficient ψ_j as the risk price (or risk aversion) because it contains the country specific non-observed component of the firms' elasticity of value with respect to GDP. Since the relationship in Eq. (18) should hold within industries, we add industry fixed effects to the specification. The results are reported in Table 6 under specification I.[31] In the left panel we report the estimated coefficients ψ_j, while in the right panel we report the corresponding average risk premia $\psi_j \sigma_h \sigma_j \rho_j \tilde{\varepsilon}_j^f$. For clarity of exposition, Table 6 only reports the risk premia for ψ_j coefficients that are either statistically significant or that correspond to a country that is an especially important FDI destination for US firms, such as the UK, Mexico, and China. We report the full set of results for all countries in Appendix B.

As Table 6 shows, 12 of the ψ_j coefficients are statistically significant at least at the ten percent level in at least one of our specifications. Of these 12 significant coefficients, 10 are associated with a positive risk premium ($\psi_j \sigma_h \sigma_j \rho_j \tilde{\varepsilon}_j^f > 0$), indicating that the corresponding host countries are a source of risk to MNCs with affiliates there. The countries with the highest risk premia are Greece, Malaysia, Singapore, Denmark, India, and China. Most European countries and Canada have relatively low risk premia, indicating that the effect of low sunk costs outweighs the one of high co-movement with the US.

Each country-specific risk premium can be interpreted as the additional annual return required to induce investors to hold shares of firms with affiliates in that country. For example, firms with affiliates in Greece have annual returns that are, on average, 0.54 percentage points higher than those of firms that do not have affiliates in Greece. For firms that have affiliates in the UK, the additional annual return is only 0.02 percentage points.

The country-specific risk premia reported here are for the average firm in our

[31] Since the firm-level elasticities $\tilde{\varepsilon}_j^f$ are generated regressors, we report bootstrapped standard errors.

Table 6: Country-specific estimates of risk premia, observations at the firm-year level.

	coefficients			risk premia		
	I	II		I	II	
	ψ_j	ψ_j	ψ_j^o	$\psi_j\sigma_h\sigma_j\rho_j\tilde{\varepsilon_j}^f$	$\psi_j\sigma_h\sigma_j\rho_j\tilde{\varepsilon_j}^f$	$\psi_j^o\sigma_h\sigma_j\rho_j prob_j^f\tilde{\varepsilon_h}^f$
US Domestic	0.036***	0.047***		0.2302	0.3005	
	(0.007)	(0.013)				
Canada	0.030***	0.030***	0.7091	0.1209	0.1209	0.0953
	(0.011)	(0.011)	(0.531)			
Mexico	0.0534	0.060*	0.4184	0.1888	0.2123	0.0231
	(0.036)	(0.036)	(1.018)			
Denmark	0.162***	0.163***	-0.4970	0.3977	0.4001	-0.0238
	(0.052)	(0.052)	(2.201)			
Germany	-0.0089	-0.0081	1.492*	-0.0158	-0.0144	0.1475
	(0.006)	(0.006)	(0.886)			
Greece	0.314***	0.306**	-0.3356	0.5582	0.5440	-0.0072
	(0.144)	(0.144)	(5.150)			
Ireland	0.0015	0.004*	-1.455*	0.0207	0.0555	-0.3290
	(0.002)	(0.002)	(0.803)			
Netherlands	0.028**	0.025**	0.2572	0.1355	0.1210	0.0293
	(0.011)	(0.011)	(1.018)			
United Kingdom	0.0046	0.0043	1.4119	0.0253	0.0236	0.3366
	(0.008)	(0.008)	(0.428)			
Israel	-0.572**	-0.524**	-32.222***	-0.6913	-0.6333	-0.2115
	(0.222)	(0.223)	(10.394)			
Australia	0.089*	0.080*	-3.1719	0.1438	0.1293	-0.0580
	(0.050)	(0.050)	(3.188)			
Indonesia	0.075*	0.0655	14.1327	-0.0731	-0.0639	-0.0504
	(0.046)	(0.047)	(13.861)			
Japan	0.011**	0.011**	-0.1613	0.0110	0.0110	-0.0053
	(0.006)	(0.006)	(0.672)			
Malaysia	0.244***	0.228***	-0.9948	0.5780	0.5401	-0.0177
	(0.086)	(0.087)	(5.368)			
Singapore	0.070***	0.062***	-1.1673	0.4580	0.4057	-0.0785
	(0.018)	(0.019)	(1.570)			
China	0.5649	0.5217	1.0715	0.2427	0.2242	0.0069
	(0.578)	(0.584)	(8.350)			

Notes: *,** and *** indicate significance at the 10, 5 and 1 percent levels. Both specifications include industry and year fixed effects and have N=25536. Bootstrapped standard errors are in parentheses.

sample. However, firms are very heterogeneous in terms of their responsiveness to shocks. This heterogeneity enters through ε_j^f, the elasticity of the firm's value with respect to changes in host country GDP. Thus the positive values for the country-level risk premia indicate that firms whose values are more responsive to changes in destination countries' GDP tend to be riskier and to exhibit higher returns.

As mentioned above, the results of specification I do not take into account the contribution to the risk premium of potential host countries (the option value). This results in biased estimates of the risk premia. To address this concern, in specification II we report the results of regression (18) including the controls for the option value countries. As long as our proxy for the option value is a good one, controlling for the option value term corrects the omitted variable bias in the estimated coefficients on assets in place, ψ_j. Moreover, the difference between the R^2 in the two specifications quantifies how much more of the variance of the risk premium is explained by explicitly taking into account the option value of entering new countries using the approximation described above.

For the majority of the countries that had a positive risk premium in specification I, adding the control for the option value decreases the estimated risk premium. This suggests that attempting to estimate the risk premium without controlling for the option value overestimates the risk premium. Figure 1 plots the estimated country-level contributions to the risk premium. To keep the graph legible, we've only labeled data points for the highest and lowest risk countries, as well as for the most important FDI destination countries.

In addition to their role in resolving the omitted variable bias, the option value terms are also informative themselves. In the entire sample of top 50 countries, there are 14 for which the ψ_j^o coefficient is significant; of those, 6 are associated with a positive risk premium, indicating that the mere possibility of a firm entering those countries is a source of risk to investors. The coefficients on the option value terms vary much more widely than the coefficients on the the assets in place. This is not surprising, as the approximated firm-level elasticities for the option value countries are not as good of an approximation of the true elasticity as in the case of assets in place. The corresponding risk premia ($\psi_j^o \sigma_h \sigma_j \rho_j prob_j^f \tilde{\varepsilon}_h^f$) are still reasonable in magnitude, ranging from -0.38 to 0.54.

Finally, F-tests (not reported here) show that all the estimated parameters ψ_j and ψ_j^o are significantly different from each other. This result confirms the impor-

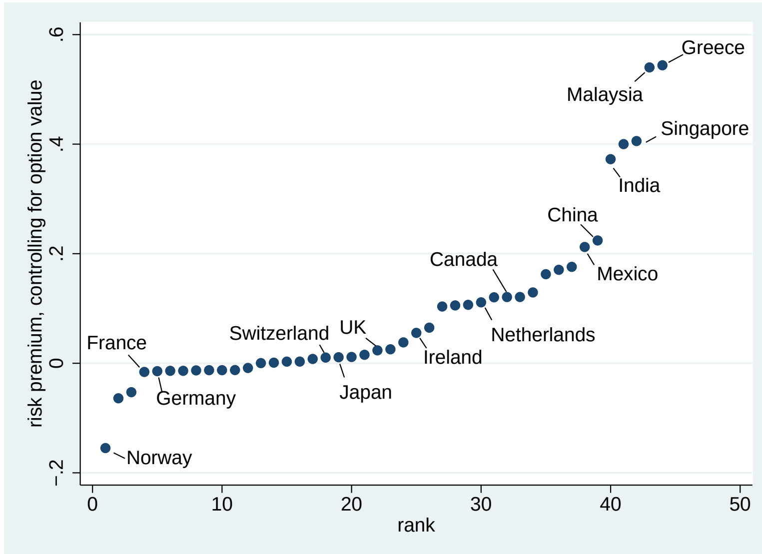

Figure 1: Estimated Country-Specific Risk Premia.

tance of heterogeneity across-countries in the unobserved component of the elasticity of firms' value with respect to GDP.

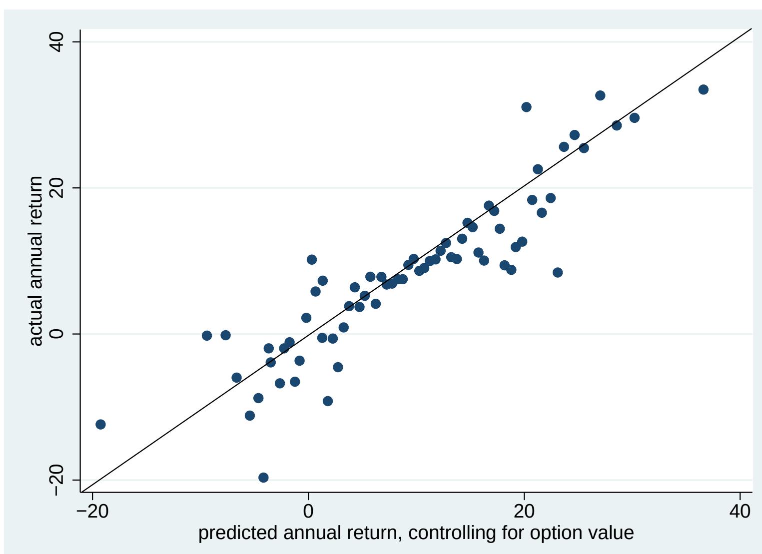

Figure 2: Predicted versus realized returns. Predicted returns include the option value of entering new countries.

We conclude this section with a graphical representation of the model fit controlling for the option value of entering new countries. Figure 2 plots realized returns

Table 7: Aggregate risk premia.

	I	II
Risk premium:		
- from domestic sales:	0.230	0.301
- from foreign sales:	3.014	3.003
- from option value:		0.651

against returns predicted by the model, corresponding to the full specification II.[32] The plot gives a graphical representation of the fit of the model. Overall, the estimated stock returns do a good job of matching the actual returns.

4.3.2 Aggregate Risk Premium

The results presented in Table 6 shed light on the magnitude of country-level risk premia. However, we are also interested in their aggregation to the overall risk premium of multinational firms, most of which have affiliates in more than one country.

To estimate the aggregate risk premium we sum the country-specific risk premia reported in Table 6. Table 7 shows the results. The aggregate risk premium from foreign assets in place is large, at about 3 percentage points. By summing over the risk premia for all countries, we are constructing an estimate of what the risk premium would be for a firm that has affiliates in all of the top 50 FDI host countries. This implies that a firm with affiliates in every country in our sample would have, on average, expected annual returns that are 3% higher than those of a purely domestic firm.[33]

As was the case for most of the country-level risk premia, the aggregate risk premium from assets in place falls slightly when the option value term is included. The aggregate risk premium of the option value implies that, for a firm that does not have affiliates in any of the countries in our sample, the option to enter all the

[32]To construct the plots, we divided the observations into bins based on their predicted annual returns from regression (18). Each bin is 0.5 units wide, resulting in about 70 bins. Then we averaged actual and predicted annual returns within these bins and graphed those averages.

[33]As mentioned above, these results hinge on the assumption that firms take the decision of entering a country independently of their presence in other countries.

potential host countries in the future increases expected returns by 0.651% for the average firm.

As mentioned above, the aggregate results give the risk premium for an average firm with affiliates in all of the countries in the sample. However, it is also possible to use the country-specific results from Table 6 to estimate the expected risk premium for a typical firm with any combination of foreign affiliates. For example, suppose that a firm only has affiliates in Canada, Singapore, and Ireland. The expected contribution of these assets in place to the firm's risk premium would be $0.1209 + 0.4057 + 0.0555 = 0.582$. The contribution to the risk premium from the option value of entering countries in which the firm does not currently have affiliates would be the sum $\sum_{j \notin \mathcal{A}} \psi_j^o \sigma_h \sigma_j \rho_j prob_j^f \tilde{\varepsilon}_h^f$ where $j \notin \mathcal{A}$ includes all countries except for Canada, Singapore, and Ireland. This is a value of 0.963. Adding in the risk premium for domestic US assets, the total risk premium for the average firm with affiliates in Canada, Singapore, and Ireland would be $0.301 + 0.582 + 0.963 = 1.846$, so the expected returns would be almost 2 percentage points higher than the returns of a purely domestic firm.

5 Conclusions

In this paper we study theoretically and empirically the cross-section of returns of multinational corporations, to establish a link between the geographic structure of a firm and its risk premium. Stock returns are impacted by firms' diversification of country-level risk, which makes firms safer and decreases returns, and by the fixed and sunk costs associated with investing abroad, which make firms more leveraged, hence riskier, and increase returns. We test the predictions of the model using firm level data on multinational corporations from the US BEA merged with firm level stock return data from CRSP. The empirical results support the model's predictions. MNCs with affiliates in countries where shocks co-move more with the home country and where entry costs are higher tend to have higher risk premia. We use the structural model to decompose firm-level risk premia into individual host countries' contributions and to assess the relative importance of assets in place versus option value for the returns.

This paper plays an important role in understanding the complex interactions between MNCs and financial markets. There are a number of additional questions that this analysis leaves aside. Are there systematic patterns in the expansion strategies of MNCs across host countries over time? Are entry and exit episodes associated with sizable changes in the stock market valuation of firms? What is the relevant time horizon to study MNCs' expansion across countries and the corresponding stock market responses? These are interesting avenues that we plan to pursue in future work.

References

Alfaro, Laura, and Maggie X. Chen. 2013. "The Global Agglomeration of Multinational Firms." *NBER working paper 15576.*

Atkeson, Andrew, and Tamim Bayoumi. 1993. "Do private capital markets insure regional risk? Evidence from the United States and Europe." *Open Economies Review* 4:303–324.

Baker, Malcolm, C. Fritz Foley, and Jeffrey Wurgler. 2009. "Multinationals as Arbitrageurs? The Effect of Stock Market Valuations on Foreign Direct Investment." *Review of Financial Studies* 22 (1): 337–369.

Barro, Robert J., and Jong-Wha Lee. 2010. "A new data set of educational attainment in the world, 1950-2010." NBER working paper 15902.

Brainard, S. Lael. 1997. "An Empirical Assessment of the Proximity-Concentration Trade-off between Multinational Sales and Trade." *The American Economic Review* 87 (4): 520–544.

Branstetter, Lee G., Raymond Fisman, and C. Fritz Foley. 2006. "Do Stronger Intellectual Property Rights Increase International Technology Transfer? Empirical Evidence from U.S. Firm-Level Panel Data." *Quarterly Journal of Economics* 121 (1): 321349.

Carr, David L, James R. Markusen, and Keith E. Maskus. 2001. "Testing the knowledge-capital model of the multinational enterprise." *American Economic Review* 91 (3): 995–1001.

Caselli, Francesco, Miklos Koren, Milan Lisicky, and Silvana Tenreyro. 2014. "Diversification through Trade." Mimeo, London School of Economics.

Chen, Maggie X. 2011. "Interdependence in Multinational Production Networks." *Canadian Journal of Economics* 44 (3): 930–956.

Chen, Maggie X., and Michael Moore. 2010. "Location Decision of Heterogeneous Multinational Firms." *Journal of International Economics* 80 (2): 188–199.

Crucini, Mario. 1999. "On international and national dimensions of risk sharing." *Review of Economics and Statistics* 8 (1): 73–84.

Das, Sanghamitra, Mark J. Roberts, and James R. Tybout. 2007. "Market Entry Costs, Producer Heterogeneity, and Export Dynamics." *Econometrica* 75 (3): 837–873.

Denis, David J., Diane K. Denis, and Keven Yost. 2002. "Global Diversification, Industrial Diversification, and Firm Value." *The Journal of Finance* 57 (5): 1951–1979.

Dixit, Avinash K. 1989. "Entry and Exit Decisions under Uncertainty." *Journal of Political Economy* 97 (3): 620–638.

Dixit, Avinash K., and Robert S. Pindyck. 1994. *Investment under Uncertainty.* Princeton, NJ: Princeton University Press.

Ekholm, Karolina, Rikard Forslid, and James R. Markusen. 2007. "Export-Platform Foreign Direct Investment." *Journal of the European Economic Association* 5 (4): 776–795.

Fama, Eugene F., and Kenneth R. French. 1996. "Multifactor Explanations of Asset Pricing Anomalies." *Journal of Finance* 51 (1): 55–84.

Fillat, José L., and Stefania Garetto. 2014. "Risk, Returns, and Multinational Production." Mimeo, Boston University.

Hall, Robert E. 1978. "Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence." *Journal of Political Economy* 86 (6): 971–987.

Head, Keith, Thierry Mayer, and Joh Ries. 2010. "The erosion of colonial trade linkages after independence." *Journal of International Economics* 81 (1): 1–14.

Helpman, Elhanan, Marc J. Melitz, and Stephen R. Yeaple. 2004. "Exports Versus FDI with Heterogeneous Firms." *The American Economic Review* 94 (1): 300–316.

Inoue, Atsushi, and Gary Solon. 2010. "Two-Sample Instrumental Variables Estimators." *The Review of Economics and Statistics* 92 (3): 557561.

Jacquillat, Bertrand, and Bruno Solnik. 1978. "Multinationals are poor tools for international diversification." *Journal of Portfolio Management* 4 (2): 812.

Kravis, Irving B., and Robert E. Lipsey. 1982. "The location of overseas production and production for export by U.S. multinational firms." *Journal of International Economics* 12 (3-4): 201–223.

Markusen, James R., and Keith E. Maskus. 2002. "Discriminating among alternative theories of the multinational enterprise." *Review of International Economics* 10:694–707.

Mrazova, Monika, and J. Peter Neary. 2011. "Firm Selection into Export-Platform Foreign Direct Investment." *Working paper*.

Ramondo, Natalia, Veronica Rappoport, and Kim J. Ruhl. 2013. "The Proximity-Concentration Tradeoff under Uncertainty." *Review of Economic Studies* 80 (4): 1582–1621.

Roberts, Mark J., and James R. Tybout. 1997. "The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs." *The American Economic Review* 87 (4): 545–564.

Rowland, Patrick F., and Linda L. Tesar. 2004. "Multinationals and the gains from international diversification." *Review of Economic Dynamics* 7:798–826.

Senchack, Andrew J., and William L. Beedles. 1980. "Is indirect international diversification desirable?" *Journal of Portfolio Management* 6 (2): 49–57.

Sorensen, Bent E., and Oved Yosha. 1998. "International risk sharing and European monetary unification." *Journal of International Economics* 45:211–238.

Teorell, Jan, Nicholas Charron, Stefan Dahlberg, Sren Holmberg, Bo Rothstein, Petrus Sundin, and Richard Svensson. 2013. "The Quality of Government Dataset." *University of Gothenburg: The Quality of Government Institute, http://www.qog.pol.gu.se*.

Tesar, Linda L., and Ingrid Werner. 1998. "The internationalization of securities markets since the 1987 crash." In R. Litan and A. Santomero (eds.) , *Brookings-Wharton Papers on Financial Services*. Washington: The Brookings Institution.

Yeaple, Stephen. 2003. "The Complex Integration Strategies of Multinational Firms and Cross-Country Dependencies in the Structure of Foreign Direct Investment." *Journal of International Economics* 60 (2): 293–314.

———. 2009. "Firm Heterogeneity and the Structure of U.S. Multinational Activity: An Empirical Analysis." *Journal of International Economics* 78 (2): 206–215.

Appendix

A Derivation of the Model

We present here the derivation of the results contained in Section 2. In the continuation region, each one of the three components of the value function of a firm (V_h, V_j, and V_j^o) satisfies:

$$\pi(a, Y, X)M\Delta t + E[M\Delta t \cdot V(a, Y', X|Y)] - V(a, Y, X) = 0. \tag{B.1}$$

For $\Delta t \to 0$:

$$\pi(a, Y, X)Mdt + E[d(M \cdot V(a, Y, X))] = 0. \tag{B.2}$$

The term in the expectation can be written as:

$$\begin{aligned} E[d(M \cdot V)] &= E[dM \cdot V + M \cdot dV + dM \cdot dV] \\ &= M \cdot V \cdot E\left[\frac{dM}{M} + \frac{dV}{V} + \frac{dM}{M} \cdot \frac{dV}{V}\right] \\ &= M \cdot V \left[-rdt + E\left(\frac{dV}{V}\right) + E\left(\frac{dM}{M} \cdot \frac{dV}{V}\right)\right] \\ &= Mdt\left[-rV + E\left(\frac{dV}{dt}\right) + E\left(\frac{dM}{M} \cdot \frac{dV}{dt}\right)\right] \end{aligned} \tag{B.3}$$

where the dependence of V on (a, Y, X) has been suppressed to ease the notation. Plugging Eq. (B.3) into Eq. (B.2):

$$\pi - rV + E\left(\frac{dV}{dt}\right) + E\left(\frac{dM}{M} \cdot \frac{dV}{dt}\right) = 0. \tag{B.4}$$

By applying Ito's Lemma and using the expressions for the Brownian motions ruling the evolution of Y, we can derive expressions for some of the terms in Eq. (B.4):

$$\begin{aligned} dV &= V_Y' dY + \frac{1}{2}\sigma^2 Y^2 V_Y'' dt = V_Y'[\mu Y dt + \sigma Y dz] + \frac{1}{2}\sigma^2 Y^2 V_Y'' dt \\ E[dV] &= \mu Y V_Y' dt + \frac{1}{2}\sigma^2 Y^2 V_Y'' dt\ . \end{aligned}$$

Using these results and the equation describing the evolution of M, we can rewrite Eq. (B.4) for the three value functions as:

$$
\begin{aligned}
&\pi_h dt - r_h V_h dt + \mu_h Y_h V'_{hY} dt + \frac{1}{2}\sigma_h^2 Y_h^2 V''_{hY} dt + ...\\
&...E\left[(-r_h dt - \gamma\sigma_h dz_h)\cdot\left(\mu_h Y_h V'_{hY} dt + \sigma_h Y_h V'_{hY} dz_h + \frac{1}{2}\sigma_h^2 Y_h^2 V''_{hY} dt\right)\right] = 0.\\
&\pi_j dt - r_h V_j dt + \mu_j Y_j V'_{jY} dt + \frac{1}{2}\sigma_j^2 Y_j^2 V''_{jY} dt + ...\\
&...E\left[(-r_h dt - \gamma\sigma_h dz_h)\cdot\left(\mu_j Y_j V'_{jY} dt + \sigma_j Y_j V'_{jY} dz_j + \frac{1}{2}\sigma_j^2 Y_j^2 V''_{jY} dt\right)\right] = 0.\\
&-r_h V_j^o dt + \mu_j Y_j V^{o\prime}_{j\ Y} dt + \frac{1}{2}\sigma_j^2 Y_j^2 V^{o\prime\prime}_{j\ Y} dt + ...\\
&...E\left[(-r_h dt - \gamma\sigma_h dz_h)\cdot\left(\mu_j Y_j V^{o\prime}_{j\ Y} dt + \sigma_j Y_j V^{o\prime}_{j\ Y} dz_j + \frac{1}{2}\sigma_j^2 Y_j^2 V^{o\prime\prime}_{j\ Y} dt\right)\right] = 0.
\end{aligned}
$$

The terms in expectations can be reduced to:

$$
\begin{aligned}
&E\left[(-r_h dt - \gamma\sigma_h dz_h)\cdot\left(\mu_h Y_h V'_{hY} dt + \sigma_h Y_h V'_{hY} dz_h + \frac{1}{2}\sigma_h^2 Y_h^2 V''_{hY} dt\right)\right] = ...\\
&... - \gamma\sigma_h^2 Y V'_{hY} dt\\
&E\left[(-r_h dt - \gamma\sigma_h dz_h)\cdot\left(\mu_j Y_j V'_{jY} dt + \sigma_j Y_j V'_{jY} dz_j + \frac{1}{2}\sigma_j^2 Y_j^2 V''_{jY} dt\right)\right] = ...\\
&... - \gamma\rho_j\sigma_h\sigma_j Y V'_{jY} dt\\
&E\left[(-r_h dt - \gamma\sigma_h dz_h)\cdot\left(\mu_j Y_j V^{o\prime}_{j\ Y} dt + \sigma_j Y_j V^{o\prime}_{j\ Y} dz_j + \frac{1}{2}\sigma_j^2 Y_j^2 V^{o\prime\prime}_{j\ Y} dt\right)\right] = ...\\
&... - \gamma\rho_j\sigma_h\sigma_j Y V^{o\prime}_{j\ Y} dt.
\end{aligned}
$$

So we obtain the no-arbitrage conditions (7)-(9) in the paper:

$$
\begin{aligned}
\pi_h - r_h V_h + (\mu_h - \gamma\sigma_h^2) Y_h V'_{hY} + \frac{1}{2}\sigma_h^2 Y_h^2 V''_{hY} &= 0\\
\pi_j - r_h V_j + (\mu_j - \gamma\rho_j\sigma_h\sigma_j) Y_j V'_{jY} + \frac{1}{2}\sigma_j^2 Y_j^2 V''_{jY} &= 0\\
-r_h V_j^o + (\mu_j - \gamma\rho_j\sigma_h\sigma_j) Y_j V^{o\prime}_{j\ Y} + \frac{1}{2}\sigma_j^2 Y_j^2 V^{o\prime\prime}_{j\ Y} &= 0.
\end{aligned}
$$

To derive the expression for the returns that guides our empirical analysis (Eq.

(10)), we combine the three equations above to obtain:

$$\pi_h - r_h V_h - \gamma \sigma_h^2 Y_h V_{hY}' + \underbrace{\mu_h Y_h V_{hY}' + \frac{1}{2}\sigma_h^2 Y_h^2 V_{hY}''}_{E(dV_h)} + ...$$

$$\sum_{j\in\mathcal{A}} \pi_j - r_h V_j - \gamma \rho_j \sigma_h \sigma_j Y_j V_{jY}' + \underbrace{\mu_j Y_j V_{jY}' + \frac{1}{2}\sigma_j^2 Y_j^2 V_{jY}''}_{E(dV_j)} + ...$$

$$+ \sum_{j\notin\mathcal{A}} \left[-r_h V_j^o - \gamma \rho_j \sigma_h \sigma_j) Y_j V_{j\ Y}^{o\prime} + \underbrace{\mu_j Y_j V_{j\ Y}^{o\prime} + \frac{1}{2}\sigma_j^2 Y_j^2 V_{j\ Y}^{o\prime\prime}}_{E(dV_j^o)} \right] = 0.$$

Since $E(dV_h) + \sum_{j\in\mathcal{A}} E(dV_j) + \sum_{j\notin\mathcal{A}} E(dV_j^o) = E(d\mathcal{V})$:

$$\begin{aligned} \pi_h + \sum_{j\in\mathcal{A}} \pi_j + E(d\mathcal{V}) &= r_h V_h + \gamma \sigma_h^2 Y_h V_{hY}' + \sum_{j\in\mathcal{A}} \left(r_h V_j + \gamma \rho_j \sigma_h \sigma_j Y_j V_{jY}' \right) + ... \\ &\quad ... \sum_{j\notin\mathcal{A}} \left(r_h V_j^o + \gamma \rho_j \sigma_h \sigma_j Y_j V_{j\ Y}^{o\prime} \right) \\ \frac{\pi_h + \sum_{j\in\mathcal{A}} \pi_j + E(d\mathcal{V})}{\mathcal{V}} &= r_h + \gamma \left(\frac{\sigma_h^2 Y_h V_{hY}' + \sum_{j\in\mathcal{A}} \sigma_h \sigma_j \rho_j Y_j V_{jY}' + \sum_{j\notin\mathcal{A}} \sigma_h \sigma_j \rho_j Y_j V_{j\ Y}^{o\prime}}{\mathcal{V}} \right). \end{aligned}$$

To gain additional insight on the components of this expression, we can solve explicitly each no-arbitrage condition to deliver quasi-closed form solutions for the components of a firm's value function. For illustration purposes, assume that profits π_j are a linear affine function of Y_j (as it would be under linear cost functions and CES demand): $\pi_j(a, Y_j, X_j) = \delta_j(a, X_j) Y_j - f_j$ where $\delta_j(a, X_j)$ denotes variable profits as a share of GDP in country j and f_j denotes the fixed costs of production in country j. Then we can solve explicitly Eqs. (7)-(9) in the paper to obtain:

$$V_h = \frac{\delta_h(a, X_h) Y_h}{r_h - \mu_h + \gamma \sigma_h^2} - \frac{f_h}{r_h} \tag{B.5}$$

$$V_j = \frac{\delta_j(a, X_j) Y_j}{r_h - \mu_j + \gamma \rho_j \sigma_h \sigma_j} - \frac{f_j}{r_h} + c_j(a, X_j) Y_j^{\alpha} \tag{B.6}$$

$$V_j^o = c_j^o(a, X_j) Y_j^{\beta} \tag{B.7}$$

where $\alpha < 0$ and $\beta > 1$ are known combinations of aggregate parameters and $c_j(a, X_j)$ and $c_j^o(a, X_j)$ are firm-specific, positive magnitudes that can be determined by imposing value-matching and smooth pasting conditions linking Eqs. (B.6) and (B.7) for each country j, like in Dixit (1989). Hence the elasticity of assets in place in country j is:

$$\frac{Y_j V_{jY}'}{\mathcal{V}} = \frac{\frac{\delta_j(a,X_j)Y_j}{r_h - \mu_j + \gamma \rho_j \sigma_h \sigma_j} + \alpha c_j(a, X_j) Y_j^{\alpha}}{\mathcal{V}} \tag{B.8}$$

and the elasticity of the option value of entering country j is:

$$\frac{Y_j V_{j\,Y}^{o\prime}}{\mathcal{V}} = \frac{\beta c_j^o(a, X_j) Y_j^{\beta}}{\mathcal{V}}. \tag{B.9}$$

Eqs. (B.8)-(B.9) illustrate that the elasticity of the value of assets in place in a country is different from the elasticity of the option value in that country. Since both profits and the magnitudes $c_j(a, X_j)$, $c_j^o(a, X_j)$ are firm-specific, the elasticities also differ across firms.

The processes for the elasticities that we estimate in our model-based empirical analysis are meant to mimic the variation that Eqs. (B.8)-(B.9) imply. For the elasticity of assets in place, having information on firm's income in each host country $j \in \mathcal{A}$ allows us to approximate the elasticity directly. The approximation of the elasticity of the option value is more indirect. It can be shown that the magnitude $c_j^o(a, X_j)$ is increasing in firm's productivity, indicating that more productive firms have a higher likelihood to enter a country. In the empirical specification, this higher likelihood to enter is expressed by $prob_j^f$, which is the estimated probability that firm f will enter country j given the country characteristics included in the probit specification (X_j). However, the only firm-level characteristic included among the regressors of the probit is the previous presence in a region. This is clearly not enough to incorporate all the firm-level variation embodied in $\frac{c_j^o(a,X_j)}{\mathcal{V}}$, so we multiply the estimated probability by the domestic elasticity to capture the firm-specific components of the elasticity of the option value without suffering from the potential bias due to selection into affiliate countries that one would introduce using not purely domestic measures. Finally, the aggregate, host country-specific term βY_j^{β} is captured by the estimated unobserved component ζ_j^o.

B Robustness: Reduced Form Estimates

In this section we include a number of robustness tests to ensure that our empirical results are not sensitive to changes in variable definitions or controls. We begin by reporting the full set of results presented in Table 3 with all controls included. Next we repeat our preferred specification controlling for a variety of other factors related to size that may impact stock returns beyond total firm sales. These are market capitalization, leverage, and the book-to-market ratio of the firm. We then replace our measure of country-specific entry costs with two alternative measures from the World Bank's Doing Business Database: the number of procedures required to start a business and the average number of days required to start a business. We also present the results using a different methods to construct the firm-level sunk cost measure, using affiliates counts as weights in Eq. (12). Finally, we measure the co-movement of GDP shocks in the US and the host countries using the correlations, rather than the covariances, of these shocks. Since our reduced form specification does not control for the option value of opening new affiliates, we then report the results of the second-step regressions including measures of the option value term that we constructed using the results of the dynamic selection equation in Section 4.2. We conclude by reporting the entire set of results of our model-based estimation.

Table B.2 reports the complete results of the specifications that we summarized in Table 3 in the paper. Our measure of firm size is total firm sales from the BEA data. Gravity variables for the affiliates' host countries come from CEPII (see Head, Mayer, and Ries (2010)) and are aggregated at the firm level following the same aggregation method as in Eq. (12). To control for the potential bias induced by the fact that neither our model nor our empirical analysis incorporate exports, we include an aggregate country-level measure of the ratio of total FDI sales by US firms over total US exports for each country. In addition to these, we add other sources of country risk as controls. Exchange rate volatility may be another source of country-level risk, hence we control for the standard deviation of the country's exchange rate with respect to the US dollar over the sample period. Finally, we use measures of rule of law, property rights, and conflict form the Quality of Government Dataset. This dataset was compiled by Teorell et al. (2013) using information from various different sources. These include the PRS Group's International Country Risk Guide (ICRG) indicator of quality of government, which we use to proxy for

Table B.1: Summary Statistics of Robustness Controls.

	N. Obs	Mean	Std. Dev.	Min	Max
ALL FIRMS					
GDP	21809	1070.237	743.855	0	5333.925
distance	21809	5860.26	3057.661	0	16370.82
firm *beta*	21809	0.920885	1.128112	-12.4866	23.55242
FDI/exports	21809	3.59962	3.584225	0	268.9246
exchange rate volatility	21809	202580.4	3779169	0	1.43E+08
property rights	21809	76.95142	19.53968	0	95
conflict	21809	0.330663	0.566426	0	7
quality of gov.	21809	0.80038	0.212841	0	1
market cap. ($b)	21809	5348.61	20507.98	0.5895	511887.1
book-to-market	21809	0.906032	7.455636	-906.639	66.02167
leverage	21809	0.047377	1.701048	-122.097	206.2544
No. of procedures	21809	5.900765	2.321864	1	17
No. of days	21809	17.34598	11.31179	1	195
correlation (ρ_{ft})	21809	0.630249	0.209387	-0.35508	0.918361
HORIZONTAL FIRMS					
GDP	5688	987.1623	794.9395	0	5333.925
distance	5688	4589.752	3484.31	0	15958.05
firm *beta*	5688	0.928362	1.256345	-5.94042	23.55242
FDI/exports	5688	3.280831	2.413245	0	30.45844
exchange rate risk	5688	555.782	33142.58	0	2470451
property rights	5688	76.4386	25.64016	0	90.00001
conflict	5688	0.424223	0.637222	0	3
quality of gov.	5688	0.801403	0.27883	0	1
market cap. ($b)	5688	2753.551	10485.87	1.3805	267336.1
book-to-market	5688	0.761953	6.786054	-479.385	30.29988
leverage	5688	0.074149	2.743336	-5.93724	206.2544
No. of procedures	5688	5.036176	2.802281	1	17
No. of days	5688	14.30879	11.9979	1	149
correlation (ρ_{ft})	5688	0.651821	0.268085	-0.21991	0.918361

rule of law. ICRG collects political information and financial and economic data, converting these into risk points. These data have been collected annually since 1980 and cover 140 countries. The quality of government measure is a composite of corruption, law and order, and bureaucracy quality. Higher values indicate higher quality of government. We also use a measure of property rights from the Heritage Foundation. This factor scores the degree to which a country's laws protect private property rights and the degree to which its government enforces those laws. It also accounts for the possibility that private property will be expropriated. The country's property rights score ranges from 0 to 100, where 100 represents the maximum degree of protection of property rights. Finally, we control for risks associated with armed conflicts using the number of conflicts in which the government of the country is involved in each year from the Uppsala Conflict Data Program UCDP/PRIO Conflict Database, which provides information on armed conflicts of the world. We aggregate each of these measures from the country to the firm level following Eq. (11).

Table B.1 reports summary statistics for the controls included in the Tables of this Appendix. As Table B.2 shows, most of the included controls are not significant, with the exception of the firm *beta*, which is positive and significant in four out of five specifications, indicating that domestic market exposure is strongly correlated with returns at the firm level.

Table B.3 reports the reduced form estimates inclusive of additional potential determinants of annual stock returns: market capitalization, leverage, and book-to-market. Total firm sales and market capitalization are conceptually similar, as they each proxy for firm size, so we do not include both of these variables in the same specification. The same applies to leverage and book-to-market. Our results are robust to the inclusion of these measures. The coefficients on GDP growth covariances and entry costs are all positive and significant regardless of which combination of the firm-level controls is included.

In the next table we present the results of our baseline specification using alternative ways of defining the variables of interest. Column I of Table B.4 reports the results using the correlation of GDP shocks in the US and the host country, rather than the covariance of these shocks.[1] Correlations are convenient measures to interpret the coefficients of our regressions. We can compare risk exposures in the extreme cases of perfect diversification ($\rho_{ft} = 0$) and no diversification (ρ_{ft}=1): ceteris paribus, a firm that has affiliates only in a host country whose GDP growth is perfectly correlated with the US has a risk premium about 13% higher than a

[1] Country-level correlations are aggregated into firm-level measures using the same methodology we used to aggregate covariances.

Table B.2: The relationship between annual stock returns, GDP growth covariances, and entry costs.

	I Horizontal Firms	II Single Industry	III Manufacturing Only	IV All Firms	V $> 75\%$ Horizontal
covariances (Cov_{ft})	2.492**	4.454***	3.059*	0.504	1.621**
	(0.985)	(1.661)	(1.651)	(0.343)	(0.683)
entry costs (F_{ft})	0.0005***	0.001***	0.0004*	0.0002***	0.0002**
	(0.0002)	(0.0003)	(0.0002)	(0.0001)	(0.0001)
$ln(totalsales)$	0.512	-1.260	0.689	0.630***	0.686***
	(0.526)	(0.816)	(1.019)	(0.222)	(0.351)
$ln(GDP)$	0.291	-0.151	-0.515	0.411	0.522
	(1.032)	(1.570)	(1.706)	(0.394)	(0.719)
$ln(distance)$	-0.871	-0.545	1.992	-0.609	-0.555
	(0.985)	(1.587)	(1.744)	(0.417)	0.679
No. of countries	0.015	0.092	-0.291	0.003	-0.006
	(0.139)	(0.218)	(0.283)	(0.031)	0.058
beta	4.475***	6.796***	-0.274	2.511***	2.733***
	(0.588)	(0.942)	(1.101)	(0.260)	(0.387)
FDI-exports ratio	0.068	-0.043	0.117	-0.018	-0.005
	(0.166)	(0.252)	(0.231)	(0.037)	(0.085)
exchange rate volatility	-0.000005	0.002	-0.007	7.89e-08	3.94e-08
	(0.00002)	(0.008)	(0.012)	(9.72e-08)	(4.05e-07)
property rights	-0.044	-0.287	-0.126	0.031	-0.012
	(0.115)	(0.179)	(0.176)	(0.047)	(0.083)
quality of gov.	-6.863	10.084	10.585	-7.878*	-9.345
	(10.468)	(16.010)	(15.469)	(4.484)	(7.803)
conflict	-0.048	-1.321	-2.067	0.612	-0.186
	(1.900)	(2.987)	(2.988)	(0.824)	(1.323)
industry and year FE	YES	YES	YES	YES	YES
N	5223	2853	2043	21204	9589
R-sq	0.0742	0.0728	0.0598	0.0855	0.0737

Notes: *,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively. Bootstrapped standard errors are in parentheses.

firm with affiliates only in a host country whose GDP growth is uncorrelated with the US.

Columns II-III of Table B.4 use alternate measures of country-level entry costs

Table B.3: The relationship between annual stock returns, GDP growth covariances and correlations, and entry costs: robustness to the inclusion of additional controls.

	I	II	III
covariances (Cov_{ft})	2.492**	2.296**	2.378**
	(0.985)	(0.978)	(0.978)
entry costs (F_{ft})	0.001***	0.001***	
	(0.000)	(0.000)	(0.000)
$ln(totalsales)$	0.512	0.550	
	(0.526)	(0.526)	
marketcap			0.0002***
			(0.000)
leverage		-0.386	
		(0.241)	
book2market			0.076
			(0.096)
$ln(GDP)$	0.291	0.169	-0.011
	(1.032)	(1.025)	(1.024)
$ln(distance)$	-0.871	-1.331	-1.155
	(0.985)	(1.036)	(1.037)
No. of countries	0.018	0.019	-0.005
	(0.138)	(0.138)	(0.132)
beta	4.475***	4.483***	4.477***
	(0.588)	(0.588)	(0.589)
FDI-export ratio	0.068	0.571	0.587
	(0.166)	(0.403)	(0.402)
exchange rate volatility	-0.00001	-0.00001	-0.00001
	(0.00002)	(0.00002)	(0.00002)
property rights	-0.044	-0.037	-0.053
	(0.115)	(0.115)	(0.115)
quality of gov.	-6.863	-7.221	-5.558
	(10.468)	(10.470)	(10.451)
conflict	-0.048	-0.737	-0.805
	(1.900)	(1.957)	(1.952)
industry and year FE	YES	YES	YES
N	5223	5223	5224
R-sq	0.0742	0.075	0.0766

Notes: *,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively. Bootstrapped standard errors are in parentheses.

from the World Bank's Doing Business Database. Column II reports the results using the number of required procedures necessary to start a business. Column III reports the results using the number of days. Both of these measures are positively and significantly related to annual returns. Column IV of Table B.4 uses a different method to construct the firm-level sunk cost measure. Instead of using the share of total firm sales accounted for by each country as the weights in Eq. (12), we weight each country's entry cost by the number of affiliates that the firm has in that country. This allows for the possibility that these costs may need to be paid again each time a new affiliate is opened in the same country. The results are positive and significant also for this construction of the sunk cost measure.

Table B.5 shows the reduced form results controlling for characteristics of the countries in which each firm does not have affiliates.[2] The effects of GDP growth covariances and of the sunk cost measures are qualitatively and quantitatively similar to the results from Table B.2. The effect of the GDP growth covariances and entry costs on the returns via the option value component should have the same sign as the effect of these forces through the component measuring assets in place. This is true for the covariances Cov^o_{ft}, which exhibit a positive coefficient, albeit non significant in some specifications, but not for the sunk costs, F^o_{ft}, whose coefficient is negative and significant in most specifications.

We run all the robustness test above also for the second-step regressions. Also these results are robust to the inclusion of additional controls, different definitions of entry costs, as well as to using the GDP growth correlations instead of the covariances.[3]

Regarding our alternative specifications of entry costs, Table B.6 shows the weighted average number of days and procedures necessary for starting a business in countries in which the firms do and do not have affiliates. As with the paid in capital requirement used in our primary specification, these summary statistics show that the firms in our sample are much more likely to open affiliates in countries with lower entry costs.

To conclude this appendix, Table B.7 shows the full set of country-level results described in Section 4.3.1.

[2]The use of the predicted probabilities to construct the variables Cov^o_{ft}, F^o_{ft} implies a generated regressor problem. As illustrated by Inoue and Solon (2010), there are two ways to correct the standard errors for the presence of generated regressors: consistently estimating the correct theoretical covariance matrix, or bootstrapping. We report bootstrapped standard errors together with our estimates.

[3]The results are available upon request to the authors.

Table B.4: The relationship between annual returns, GDP growth covariances and correlations, and entry costs: robustness to alternative variable definitions.

	I	II	III	IV
covariances (Cov_{ft})		1.630*	1.565*	2.335**
		(0.952)	(0.948)	(0.961)
correlations (ρ_{ft})	13.311**			
	(6.886)			
entry costs (F_{ft})	0.001***			0.0006***
	(0.000)			(0.0002)
entry costs (procedures)		0.782*		
		(0.433)		
entry costs (days)			0.118*	
			(0.073)	
$ln(totalsales)$	0.543	0.507	0.454	0.504
	(0.526)	(0.527)	(0.526)	(0.526)
$ln(GDP)$	-0.164	-0.668	-0.466	0.019
	(1.028)	(1.058)	(1.037)	(1.039)
$ln(distance)$	-0.925	-1.655	-0.875	-0.979
	(1.123)	(1.143)	(1.026)	(0.987)
No. of countries	0.012	0.083	0.074	-0.025
	(0.138)	(0.138)	(0.138)	(0.140)
beta	4.558***	4.478***	4.512***	4.445***
	(0.588)	(0.589)	(0.589)	(0.589)
FDI-export ratio	0.569	0.495	0.063	0.079
	(0.408)	(0.410)	(0.403)	(0.165)
exchange rate volatility	-0.000004	-0.000003	-0.000003	-0.000003
	(0.00002)	(0.00002)	(0.00002)	(0.00002)
property rights	-0.023	0.031	0.016	-0.035
	(0.116)	(0.115)	(0.115)	(0.118)
quality of gov.	-12.049	-0.55	-1.167	-6.415
	(10.593)	(10.812)	(10.792)	(10.695)
conflict	-1.214	-1.689	-1.694	-0.154
	(1.962)	(1.937)	(1.937)	(1.893)
industry and year FE	YES	YES	YES	YES
N	5223	5223	5223	5218
R-sq	0.0742	0.073	0.0729	0.0751

Notes: *,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively. Bootstrapped standard errors are in parentheses.

Table B.5: Second step estimation: the relationship between annual stock returns, GDP growth covariances, and sunk costs, controlling for the option value of entering new countries.

	I Horizontal Firms	II Single Industry	III Manufacturing Only	IV All Firms	V > 75% Horizontal
covariances (Cov_{ft})	2.685***	4.824***	3.216*	0.500	1.758**
	(1.016)	(1.710)	(1.698)	(0.351)	(0.693)
entry costs (F_{ft})	0.0004**	0.0005**	0.0003	0.0002**	0.0002*
	(0.0002)	(0.0003)	(0.0003)	(0.0001)	(0.0001)
covar. non-aff. (Cov^o_{ft})	5.363	6.725	-0.736	1.394*	3.485**
	(4.115)	(6.294)	(10.294)	(0.830)	(1.713)
entry costs non-aff. (F^o_{ft})	-0.002***	-0.002**	-0.001	-0.0003*	-0.001**
	(0.001)	(0.001)	(0.001)	(0.0002)	(0.0004)
$ln(totalsales)$	0.542	-1.080	0.554	0.622***	0.704*
	(0.548)	(0.843)	(1.054)	(0.230)	(0.361)
$ln(GDP)$	-0.343	-0.884	-2.262	0.015	-0.018
	(1.180)	(1.791)	(1.873)	(0.414)	(0.785)
$ln(distance)$	-0.199	0.416	2.631	-0.369	0.007
	(1.028)	(1.647)	(1.836)	(0.428)	(0.706)
No. of countries	0.049	0.085	-0.172	0.004	-0.001
	(0.147)	(0.228)	(0.322)	(0.034)	(0.061)
beta	4.560***	6.739***	-0.151	2.699***	2.850***
	(0.599)	(0.948)	(1.141)	(0.266)	(0.389)
FDI-exports ratio	0.079	-0.056	0.105	-0.025	-0.003
	(0.169)	(0.255)	(0.239)	(0.038)	(0.085)
exchange rate volatility	-0.000005	0.003	-0.007	9.03e-08	6.24e-08
	(0.00002)	(0.008)	(0.012)	(1.02e-07)	(4.14e-07)
property rights	-0.060	-0.335*	-0.109	0.023	-0.023
	(0.123)	(0.191)	(0.183)	(0.050)	(0.087)
quality of gov	-1.303	20.840	14.439	-6.447	-6.054
	(11.290)	(17.561)	(16.252)	(4.756)	(8.100)
conflict	0.034	-1.325	-1.987	0.662***	-0.076
	(1.937)	(3.050)	(3.078)	(0.230)	(1.338)
industry and year FE	YES	YES	YES	YES	YES
N	5060	2788	1964	20427	9287
R-sq	0.0773	0.0762	0.0612	0.0888	0.0777

Notes: *,** and *** indicate significance at the 10, 5 and 1 percent levels, respectively. Bootstrapped standard errors are in parentheses.

Table B.6: Summary statistics by affiliate presence: Robustness to different measures of entry costs.

	Entry cost (No. of days)	Entry cost (No. of procedures)
ALL FIRMS		
Countries with affiliates	15.181	5.319
Countries without affiliates	22.287	7.478
HORIZONTAL FIRMS		
Countries with affiliates	12.054	4.314
Countries without affiliates	21.567	7.318

Table B.7: Country-specific estimates of risk premia, observations at the firm-year level.

	coefficients			risk premia		
	ψ_j	ψ_j	ψ_j^o	$\psi\sigma_h\sigma_j\rho_j\varepsilon_j^f$	$\psi\sigma_h\sigma_j\rho_j\varepsilon_j^f$	$\psi_j^o\sigma_h\sigma_j\rho_j Z_j^f$
Country	I	II		I	II	
US Domestic	0.036***	0.047***		0.2302	0.3005	
	(0.007)	(0.013)				
Canada	0.030***	0.030***	0.7091	0.1209	0.1209	0.0953
	(0.011)	(0.011)	(0.531)			
Argentina	0.0155	0.0188	97.422**	-0.0107	-0.0130	-0.3857
	(0.047)	(0.047)	(41.798)			
Brazil	-0.0247	-0.0244	-5.2882	-0.0128	-0.0126	-0.0303
	(0.021)	(0.021)	(8.004)			
Chile	0.0832	0.1023	2.8330	0.0905	0.1112	0.0290
	(0.091)	(0.091)	(4.823)			
Colombia	-0.9170	-1.0555	568.0200	-0.0120	-0.0138	0.0536
	(2.368)	(2.369)	(522.099)			
Ecuador	-0.0010	-0.0008	-15.8529	0.0037	0.0030	0.1591
	(0.003)	(0.004)	(61.211)			
Mexico	0.0534	0.060*	0.4184	0.1888	0.2123	0.0231
	(0.036)	(0.036)	(1.018)			
Panama	-0.0004	-0.0006	0.9004	-0.0067	-0.0086	0.1010
	(0.008)	(0.008)	(6.994)			
Peru	-0.0040	-0.0037	-34.3489	0.0085	0.0079	0.3945
	(0.013)	(0.013)	(31.907)			
Venezuela	-1.3071	-1.4563	-53.5764	0.1579	0.1760	0.0390
	(1.156)	(1.157)	(141.123)			
Austria	0.0054	0.0082	-8.859**	0.0075	0.0115	-0.2544
	(0.029)	(0.029)	(3.554)			
Belgium	0.0121	0.0146	4.920***	0.0211	0.0255	0.1985
	(0.024)	(0.024)	(1.740)			
Denmark	0.162***	0.163***	-0.4970	0.3977	0.4001	-0.0238
	(0.052)	(0.052)	(2.201)			
Finland	0.0131	0.0180	1.1940	0.0278	0.0381	0.0431
	(0.016)	(0.016)	(1.650)			
France	-0.0113	-0.0072	-2.067**	-0.0247	-0.0158	-0.1831
	(0.013)	(0.013)	(0.978)			
Germany	-0.0089	-0.0081	1.492*	-0.0158	-0.0144	0.1475
	(0.006)	(0.006)	(0.886)			
Greece	0.314***	0.306**	-0.3356	0.5582	0.5440	-0.0072
	(0.144)	(0.144)	(5.150)			

	coefficients			risk premia		
	ψ_j	ψ_j	ψ_j^o	$\psi\sigma_h\sigma_j\rho_j\varepsilon_j^f$	$\psi\sigma_h\sigma_j\rho_j\varepsilon_j^f$	$\psi_j^o\sigma_h\sigma_j\rho_j Z_j^f$
Country	I	II		I	II	
Ireland	0.0015	0.004*	-1.455*	0.0207	0.0555	-0.3290
	(0.002)	(0.002)	(0.803)			
Italy	0.0350	0.0382	-0.6600	0.0949	0.1036	-0.0562
	(0.026)	(0.026)	(1.032)			
Luxembourg	0.0067	0.0073		0.0982	0.1067	
	(0.008)	(0.008)				
Netherlands	0.028**	0.025**	0.2572	0.1355	0.1210	0.0293
	(0.011)	(0.011)	(1.018)			
Norway	-0.0885	-0.1016	-6.3979	-0.1347	-0.1548	-0.1606
	(0.108)	(0.109)	(4.861)			
Portugal	-0.0102	-0.0111	8.331**	0.0028	0.0031	-0.0340
	(0.022)	(0.022)	(4.102)			
Spain	-0.0037	-0.0047	0.6094	0.0009	0.0011	-0.0035
	(0.009)	(0.009)	(1.357)			
Sweden	0.0009	-0.0026	0.6108	0.0042	-0.0126	0.0511
	(0.024)	(0.024)	(1.521)			
Switzerland	0.0247	0.0067	-1.7172	0.0383	0.0104	-0.0569
	(0.039)	(0.040)	(2.554)			
Turkey	0.0532	0.0714	16.969***	0.0484	0.0650	0.1842
	(0.109)	(0.109)	(3.874)			
United Kingdom	0.0046	0.0043	1.4119	0.0253	0.0236	0.3366
	(0.008)	(0.008)	(0.428)			
Russia	-0.0101	-0.0093	-29.436***	0.0169	0.0155	0.4779
	(0.025)	(0.025)	(7.294)			
Hungary	0.0244	0.0199	-3.483**	0.2094	0.1706	-0.3299
	(0.017)	(0.017)	(1.733)			
Poland	-0.0683	-0.0688	8.760***	-0.3709	-0.3735	0.5473
	(0.057)	(0.057)	(2.574)			
Czech Republic	-0.0162	0.0002	-1.5008	-0.0231	0.0003	-0.0245
	(0.053)	(0.054)	(2.488)			
South Africa	-0.0401	-0.0117	11.7530	-0.0473	-0.0138	0.0660
	(0.092)	(0.092)	(10.307)			
Israel	-0.572**	-0.524**	-32.222***	-0.6913	-0.6333	-0.2115
	(0.222)	(0.223)	(10.394)			
Australia	0.089*	0.080*	-3.1719	0.1438	0.1293	-0.0580
	(0.050)	(0.050)	(3.188)			
Hong Kong	0.0203	0.0161		0.1330	0.1056	0.0000
	(0.016)	(0.016)				
India	0.2466	0.2255	1.2679	0.4075	0.3726	0.0229
	(0.177)	(0.178)	(6.535)			

	coefficients			risk premia		
	ψ_j	ψ_j	ψ_j^o	$\psi\sigma_h\sigma_j\rho_j\varepsilon_j^f$	$\psi\sigma_h\sigma_j\rho_j\varepsilon_j^f$	$\psi_j^o\sigma_h\sigma_j\rho_j Z_j^f$
Country	I	II		I	II	
Indonesia	0.075*	0.0655	14.1327	-0.0731	-0.0639	-0.0504
	(0.046)	(0.047)	(13.861)			
Japan	0.011**	0.011**	-0.1613	0.0110	0.0110	-0.0053
	(0.006)	(0.006)	(0.672)			
Malaysia	0.244***	0.228***	-0.9948	0.5780	0.5401	-0.0177
	(0.086)	(0.087)	(5.368)			
New Zealand	0.0643	0.0727	-6.0231	0.1065	0.1204	-0.0826
	(0.088)	(0.088)	(6.658)			
Philippines	-0.0330	-0.0176	34.405***	-0.0233	-0.0124	0.1690
	(0.079)	(0.079)	(10.728)			
Singapore	0.070***	0.062***	-1.1673	0.4580	0.4057	-0.0785
	(0.018)	(0.019)	(1.570)			
Korea	0.1012	0.0964	7.513*	0.1706	0.1626	0.1562
	(0.095)	(0.096)	(4.482)			
Thailand	-0.0351	-0.0268	-18.062**	-0.0691	-0.0528	-0.2970
	(0.029)	(0.029)	(7.926)			
China	0.5649	0.5217	1.0715	0.2427	0.2242	0.0069
	(0.578)	(0.584)	(8.350)			
R-Sq	0.175	0.179				

Notes: Bootstrapped standard errors are in parentheses. *,** and *** indicate significance at the 10, 5 and 1 percent levels. Both specifications include industry and year fixed effects and have n=25536.