Exchange Rate Effects on Multinational Activity: Theory and Evidence*

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Abstract

This paper presents a three-country model with coexisting multinationals and exporters that engage in Cournot competition. The effects of an exchange rate appreciation are analyzed, with special emphasis placed on the role of third-country effects for multinational activities. In particular, the paper focuses on the impact of exchange rate movements on the number of foreign affiliate plants, the value of foreign affiliate sales and the value of foreign direct investment. Based on the theoretical insights, the third-country effects of exchange rate appreciation for foreign multinational activities of the U.S. and Japan are investigated empirically. To accomplish this task, an econometric approach is adopted that allows one to model cross-sectional dependence at the international level and to estimate the parameters of interest by generalized method of moments.

Key words: Exchange rate appreciation, Third-country effects, Multinational firms

JEL classification: C23; F12; F14; F23;

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1 Introduction

“(…) the topic of exchange rate effects on FDI is an area rich for future work.”

(Blonigen, 2005, p. 8)

Profound empirical evidence shows that exchange rate movements are important for multinational enterprise (MNE) activity (see Caves, 1989; Swenson, 1994; Blonigen, 1997). However, this is usually ignored in the textbook general equilibrium models of MNEs and trade (see Markusen, 2002; Barba Navaretti and Venables, 2004). The assumption of Dixit-Stiglitz-type iso-elastic demand curves and constant mark-ups, which many of the MNE models are built on, even prevents an analysis of the role of exchange rates. As put forward by Krugman (1986, p. 15), “(…) if the demand curve has constant elasticity, the (...) price will fall in full proportion to the exchange rate change” and, thus, rule out any real effects. Additionally, Goldberg and Knetter (1999, p.30) make clear that “(...) the adjustment of mark-ups to cost-shocks, which determines pass-through and pricing-to-market, depends on the convexity of the demand schedule the firm faces. Convexity is not directly related to the level of demand elasticity faced by the firm, but rather to how elasticity changes along the demand schedule.” Hence, to investigate the role of exchange rate changes for MNE activity, a variable elasticity of demand is essential.

A theoretical foundation of the exchange rate effect on international economic activity is provided by two different branches of research: one on the uncertainty of future exchange rate movements (see, e.g., Cushman, 1985; for an early contribution), and one on market imperfections as a source of pricing to market. The latter line of the literature allows for deviations from the law of one price and addresses the effects of even perfectly anticipated exchange rate movements (Baldwin and Krugman, 1989; Krugman, 1986; Goldberg and Knetter, 1997, give an excellent overview on different theoretical approaches). While most of the theoretical studies focus on the role of exchange rates for trade, there is less emphasis on their impact on MNE activity.

Empirical research on exchange rates and MNEs is mainly available for direct invest-
ment into the U.S. (see Caves, 1989; Froot and Stein, 1991; Swenson 1994; Blonigen, 1997). This literature supports a positive impact of a dollar depreciation on inward direct investment into the U.S., which may be explained by the reduced price of U.S. assets in foreign currency in a setting with imperfect international capital/asset markets (Froot and Stein, 1991).

Alternatively, Blonigen (1997) argues that firm-specific assets are important to understand the relationship between exchange rate changes and developments of foreign direct investment (FDI). The reason is that firm-specific assets are not location-specific and, therefore, may generate returns in currencies other than that one used for purchase.

It is this paper’s purpose to investigate the role of exchange rates for complex MNE activity. In doing so, we follow recent research to avoid the restrictive features of models with simple vertical MNEs (Helpman, 1984, 1985) or simple horizontal ones (Markusen, 1984; Markusen and Venables, 2000). But rather, firms may produce locally in some markets and serve others via trade (see Ekholm, Forslid, and Markusen, 2003; Yeaple, 2003; Helpman, Melitz and Yeaple, 2004) Hanson, Mataloni, and Slaughter (2001, 2005), Baltagi, Egger, and Pfaeffermayr (2005), and Blonigen, Davies, Waddell, and Naughton (2005) provide empirical support in favor of complex organization structures of MNEs.

To study such complex organizational strategies, we set up a three-country model with coexistence of two types of producers: Complex MNEs which produce in two economies but serve a third market through goods trade, and national exporting firms that supply goods from a single production site to consumers all over the world. MNEs and exporters engage in Cournot competition, rendering goods market imperfections the source of exchange rate effects (see Krugman, 1986). Moreover, we assume linear demand, which allows us to tackle the pricing-to-market effects of exchange rate changes.

The presence of more than two countries is crucial for all models of complex MNEs.

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1In contrast, for the case of perfect capital markets, McCulloch (1989, p. 188) notes that “(...) if a U.S. asset is seen as a claim to a future stream of dollar-denominated profits, and if profits will be converted back into the domestic currency of the investor at the same exchange rate, the level of the exchange rate does not affect the present discounted value of the investment.”

2See Markusen (2002) for a unified treatment of vertical and horizontal MNEs.
Such a framework also seems warranted from an empirical point of view where MNE activity is usually analyzed at the bilateral (rather than the unilateral) level.\(^3\) To date, almost all empirical research on the determinants of bilateral MNE activity implicitly assumes that FDI decisions in a particular host-country are independent of the decisions in other host countries. According to Blonigen (2005, p. 27), “this is not a good assumption.” Blonigen, Davies, and Head (2003, p. 982) indicate that for a bilateral empirical analysis the theoretical hypotheses should in fact rely on a model of more than two economies.

Extending previous research on exchange rate movements and multinational activity, we put special emphasis on the \textit{third-country effects} and assess the major exchange-rate-related implications of our theoretical model empirically.\(^4\) In doing so, we rely on spatial econometric methods for panel data that are particularly suited to study third-country effects on bilateral outcome variables. Specifically, we infer the following results for bilateral MNE activity: (i) third-country effects of exchange rate movements matter; (ii) the third-country exchange rate effects are qualitatively identical for different measures of MNE activities: the number of foreign affiliate plants, foreign affiliate sales and foreign direct investment; (iii) third-country effects are inversely related to trade costs (distance); and (iv) the expected sign of third-country effects depends on the firm pattern in the parent country, i.e., on the share of exporters relative to the share of MNEs in the total number of competitors.

In the next section, we introduce the theoretical model. Sections 3 and 4 provide a characterization of the equilibrium and a comparative static analysis. Section 5 presents the estimation approach and the empirical findings. In Section 6 we conduct a robustness analysis. The last section concludes with a short summary of the most important results.

\(^3\)E.g., Carr, Markusen, and Maskus (2001) and Blonigen, Davies, and Head (2003), provide an empirical analysis on the determinants of U.S. bilateral \textit{inbound} and \textit{outbound} affiliate sales. See also Brainard (1997) and Ekholm (1998) for a bilateral approach.

\(^4\)Recent empirical research points out that third-country effects on MNE activity are generally important (see Blonigen, Davies, Waddell, and Naughton, 2004; Baltagi, Egger, and Pfaffermayr, 2005; and Blonigen, 2005, for an overview). However, third-country exchange rate effects have not been studied so far.
2 Theoretical background

We consider three economies endowed with capital $K$, high-skilled labor $S$, and low-skilled labor $L$. The three factors are inelastically supplied in perfectly competitive and internationally segmented markets. The three economies are identical with respect to their production technologies but may differ in their factor endowments. Besides a perfectly competitive agricultural $Y$-sector, there is an infinite number of symmetric industrial $X$-sectors active in the three economies. A small number of oligopolistic firms competes in quantities in each $X$-industry. Trade in industrial goods is subject to iceberg transport costs, implying that only a share of $1/t_{ij}$ of the quantity produced in country $i$ arrives in destination country $j \neq i$. There are no further trade frictions. In particular, transport costs for the agricultural good are zero.

Production of one unit of good $Y$ requires one unit of low-skilled labor, i.e., $Y = L$. Two types of oligopolistic firms are active in the industrial sectors, namely exporters $n$ and complex horizontal multinationals $h$. One unit of physical capital and one unit of high-skilled labor is required to headquarter a firm (multinational or exporter) in a particular economy. Local production can start immediately without further investment. However, if a firm decides to set up a second production facility abroad, $g - 1$ units of physical capital must be invested as fixed factor input before production can start in the foreign economy.\textsuperscript{5} In addition, we assume that a multinational with headquarters in country $i$ is bound to country $i$’s supply of physical capital and high-skilled labor, when setting up production plants. (Capital markets are not integrated at an international level.) Regarding production technologies in the industrial sector, we assume that all firms employ the same technology and use one unit of low-skilled labor to produce one

\textsuperscript{5}In general, there may also be multinationals with three production plants. However, to focus the analysis on the most important features of our model, existence of such firms is ruled out by the assumption of prohibitively high fixed costs for setting up a third production facility.
unit of final output. Then, the resource constraints in the three economies are given by

\[ \overline{K}_i = n_i + gh_i \]  
\[ \overline{S}_i = n_i + h_i \]  
\[ \overline{L}_i = X_i + Y_i, \]  

where \( X_i \) and \( Y_i \) indicate overall \( X \)- and \( Y \)-supply in country \( i = 1, 2, 3 \).

Multinational firms set up a production facility at two locations and serve the third market through exports. We aim at providing a flexible system of potential firm types and allow multinationals to serve the third market from either plant. However, we assume that in the case of indifference MNEs serve the third market from the parent country, where their headquarters are located. This avoids indeterminacy problems and rules out MNEs with headquarters in country 1, foreign affiliate production in country 2, and exports from country 2 to 3 (i.e., \( h_{12F} \) in our notation). In sum, we account for the following types of multinational firms:

- \( h_{12} \) headedquartered in 1 with a plant in 2, serving country 3 through exports from 1;
- \( h_{13}, h_{13F} \) headquartered in 1 with a plant in 3, serving country 2 through exports from 1 or 3, resp.;
- \( h_{31}, h_{31F} \) headquartered in 3 with a plant in 1, serving country 2 through exports from 3 or 1, resp.

Countries 1 and 2 are assumed to be fully symmetric in all respects. Hence, \( h_{21} = h_{12}, h_{13} = h_{23}, h_{13F} = h_{23F}, h_{31} = h_{32} \) and \( h_{31F} = h_{32F} \). \( h_1 \equiv h_{12} + h_{13} + h_{13F} \) and \( h_3 \equiv 2h_{31} + 2h_{31F} \) have been considered in (1) and (2). In addition, there are national firms \( n_1 \) (= \( n_2 \)) and \( n_3 \) that serve either foreign market through exports from countries 1 and 3, respectively. We use \( h \)- and \( n \)-variables to refer to the different firm types and the number of firms of a particular type.

In the following analysis, we focus on the role of exchange rates for multinational activities. Therefore, we introduce parameter \( \zeta \), which measures the value of country 3’s currency in terms of country 1’s currency. In other words, an increase of \( \zeta \) implies an appreciation of currency 3 relative to currency 1. The exchange rate between countries 1 and 2 is equal to one throughout our analysis.
Let us next turn to the profits producers can attain under a specific type of organization. To avoid messy notation and to keep the number of variables and indices at a reasonable level, we use information on technology and make use of the fact that certain output levels will be identical if firms maximize their profits. Skipping any firm indices, we denote exports from country \( i \) to country \( j \neq i \) by \( q_{ij} \), while we denote local sales in country \( i \) by \( x_i \). Noting further that countries 1 and 2 are fully identical in all respects (hence, also in factor returns and goods prices), the relevant profit equations in reduced form read as follows:  

\[
\begin{align*}
\pi_{12}^h &= 2(p_1 - w_{L1})x_1 + \zeta (p_3 - t_3w_{L1}/\zeta) q_{13} - w_{S1} - gw_{K1}, \\
\pi_{13}^h &= (p_1 - w_{L1})x_1 + (p_1 - t_1w_{L1}) q_{12} + \zeta (p_3 - w_{L3}) x_3 - w_{S1} - gw_{K1}, \\
\pi_{13F}^h &= (p_1 - w_{L1})x_1 + (p_1 - \zeta t_3w_{L3}) q_{31} + \zeta (p_3 - w_{L3}) x_3 - w_{S1} - gw_{K1}, \\
\pi_{1}^n &= (p_1 - w_{L1})x_1 + (p_1 - t_1w_{L1}) q_{12} + \zeta (p_3 - t_3w_{L1}/\zeta) q_{13} - w_{S1} - w_{K1},
\end{align*}
\]

and

\[
\begin{align*}
\pi_{31}^h &= (p_1 - w_{L1})x_1/\zeta + (p_1 - \zeta t_3w_{L3}) q_{31}/\zeta + (p_3 - w_{L3}) x_3 - w_{S3} - gw_{K3}, \\
\pi_{31F}^h &= (p_1 - w_{L1})x_1/\zeta + (p_1 - t_1w_{L1}) q_{12}/\zeta + (p_3 - w_{L3}) x_3 - w_{S3} - gw_{K3}, \\
\pi_{3}^n &= 2(p_1 - \zeta t_3w_{L3}) q_{31}/\zeta + (p_3 - w_{L3}) x_3 - w_{S3} - w_{K3},
\end{align*}
\]

where \( w_{Li} \), \( w_{Si} \) and \( w_{Ki}, i = 1, 2, 3 \), are factor prices of low-skilled labor, high-skilled labor and physical capital (in local currency). For an interpretation of (4)-(10), the following description might be helpful: (i) \( (p_1 - w_{L1})x_1 \) are operative profits from local sales in country 1 or 2 (in terms of currency 1); (ii) \( (p_3 - w_{L3}) x_3 \) are operative profits in country 3 (in terms of currency 3); (iii) \( \zeta (p_3 - t_3w_{L1}/\zeta) q_{13} \) are operative profits associated with exports from country 1 to country 3 (in terms of currency 1); (iv) \( (p_1 - t_1w_{L1}) q_{12} \) are operative profits associated with exports from country 1 to country 2 (in terms of currency 1); (v) \( (p_1 - \zeta t_3w_{L3}) q_{31} \) are operative profits due to exports from country 3 to country 1 or 2 (in terms of currency 1);
i with foreign affiliate production in country $j \neq i$ could also serve home market $i$ through exports from country $j$. However, this option is unattractive if diversification prevails in the production pattern of all economies. Since we focus on diversification equilibria throughout our analysis, we do not account for such multinationals in equations (4)-(10). This completes our discussion of the supply side.

With regard to consumer demand, we assume that the representative consumer in country $i = 1, 2, 3$ maximizes a utility function of the form

$$U(x_i^D, Y_i^D) = \int_0^1 \left( a - \frac{b}{2E_i} d_i(z) \right) d_i(z) dz + Y_i^D,$$

(11)

where $z$ is an industry index and $d_i(z), Y_i^D$ are consumption levels of a good from the $z$th industry and the agricultural sector, respectively. In addition, $E_i \equiv L_i + S_i$ is the size of country $i$’s population. In fact, we assume that each individual is endowed with one unit of low-skilled or high-skilled labor, respectively. Capital is distributed such that each individual consumes both types of goods. Variables $a$ and $b$ denote preference parameters, which are identical for all consumers.

Under (11), demand for the industrial good is independent of income (at least, if a certain minimum level of income is exceeded). Moreover, due to the assumption of an infinite number of industrial sectors, oligopolistic firms are only large in their own industry but small with respect to the whole economy. Thus, firms consider their impact on the industry price, whereas aggregate variables such as factor returns are exogenous for the individual producer.

Neary (2003a, 2003b) suggests a different specification of the utility function to study income effects in general oligopolistic equilibrium. However, Neary’s utility specification is of no help to overcome the complexity of our model which accounts for three countries, transport costs, and more than a single firm type. For the purpose of analytical tractability, we therefore choose a quasi-linear utility function, which rules out any income effects on the demand for industrial goods.
Utility (11) gives rise to indirect demand functions of the form

$$p_1 = p_2 = a - (b/E_1) d_1, \quad \text{(12)}$$

$$p_3 = a - (b/E_3) d_3. \quad \text{(13)}$$

Furthermore, $d_1 (= d_2) \equiv (2h_{12} + h_{31} + h_{31F} + h_{13} + h_{13F} + n_1) x_1 + (n_1 + h_{13} + h_{31F}) q_{12} + (n_3 + h_{31} + h_{13F}) q_{31}$ and $d_3 \equiv (2h_{13} + 2h_{13F} + 2h_{31} + 2h_{31F} + n_3) x_3 + 2(n_1 + h_{12}) q_{13}$, if the symmetry in output levels is accounted for.

### 3 Equilibrium analysis

Due to our assumption on factor use, the numbers of multinational firms and exporters are determined by factor market clearing conditions (1), (2) and only depend on $S$- and $K$-endowments of the two economies. However, this assumption is not as restrictive as it might seem at a first glance. In a simulation analysis, we have accounted for a Leontief technology in the industrial sector and have assumed that all factors are used as variable production inputs. This modification renders the number of multinationals and exporters headquartered in a particular economy endogenous and, thus, gives rise to a more flexible model specification. It turns out that the basic mechanisms of our model survive under such a modification, but the additional feedback effects complicate the analysis. Therefore, we have chosen the simplest possible model structure to focus on the main economic mechanisms present in our model. In particular, these mechanisms work through adjustments in firm structure variables $h_{ij}$, $h_{ijF}$, as will be discussed in detail below.

We assume that countries 1 and 2 are identically endowed, whilst $K_3 = \mu_K K_1$ and $S_3 = \mu_S S_1$, with $\mu_K, \mu_S > 0$, allow us to study the role of exchange rate effects on multinational activity if countries 1 and 3 differ in their endowments with physical capital and high-skilled labor. Parameter domains with $K_i > S_i$ and $gS_i > K_i$, $i = 1, 2, 3$, are

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8 Sector indices are skipped, since all X-industries are presumed to be identical.
considered in the subsequent analysis. Equilibrium firm numbers are given by

\[ h_1 = h_2 = \frac{K_1 - S_1}{g - 1}, \quad h_3 = \frac{\mu_K K_1 - \mu S_1 S_1}{g - 1} \tag{14} \]

\[ n_1 = n_2 = \frac{g S_1 - K_1}{g - 1}, \quad n_3 = \frac{\mu S g S_1 - \mu_K K_1}{g - 1} \tag{15} \]

Profit maximization of exporters and multinationals leads to the following equilibrium quantities of local production and affiliate sales if preference parameter \( a \) is sufficiently high:\(^9\)

\[ x_1 = \frac{a + (n_3 + h_{31} + h_{13} F) (\zeta t_3 w_{L3} - w_{L1}) + (n_1 + h_{13} + h_{31} F) (t_1 - 1) w_{L1} - w_{L1}}{(b/E_1) [2h_1 + h_3 + 2n_1 + n_3 + 1]} \tag{16} \]

\[ x_3 = \frac{a + 2 (n_1 + h_{12}) (t_3 w_{L1}/\zeta - w_{L3}) - w_{L3}}{(b/E_3) [2h_1 + h_3 + 2n_1 + n_3 + 1]} \tag{17} \]

Export volumes (net of iceberg transport costs) are given by

\[ q_{12} = x_1 - (E_1/b) (t_1 - 1) w_{L1}, \quad q_{31} = x_1 - (E_1/b) (\zeta t_3 w_{L3} - w_{L1}), \]

\[ q_{13} = x_3 - (E_3/b) (t_3 w_{L1}/\zeta - w_{L3}). \tag{18} \]

A sufficiently high \( a \) and positive quantities in (16)-(18) are assumed throughout the analytical discussion below. Then, we can use (16)-(18) in (12) and (13) to determine equilibrium prices of the industrial good:\(^{10}\)

\[ p_1 = (b/E_1) x_1 + w_{L1}, \quad p_3 = (b/E_3) x_3 + w_{L3}. \tag{19} \]

\(^9\)To derive the equilibrium quantities in (16)-(18), we can differentiate the profits of exporters in country 1 (country 3), with respect to \( x_1, q_{12}, q_{13} (x_3, q_{31}, \text{respectively}) \) and set the resulting expression equal to zero. However, we cannot simply differentiate (7) or (10), as the respective profits are expressed in reduced form. But rather, we have to note that final goods markets are segmented and that exporters set their quantities independently for each country. Then, profit-maximization leads to the familiar results: \( (p_1 - w_{L1}) = (b/E_1) x_1, \quad (p_1 - t_1 w_{L1}) = (b/E_1) q_{12}, \quad (p_3 - t_3 w_{L1}/\zeta) = (b/E_3) q_{13}, \quad (p_1 - \zeta t_3 w_{L3}) = (b/E_1) q_{31} \) and \( (p_1 - w_{L3}) = (b/E_3) x_3. \) Together with (12), (13) and the definitions of \( d_1, d_3, \) these equations establish the results in (16)-(18).

\(^{10}\)Use \( (p_1 - w_{L1}) = (b/E_1) x_1 \) and \( (p_3 - w_{L3}) = (b/E_3) x_3 \) from Footnote 9.
Furthermore, overall supplies of industrial goods in countries 1 and 3 are given by

\[ X_1 = (2h_{12} + h_{31} + h_{31F} + h_{13} + h_{13F} + n_1) x_1 \]  
\[ + (n_1 + h_{13} + h_{31F}) t_1 q_{12} + (n_1 + h_{12}) t_3 q_{13}, \]
\[ X_3 = (2h_{13} + 2h_{13F} + 2h_{31} + 2h_{31F} + n_3) x_3 + 2 (n_3 + h_{31} + h_{13F}) t_3 q_{31}, \]

respectively.

We choose the agricultural good as a numéraire and set the price of $Y$ in country 1 equal to one. In the absence of any impediments to $Y$-trade and under diversification in the production of all economies, the price of good $Y$ equals $1/\zeta$ in country 3. Moreover, $w_{L1} = \zeta w_{L3} = 1$ is implied by the production technology for the agricultural good. Factor returns to physical capital and skilled labor are given by\(^\text{11}\)

\[ w_{K1} = \frac{b/E_1}{g - 1} [x_1^2 - q_1^2], \quad w_{K3} = \frac{b/E_1}{\zeta (g - 1)} [x_1^2 - q_3^2], \]
\[ w_{S1} = \frac{b/E_1}{g - 1} [(g - 2) x_1^2 + g q_{12}^2] + \zeta (b/E_3) q_{13}, \]
\[ w_{S3} = \frac{b/E_1}{\zeta (g - 1)} [(2g - 1) q_{31}^2 - x_3^2] + (b/E_3) x_3^2. \]

A positive value of $w_{K1}$, $w_{K3}$ and $w_{S3}$ is guaranteed by (18) and the assumption of $g \geq 2$. Moreover, $w_{S3} > 0$ if $g$ is sufficiently high (which is assumed throughout our analysis).

So far, the endogenous variables are expressed as functions of $h_{13}$, $h_{13F}$, $h_{31}$ and $h_{31F}$. Therefore, we have to characterize the equilibrium firm-structure in a next step. For this purpose, we compare $\pi_{13}^h$ with $\pi_{13F}^h$ and $\pi_{31}^h$ with $\pi_{31F}^h$, respectively. This gives\(^\text{12}\)

\[ h_{13F} = h_{31} = 0 \quad \text{if} \quad t_3 > t_1 \quad \text{and} \quad h_{13} = h_{31F} = 0 \quad \text{if} \quad t_3 < t_1. \]

\(^{11}\) Notice that firms make zero profits in equilibrium. Then, subtracting (7) from (4) gives $(g - 1) w_{K1} = (p_1 - 1) x_1 - (p_1 - t_1) q_{12}$ and subtracting (10) from (8) yields $\zeta (g - 1) w_{K3} = (p_1 - 1) x_1 - (p_1 - t_3) q_{31}$. Accounting for (18), (19) and using $(p_1 - 1) = (b/E_1) x_1$, $(p_1 - t_1) = (b/E_1) q_{12}$ and $(p_1 - t_3) = (b/E_1) q_{31}$, we get (22). To obtain (23) and (24), we additionally consider $(p_3 - t_3/\zeta) = (b/E_3) q_{13}$, $(p_3 - 1/\zeta) = (b/E_3) x_3$ and substitute $w_{K1}$ and $w_{K3}$ into (7) and (10), respectively.

\(^{12}\) Subtract (6) from (5) and use the insights from Footnote 11 to find that $\pi_{13}^h >, =, < \pi_{13F}^h$ if $q_{12} >, =, < q_{31}$. In an analogous way, one can show that $\pi_{31}^h >, =, < \pi_{31F}^h$ if $q_{31} >, =, < q_{12}$, by subtracting (9) from (8). Together with (18), these two results establish (25).
In addition, we assume $h_{13F} = h_{31F} = 0$ (and $h_{13}, h_{31} \geq 0$) if $t_1 = t_3$. Intuitively, export-platform FDI is only an optimal strategy if a foreign country offers better access to a third market, which in our framework may arise due to lower transport costs.

For notational simplicity, we introduce two new variables, namely $h_{13}$ and $h_{31}$, which allow us to refer to firm structure variables $h_{13}, h_{13F}$ and $h_{31}, h_{31F}$, respectively, irrespective of the particular $t_1,t_3$ regime. To be more specific, $h_{13} = h_{13}$ if $t_3 \geq t_1$ and $h_{13} = h_{13F}$ if $t_3 < t_1$. In addition, $h_{31} = h_{31}$ if $t_3 \leq t_1$ and $h_{31} = h_{31F}$ if $t_3 > t_1$. Due to our symmetry assumption, $h_{31} = h_{32} = h_3/2$ determines the pattern of country 3’s multinational activities (in terms of foreign affiliate plants) in countries 1 and 2. Moreover, concerning the decision problem of multinational firms in country 1 to operate a plant in country 2 or 3, we can define

$$
\Omega \equiv \begin{cases} 
2 (t_1 - 1) x_1 - (E_1/b) (t_1 - 1)^2 - 2 (t_3 - 1) x_3 + (E_3/b) (t_3 - 1)^2 / \zeta & \text{if } t_3 \geq t_1 \\
2 (t_3 - 1) x_1 - (E_1/b) (t_3 - 1)^2 - 2 (t_3 - 1) x_3 + (E_3/b) (t_3 - 1)^2 / \zeta & \text{if } t_3 < t_1 
\end{cases}
$$

(26)

according to (4)-(6).\textsuperscript{13} An interior solution with $h_{13} \in (0, h_1)$ is reached if multinationals with headquarters in country 1 are indifferent between operating a foreign plant in countries 2 or 3. Then,

$$
\Omega \left( h_{13}; \zeta, t_1, t_3, \mu_K, \mu_S, K_1, S_1, E_1, E_3 \right) = 0,
$$

(27)

implicitly determines $h_{13} = h_1 - h_{12}$ as a function of exchange rate parameter $\zeta$, transport cost parameters $t_1, t_3$ and endowment parameters $\mu_K, \mu_S, K_1, S_1, E_1$ and $E_3$. Of course, there is an analogous indifference condition for country 2, which is not separately displayed, due to symmetry.

\textsuperscript{13}Subtracting (5) from (4) and using the insights from Footnote 11, we derive $(b/E_1) \left[ x_1^2 - q_{12}^2 \right] + \zeta (b/E_3) \left[ q_{13}^2 - x_3^2 \right]$. Evaluating this expression gives the first line in (26). In an analogous way, we can subtract (6) from (4) to obtain $(b/E_1) \left[ x_1^2 - q_{31}^2 \right] + \zeta (b/E_3) \left[ q_{13}^2 - x_3^2 \right]$. Evaluating this expression establishes the second line in (26).
We can note that
\[
\frac{\partial \Omega}{\partial h_{13}} \bigg|_{t_3 \geq t_1} = \frac{2 (t_1 - 1)^2 (E_1 / E_3) + 4 (t_3 - 1)^2 / \zeta}{(b / E_3) [2h_1 + h_3 + 2n_1 + n_3 + 1]} > 0, \tag{28}
\]
\[
\frac{\partial \Omega}{\partial h_{13}} \bigg|_{t_3 < t_1} = \frac{(t_3 - 1)^2 [2 (E_1 / E_3) + 4 / \zeta]}{(b / E_3) [2h_1 + h_3 + 2n_1 + n_3 + 1]} > 0. \tag{29}
\]
Hence, if \( \Omega (\cdot) = 0 \) has a solution in \( h_{13} \in (0, h_1) \), this solution is unique. In addition, if factor endowment differences are not too big, an interior solution with \( h_{13} \in (0, h_1) \) is guaranteed.\(^{14}\) This is the case we are focussing on in the rest of our analytical discussion.

In principle, we can solve for firm structure variable \( h_{13} \) and use the resulting expression in (16)-(24) to obtain (for any trade cost regime \( t_1 <, =, > t_3 \)) explicit solutions for the endogenous variables of the industrial sectors. However, since these results are not needed in the subsequent analysis, the respective calculations are left open for the interested reader. To complete our description of the equilibrium, also supply and demand of the agricultural good in countries 1 and 3 \( (Y_1, Y_3, Y_1^D, Y_3^D) \) have to be determined. There are four equations left for this task: two factor market clearing conditions for low-skilled labor \( L \), according to (3) and the budget constraints of consumers in countries 1 and 3. The explicit solutions for \( Y_1, Y_3, Y_1^D, \) and \( Y_3^D \) are not of further interest in this study, as we restrict our attention to the case of diversified production in all three economies.

In the comparative-static analysis presented in Section 4, we first investigate the impact of exchange rate parameter \( \zeta \) on firm structure variables \( h_{12}, h_{13} \) and \( h_{13F} \). The insights from this analysis are essential to understand the impact of exchange rate parameter \( \zeta \) on foreign direct investment (FDI) and foreign affiliate sales \( (FAS) \). We are particularly interested in the third-country effects and focus on the impact of an appreciation (depreciation) of currency 3 on MNE activities between countries 1 and 2.

\(^{14}\)In the borderline case of full symmetry in economic fundamentals, the pattern of foreign affiliate plants is not determined in general. However, as we assume that countries 1 and 2 are fully symmetric in all respects, we restrict our attention to a situation with identical patterns of foreign production facilities in countries 1 and 2 (i.e., \( h_{12} = h_{21} \) and \( h_{31} = h_{32} \)). Then, we can identify a unique affiliate structure in an equilibrium with full symmetry of all three economies: \( h_{12} = h_{13} = h_{31} = h_{32} = h / 2 \). This result will be considered in Proposition 1 below.
4 Comparative-static analysis

4.1 Firm structure variable effects

From (14) and (15) it is obvious that the total number of multinationals and exporters is independent of exchange rate parameter $\zeta$. However, $\zeta$-variation changes the attractiveness of a country as a target of multinational and exporter activities. As a consequence, firm structure variable $h_{13}$ adjusts in reaction to a $\zeta$-movement, see (26) and (27). This relationship between $\zeta$ and $h_{13}$ is of primary interest in this subsection.

Applying the implicit function theorem to (27), gives

$$\frac{\partial h_{13}}{\partial \zeta} \bigg|_{t_3 \geq t_1} = -\frac{[2(n_1 + h_1) - 4h_{13} - (h_3 + n_3 + 1)](t_3 - 1) - 2}{2(t_3 - 1)\zeta} \left\{ 2 + \left[ \frac{(t_1 - 1)^2}{(t_3 - 1)^2} \right] (E_1/E_3) \zeta \right\},$$

(30)

$$\frac{\partial h_{13F}}{\partial \zeta} \bigg|_{t_3 < t_1} = -\frac{[2(n_1 + h_1) - 4h_{13F} - (h_3 + n_3 + 1)](t_3 - 1) - 2}{2(t_3 - 1)\zeta} \left\{ 2 + (E_1/E_3) \zeta \right\},$$

(31)

if $h_{13} \in (0, h_1)$, according to (16), (17) and (26). Moreover, $\partial h_{12}/\partial \zeta \big|_{t_3 \geq t_1} = -\partial h_{13}/\partial \zeta \big|_{t_3 \geq t_1}$ and $\partial h_{12}/\partial \zeta \big|_{t_3 < t_1} = -\partial h_{13F}/\partial \zeta \big|_{t_3 < t_1}$, according to $h_1 = h_{12} + h_{13} + h_{13F}$ and (25). For completeness, $\partial h_{31}/\partial \zeta = \partial h_{32}/\partial \zeta = \partial h_{31F}/\partial \zeta = \partial h_{32F}/\partial \zeta = 0$, since countries 1 and 2 are identical. The firm structure effects of an exchange rate appreciation/depreciation are summarized in Proposition 1.

Proposition 1 The impact of $\zeta$ on the number of country 1’s multinationals with foreign affiliate production in country 2 is in general ambiguous. However, if countries are fully

\[\begin{align*}
\frac{\partial \Omega}{\partial \zeta} &= \frac{(t_3 - 1) \{2(n_1 + h_1) - 4h_{13} - (h_3 + n_3 + 1)\}(t_3 - 1) - 2}{\zeta^2 (b/E_3) [2h_1 + h_3 + 2n_1 + n_3 + 1]}
\end{align*}\]

in

$$\frac{\partial h_{13}}{\partial \zeta} = -\frac{\partial \Omega/\partial \zeta}{\partial \Omega/\partial h_{13}}.$$

Since the third-market implications of $\zeta$-movements are of particular interest in this study, we focus on $\partial h_{12}/\partial \zeta$ in the empirical analysis. However, for a better economic intuition it is sometimes useful to stick to $\partial h_{13}/\partial \zeta$ instead of $\partial h_{12}/\partial \zeta$. Therefore, we consider both derivatives in the analytical discussion below.
symmetric, i.e., if $t_1 = t_3 = t$, $\zeta = E_1/E_3 = 1$ and $n_1 = n_3 \equiv n$ and $h_1 = h_3 \equiv h$, according to $\mu_K = \mu_S = 1$, the firm structure effect triggered by a marginal $\zeta$-increase is given by

$$\frac{\partial h_{13}}{\partial \zeta} = -\frac{\partial h_{12}}{\partial \zeta} = -\frac{(n - h - 1)(t - 1) - 2}{6(t - 1)},$$

which is positive if $(n - h - 1)(t - 1) - 2 < 0$ (multinational scenario) and negative if $(n - h - 1)(t - 1) - 2 > 0$ (exporter scenario).

**Proof.** Substitute (16) and (17) into (26) and evaluate the respective expression at $t_3 = t_1 = t$ and $\zeta = E_1/E_3 = 1$. Then, $\Omega(\cdot) = 0$ implies

$$h_{13} = \frac{(2h_1 + n_1 - n_3 - h_3/2)}{3}.$$  \hfill (33)

Substituting (33) into (30), we obtain

$$\frac{\partial h_{13}}{\partial \zeta} = -\frac{[-(2/3)h_1 + (2/3)n_1 + (1/3)n_3 - (1/3)h_3 - 1](t - 1) - 2}{6(t - 1)}.$$ \hfill (34)

Using $h \equiv h_1 = h_3$ and $n \equiv n_1 = n_3$, according to $\mu_K = \mu_S = 1$, (32) follows from (34).

This completes the proof of Proposition 1. \hfill \blacksquare

On the one hand, an appreciation of currency 3 exhibits ceteris paribus a positive impact on the value of foreign affiliate sales by a multinational headquartered in country 1. I.e., operative profits of $h_{13}$-type producers in terms of country 1’s currency increase. This effect dominates the positive impact of $\zeta$ on the value of exports to country 3. As a consequence, FDI in country 3 becomes more attractive, giving rise to a positive impact of $\zeta$ on $h_{13}$ or $h_{13F}$ and a negative one on $h_{12}$, respectively. On the other hand, there is a non-neutral indirect effect of a $\zeta$-increase on the output level of multinationals and exporters. Since multinationals with foreign affiliate production in country 3 exhibit a larger local output, they account for their sizeable impact on prices, when adjusting their foreign affiliate production in reaction to a parameter shift. At the firm level, the impact of $\zeta$ on exports to country 3 is positive, while $\zeta$ exhibits (for a given $h_{13}$) a negative effect on foreign affiliate sales in country 3, if $2(n_1 + h_1 - h_{13})(t_3 - 1) > 1$ holds, according to (17).

\footnote{For a discussion of the full symmetry case, see Footnote 14.}
In sum, we identify two (potentially) opposing effects of an appreciation of currency 3 on the attractiveness of multinational activities in country 3 (or more precisely, on operative profits associated with affiliate production in country 3 relative to operative profits associated with exports to country 3). As long as production remains diversified, these two effects arise, irrespective of whether multinationals serve the third market through production at their headquarters location or through foreign affiliate sales (export-platform FDI).

Although the $\zeta$-effect on firm structure variables $h_{13}$ and $h_{12}$ is not clear-cut in general, we gain important insights for the case of full symmetry, i.e., for $t_1 = t_3 = t$ and $\zeta = \mu_K = \mu_S = E_1 / E_3 = 1$. In this case, we expect a positive $\zeta$-effect on $h_{13}$ and a negative one on $h_{12}$, if multinationals are relatively important and $(n - h - 1)(t - 1) < 2$ (multinational scenario). The opposite holds true if exporters dominate, i.e., if $(n - h - 1)(t - 1) > 2$ (exporter scenario). According to (14) and (15), investment cost parameter $g$ and endowment parameters $S_1$, $K_1$ are key determinants of firm number variables $n$, $h$ and, therefore, also of the derivatives $\partial h_{13} / \partial \zeta$, $\partial h_{12} / \partial \zeta$, according to (32). A lower $g$ or $S_1$ and a higher $K_1$ give rise to a larger $h - n$ and, eventually, a multinational scenario. Ceteris paribus this renders a positive (negative) impact of $\zeta$ on firm structure variable $h_{13}$ ($h_{12}$) more likely, by virtue of Proposition 1.

The comparative-static analysis so far has focused on ex ante symmetric countries. Even in this case, the firm structure effects of exchange rate variation are not trivial. In the following, we aim at providing further insights into the $\zeta$-effects on $h_{12}$ if $t_1 \neq t_3$ and countries differ in their relative factor endowments ($\mu_K, \mu_S \neq 1$) or in market size ($E_1 \neq E_3$). Let us first focus on the impact of market size differences.

Differentiating (26) with respect to $h_{13}$ and $E_i$, $i = 1, 3$, and applying the implicit function theorem to (27), we can derive

$$
\frac{\partial h_{13}}{\partial E_1}_{t_3 \geq t_1} = -(t_1 - 1) \frac{[x_1/E_1 + q_{12}/E_1]}{\partial \Omega/\partial h_{13}}, \quad \frac{\partial h_{13}}{\partial E_3}_{t_3 \geq t_1} = \frac{(t_3 - 1) [x_3/E_3 + q_{13}/E_3]}{\partial \Omega/\partial h_{13}},
$$

$$
\frac{\partial h_{13F}}{\partial E_1}_{t_3 < t_1} = -(t_3 - 1) \frac{[x_1/E_1 + q_{31}/E_1]}{\partial \Omega/\partial h_{13F}}, \quad \frac{\partial h_{13F}}{\partial E_3}_{t_3 < t_1} = \frac{(t_3 - 1) [x_3/E_3 + q_{33}/E_3]}{\partial \Omega/\partial h_{13F}},
$$

with $\partial \Omega/\partial h_{13} > 0$ and $\partial \Omega/\partial h_{13F} > 0$, according to (28) and (29), respectively. A higher
$E_1$ ($E_3$) is associated with a larger market in country 1 (country 3) and, therefore, makes multinational activities more attractive there.\footnote{For given $\mu_K, \mu_S$, variation of $E_1$ ($E_3$) is associated with changes in $L_1$ ($L_3$).} As a consequence, a higher $E_1$ and a lower $E_3$ reduce $h_{13}$ and increase $h_{12}$. This renders a negative $\zeta$-effect on firm structure variable $h_{13}$ and a positive one on $h_{12}$ more likely, according to (30) and (31).

In a next step, we are interested in $t_1 \neq t_3$ and $\mu_K, \mu_S \neq 1$. Since a rigorous analytical discussion of these asymmetries is difficult (if not intractable), we stick to numerical simulation exercises in the subsequent analysis. In the first exercise (Figure 1), we keep the assumption $\mu_K = \mu_S = 1$ and calculate firm structure variable $h_{12}$ for different values of $t_3$ and $\zeta$. Two panels are depicted in Figure 1.\footnote{In Figure 1 the following parameter values are used: $a = 200$, $b = E_1 = E_3 = 1500$, $g = 2$, $t_1 = 1.15$, $t_3 \in [1.145, 1.155]$ and $\zeta \in [0.95, 1.05]$. In addition, in Panel A, $K_1 = K_3 = 750/3$, $S_1 = S_3 = 420/3$ and $L_1 = L_3 = 1080/3$, while in Panel B, $K_1 = K_3 = 550/3$ and $S_1 = S_3 = 500/3$ and $L_1 = L_3 = 1000/3$ are assumed.} In Panel A, we consider a high value of $K_1$ (relative to $S_1$), with $(n - h - 1) \times (t_3 - 1) < 2$, according to (32). In this case, we speak of a multinational scenario. In accordance with the analytical results in Proposition 1, $\zeta$ exhibits a positive impact on $h_{13}$ and a negative one on $h_{12}$, if the number of multinationals is sufficiently high. Things are different if endowment parameter $K_1$ is low (relative to $S_1$) and the number of exporters is relatively high, i.e., if $(n - h - 1) \times (t_3 - 1) > 2$. In this exporter scenario, a higher exchange rate parameter $\zeta$ leads to a lower $h_{13}$ and a higher $h_{12}$ (Panel B). Again, this is consistent with the results in Proposition 1.

> Figure 1: The impact of $\zeta$ and $t_3$ on firm structure variable $h_{12}$

In addition, we can conclude from Figure 1 that a higher $t_3$ reduces competition in country 3 and, thus, renders affiliate production there more attractive than affiliate production in country 2. As a consequence, the number of multinationals with affiliate production in country 3 increases at the cost of MNEs with affiliate production in country 2, i.e., $h_{13}$ rises and $h_{12}$ declines. This result is consistent with the idea of trade-cost-jumping FDI and independent of whether a multinational scenario (associated with a
high $K_1$) or an exporter scenario (associated with a low $K_1$) prevails. With regard to the impact of $t_3$ on $h_{12}$, we observe a kink at $t_3 = 1.15$. At this transport cost level there is a switch in firm structure variables $h_{13}$ and $h_{31}$, respectively. To be more precise, if $t_3 > t_1$, country 3 conducts export-platform FDI in countries 1 and 2, i.e., $h_{31} = h_{31F}$ (and $h_{31} = 0$), while at $t_3 < t_1$ there is export-platform FDI from countries 1 and 2 to country 3, i.e., $h_{13} = h_{13F}$ (and $h_{13} = 0$). The switch in the firm structure variables $h_{13}$ and $h_{31}$ accounts for the kink at $t_3 = t_1$ in both panels of Figure 1. There is a further kink of $h_{12}(\zeta,t_3)$ in Panel B at some high levels of $t_3 > t_1$. At a sufficiently high $t_3$, $h_{12}$ (i.e., the number of multinationals headquartered in country 1 with affiliate production in country 2 and exports to country 3) reaches zero, since the transport cost disadvantage from serving market 3 through exports from countries 1 and 2 is huge.

Figure 2 addresses the impact of factor endowment asymmetries on firm structure variable $h_{12}$.\(^{20}\) For this, we assume $t_1 = t_3$ and focus on the exporter scenario (low $K_1$) in the graphical analysis. The respective effects for the multinational scenario (high $K_1$) are verbally discussed (without graphical presentation). Again, two panels are considered in Figure 2. In Panel A, we allow for variation in $\mu_K$, keeping $\mu_S$ constant, while in Panel B, we consider variation of $\mu_S$ for a constant $\mu_K$.

> Figure 2: The impact of $\zeta$ and $\mu_j$, $j = K, S$, on firm structure variable $h_{12}$ <

Due to the underlying parameter domain, which is associated with an exporter scenario, we observe a positive impact of $\zeta$ on $h_{12}$. (This is consistent with Panel B in Figure 1.) In addition, there is a negative impact of endowment parameter $\mu_K$ on $h_{12}$ (Panel A). A better endowment of country 3 with physical capital raises the number of MNEs with headquarters in country 3 relative to the number of local exporters. This intensifies competition in countries 1 and 2 (relative to country 3), since foreign affiliate sales in a

\(^{20}\)In Figure 2 the following parameter values are used: $a = 200$, $g = 2$, $t_1 = t_3 = 1.15$, $b = E_1 = E_3 = 1500/3$, $L_1 = 1000/3$, $K_1 = 550/3$, $S_1 = 500/3$ and $\zeta \in [0.95, 1.05]$. In addition, in Panel A, $\mu_K = K_3/K_1 \in [0.9, 1.1]$, $\mu_S = S_3/S_1 = 1$ and $L_3 = L_1$, while in Panel B $\mu_K = 1$, $\mu_S \in [0.9, 1.1]$ and $dL_3/dS_3 = -1$ are assumed.
certain market are higher than exports to this market as multinationals save on transport costs. As a consequence, country 3 becomes relatively more attractive for foreign affiliate production of MNEs, and $h_{12}$ declines if $\mu_K$ goes up. The opposite holds true if country 3’s endowment with high-skilled labor is increased (Panel B). A higher $\mu_S$ is associated with a higher number of exporters headquartered in country 3 relative to the number of MNEs with headquarters in country 3. This reduces competition in countries 1 and 2 relative to country 3 and, thus, renders foreign affiliate production in countries 1 and 2 relatively more attractive. As a consequence, $h_{12}$ rises if $\mu_S$ goes up.

We have also investigated the impact of $\mu_K$ and $\mu_S$ for high values of $K_1$, leading to a multinational scenario as depicted in Panel A of Figure 1. Under this parameter domain, the impact of $\zeta$ on $h_{12}$ is negative, while $\mu_K$- and $\mu_S$-effects are the same as in the exporter scenario displayed in Figure 2. Hence, the factor endowment effects in Figure 2 are robust in this respect.

4.2 FDI- and FAS-effects

Based on the firm structure implications analyzed in Subsection 4.1, we can investigate third-country effects of an exchange rate appreciation on foreign direct investment (FDI) and foreign affiliate sales (FAS). Denoting the value of country 1’s FDI in country 2 by $FDI_{12}$ and accounting for

$$FDI_{12} \equiv h_{12} (g - 1) w_{K_1} = h_{12} \left(\frac{b}{E_1}\right) \left[x_1^2 - q_{12}^2\right], \quad (35)$$

according to (22), we can make use of $\left(\frac{b}{E_1}\right) \left[x_1^2 - q_{12}^2\right] = (t_1 - 1) [x_1 + q_{12}]$ to calculate

$$\frac{\partial FDI_{12}}{\partial \zeta} = \begin{cases} \frac{\partial h_{12}}{\partial \zeta} \left[x_1 + q_{12} - \frac{2(h_1-h_{13})(E_1/b)(t_1-1)}{2h_1+h_3+2n_1+n_3+1}\right] (t_1 - 1) & \text{if } t_3 \geq t_1, \\ \frac{\partial h_{12}}{\partial \zeta} \left[x_1 + q_{12} - \frac{2(h_1-h_{13})(E_1/b)(t_3-1)}{2h_1+h_3+2n_1+n_3+1}\right] (t_1 - 1) & \text{if } t_3 < t_1, \end{cases} \quad (36)$$

according to (16) and (18). Proposition 2 summarizes our findings for the exchange rate effects on FDI.
**Proposition 2** If the number of multinationals with headquarters in country 1 and foreign affiliate production in country 2 is positively affected by an appreciation of currency 3, i.e., if $\partial h_{12}/\partial \zeta > 0$, $FDI_{12}$ rises with $\zeta$. The opposite holds true if $h_{12}$ declines with an increase in $\zeta$.

**Proof.** Note that

$$\frac{2(h_{1}-h_{13})}{2h_{1}+h_{3}+2n_{1}+n_{3}+1} \in (0, 1).$$

Then, $q_{12} = x_{1} - (E_{1}/b)(t_{1} - 1) > 0$ and $q_{31} = x_{1} - (E_{1}/b)(t_{3} - 1) > 0$ guarantee positive bracket terms in (36), so that $\partial h_{12}/\partial \zeta$ and $\partial FDI_{12}/\partial \zeta$ exhibit the same signs.

If a higher $\zeta$ renders foreign affiliate production in country 3 more attractive (i.e., if $\partial h_{13}/\partial \zeta > 0$ and $\partial h_{12}/\partial \zeta < 0$), demand for physical capital $K$ relative to high-skilled labor $S$ increases, since setting up a multinational firm is a physical capital intensive activity. This raises the factor return to physical capital in country 1 ($w_{K1}$). However, there is a second opposing effect on country 1’s FDI in country 2, as the number of multinationals with foreign affiliate production in country 2 declines if $h_{13}$ is positively affected by an increase in $\zeta$. In any case, it is the latter direct firm structure effect that dominates and determines the sign of $\partial FDI_{12}/\partial \zeta$. As a consequence, $\partial FDI_{12}/\partial \zeta > 0$ if $\partial h_{12}/\partial \zeta > 0$ (and $\partial h_{13}/\partial \zeta < 0$), while $\partial FDI_{12}/\partial \zeta < 0$ if $\partial h_{12}/\partial \zeta < 0$ (and $\partial h_{13}/\partial \zeta > 0$).

In a next step, we define the value of country 1’s foreign affiliate sales in country 2 as $FAS_{12} = h_{12}p_{1}x_{1}$ and calculate

$$\frac{\partial FAS_{12}}{\partial \zeta} = \begin{cases} 
[\frac{p_{1}x_{1} - (h_{1}-h_{13})(p_{1}+(b/E_{1})x_{1})[(t_{1}-1)]}{(b/E_{1})[2h_{1}+h_{3}+2n_{1}+n_{3}+1]}] \frac{\partial h_{12}}{\partial \zeta} & \text{if } t_{3} \geq t_{1} \\
[\frac{p_{1}x_{1} - (h_{1}-h_{13})(p_{1}+(b/E_{1})x_{1})[(t_{3}-1)]}{(b/E_{1})[2h_{1}+h_{3}+2n_{1}+n_{3}+1]}] \frac{\partial h_{12}}{\partial \zeta} & \text{if } t_{3} < t_{1}
\end{cases}$$

(37)

according to (16) and (19). The third-market effect of $\zeta$ on $FAS_{12}$ is summarized in Proposition 3.

**Proposition 3** If the number of multinationals with headquarters in country 1 and foreign affiliate production in country 2 is positively (negatively) affected by an appreciation of currency 3, $FAS_{12}$ rises (declines) with $\zeta$. 

\[\]
Proof. Note that $p_1 = (b/E_1)x_1 + 1$, according to (16) and (19). Hence, we can reformulate (37) and obtain $dFAS_{12}/d\zeta = \Psi dh_{12}/d\zeta$, with

$$\Psi \equiv \left\{ \begin{array}{ll} 
[(b/E_1)x_1 + 1] \left[ x_1 - \frac{2(h_1-h_{13})(E_1/b)(t_1-1)}{2h_1+h_3+2n_1+n_3+1} \right] + \frac{(h_1-h_{13})(E_1/b)(t_1-1)}{2h_1+h_3+2n_1+n_3+1} & \text{if } t_3 \geq t_1 \\
[(b/E_1)x_1 + 1] \left[ x_1 - \frac{2(h_1-h_{13}')(E_1/b)(t_3-1)}{2h_1+h_3+2n_1+n_3+1} \right] + \frac{(h_1-h_{13}')(E_1/b)(t_3-1)}{2h_1+h_3+2n_1+n_3+1} & \text{if } t_3 < t_1
\end{array} \right. $$

Noting further that $\frac{2(h_1-h_{13})}{2h_1+h_3+2n_1+n_3+1} \in (0, 1)$, it follows from $q_{12} = x_1 - (E_1/b)(t_1 - 1) > 0$ and $q_{31} = x_1 - (E_1/b)(t_3 - 1) > 0$ that $\Psi > 0$ and, thus, $\partial FAS_{12}/\partial \zeta > 0$ if $\partial h_{12}/\partial \zeta > 0$, whilst $\partial FAS_{12}/\partial \zeta < 0$ if $\partial h_{12}/\partial \zeta < 0$. ■

Exchange rate parameter $\zeta$ exerts an impact on the value of country 1’s affiliate sales in country 2 only if the number of $h_{12}$-firms changes. There are two opposing effects. On the one hand, if $h_{12}$ increases, there is intensified competition and, hence, there are lower revenues at the individual firm level in market 2 (i.e., $p_1x_1$ declines). On the other hand, there is a higher number of MNEs with headquarters in country 1 and foreign affiliate production in country 2, which dominates the aforementioned negative revenue effect. Accordingly, the total value of $FAS_{12}$ increases, if $h_{12}$ is positively affected by a $\zeta$-increase.

Propositions 2 and 3 make clear (i) that FDI- and FAS-effects of $\zeta$ point into the same direction and (ii) that these effects are fully determined by the firm structure change analyzed in Subsection 4.1 (at least, if there is diversification in the pattern of production). However, Propositions 2 and 3 do not directly relate FDI and FAS to the main economic fundamentals such as transport cost or endowment and market size parameters of the involved economies. To discuss the influence of these variables is the purpose of the subsequent analysis. The main insights are gained from simulation exercises, based on the parameter domains underlying Figures 1 and 2, respectively. For the sake of brevity, we do not display the respective figures but relegate them to a supplement, which is available from the authors upon request.

First, we are capable to confirm the intuitive result of Subsection 4.1 that a higher $E_1$ and a lower $E_3$ render countries 1 and 2 more attractive locations for MNE activities. Both $FDI_{12}$, according to (35), and $FAS_{12}$, according to the respective definition above
(37), increase in $E_1$ and decline in $E_3$.

Let us next consider the impact of transport costs. From the inspection of (16) and (18), we can conclude that $t_3$ exhibits a positive impact on $x_1$ and $q_{12}$, which tends to raise $FDI_{12}$, according to (35).\footnote{For this assessment, use $x_1^2 - q_{12}^2 = 2x_1(E_1/b)(t_1 - 1) - (E_1/b)^2(t_1 - 1)^2$ and $\partial x_1/\partial t_3 > 0$, according to (16) and (18).} However, there is a further effect of transport cost parameter $t_3$ working through the adjustment of firm structure variable $h_{12}$. Since $h_{12}$ declines in $t_3$ (see Figure 1), we expect that the latter firm structure effect counteracts the former competition effect. In fact, simulation results indicate that the firm structure effect dominates, giving rise to a negative impact of transport cost parameter $t_3$ on $FDI_{12}$. With respect to the $FAS_{12}$-effect, we can note that for given $h_{13}$, $h_{31}$, $p_1 x_1$ is positively influenced by a $t_3$ increase, while the decline in $h_{12}$ (see Figure 1) counteracts this effect. Insights from our simulation exercises indicate that the second effect dominates, which implies a negative impact of $t_3$ on $FAS_{12}$.

The role of relative endowment parameters $\mu_K$ and $\mu_S$ is more difficult to determine. Evaluating $FDI_{12}$ and $FAS_{12}$ at the parameter values considered in Figure 2, we find that a higher $\mu_K$ leads to lower $FDI_{12}$ and $FAS_{12}$, while a higher $\mu_S$ has opposite effects. Again, the $FDI_{12}$- and $FAS_{12}$-effects exhibit the same sign as the firm structure effect on $h_{12}$ (while the effect on $h_{13}$ points in the opposite direction). In this sense, understanding the firm structure implications of changes in endowment differences ($\mu_K$, $\mu_S$), market size parameters ($E_1$ and $E_3$) and transport costs $t_3$ is essential for understanding the respective $FDI_{12}$- and $FAS_{12}$-effects.

This completes our theoretical discussion. In the next section, we use insights from the equilibrium analysis and the comparative static results to develop a proper econometric specification and to interpret the empirical findings.
5 Empirical analysis

In the empirical analysis, we use panel data on foreign multinational activity of both the U.S. and Japan over the period 1990-1999. Our theoretical model suggests that both bilateral and third-country exchange rates should be important for MNE activity. Moreover, total and relative economic size, relative factor endowments (physical capital, high-skilled labor, low-skilled labor), trade and investment costs are key determinants. Motivated by our theoretical insights and previous empirical work, we specify the following empirical model to estimate the exchange rate effects on MNE activity

\[ y_{jt} = \beta_0 + \beta_1 SGDP_{jt} + \beta_2 RGDP_{jt} + \beta_3 RK_{jt} + \beta_4 RS_{jt} + \beta_5 RL_{jt} \]
\[ + \beta_6 RKG_{jt} + \beta_7 D_j + \beta_8 \zeta_{jt} + \lambda_t \]
\[ + \gamma_1 WSGDP_{jt} + \gamma_2 WRGDP_{jt} + \gamma_3 WRK_{jt} + \gamma_4 WRS_{jt} + \gamma_5 WRL_{jt} \]
\[ + \gamma_6 WRKG_{jt} + \gamma_7 D_j + \gamma_8 W\zeta_{jt} + W\lambda_t + u_{jt}, \]  

(38)

where \( y_{jt} \) is either the number of foreign affiliates (as a proxy for \( h_{12} \)), the value of foreign affiliate sales (associated with \( FAS_{12} \)) or the value of outbound foreign direct investment (associated with \( FDI_{12} \)) in host-country \( j \) and year \( t \).\(^{23}\) The explanatory variables consist of bilateral and third-country ones. The role of third-country (\( W\)-) variables is of primary interest, here. In addition, bilateral variables have to be added in the econometric model to obtain reliable results. Let us start with a short description of the bilateral explanatory variables. They are defined as follows.\(^{24}\) \( SGDP_{jt} = \ln(GDP_{parent,t} + GDP_{jt}) \) is a measure of total bilateral economic size, where \( GDP \) refers to real gross domestic product. Although, income effects were ruled out by the assumption of quasi-linear utility in the theoretical model, we may interpret \( SGDP_{jt} \) as being related to market size parameter \( E_1 \) in Sections 2-4. In this case, we would expect a positive sign

\(^{22}\) All variables are in logs, so that the coefficients can be interpreted as elasticities.

\(^{23}\) In some regressions, we employ data at the industry level. Then, we use host-country-industry random effects and fixed industry-time effects. The latter control for and time-specific determinants at the industry level.

\(^{24}\) A detailed description of data sources is provided in the Appendix.
of coefficient $\beta_1$, according to our discussion below Propositions 1 and 3. $RGDP_{jt} = \ln\{1 - [GDP_{\text{parent},t}/(GDP_{\text{parent},t} + GDP_{jt})]^2 - [GDP_{jt}/(GDP_{\text{parent},t} + GDP_{jt})]^2\}$ measures two countries’ similarity in economic size (see Helpman, 1987). $RK_{jt} = \ln(K_{\text{parent},t}/K_{jt})$, $RS_{jt} = \ln(S_{\text{parent},t}/S_{jt})$, $RL_{jt} = \ln(L_{\text{parent},t}/L_{jt})$ refer to parent-to-host endowment ratios in physical capital ($K$), high-skilled labor ($S$), and low-skilled labor ($L$). Due to our focus on third-country effects, the theoretical model does not provide insights into the role of bilateral relative market size ($RGDP_{jt}$), and bilateral relative factor endowments ($RK_{jt}$, $RS_{jt}$ and $RL_{jt}$). However, previous empirical research on multinational activities suggests accounting for the impact of these variables to guard against an omitted variables bias (see, e.g., Egger and Pfaffermayr, 2004; Baltagi, Egger, and Pfaffermayr, 2005). $RKG_{jt} = RK_{jt} \times SGDP_{jt}$ is an interaction term, which may have a positive or a negative sign. According to Markusen and Maskus (2002) and Egger and Pfaffermayr (2004), we expect a negative parameter, if horizontal MNEs are prevalent, and a positive one, if vertical MNEs are relevant. To assess the impact of bilateral transport and investment costs we include geographical distance ($D_j$) as a control variable (see Lipsey, 1999, for a similar approach). Since higher distance may raise both trade costs and investment costs, the sign of $\beta_7$ is not clear-cut from a theoretical point of view (Carr, Markusen, and Maskus, 2001). We do not account for the impact of transport costs separately, because reliable information on transport costs is not available for our country sample.

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25 Markusen and Maskus (2002) account for the interaction between high-skilled labor endowment and the sum of bilateral GDP but do not control for physical capital endowment effects. In our theoretical analysis, physical capital is a direct determinant of FDI. Therefore, we include an interaction term between the bilateral sum of GDP and the absolute difference in physical capital endowments (instead of high-skilled labor endowments).

26 Markusen and Maskus (2002, p. 702) argue that “distance may encourage horizontal investments abroad in preference to exports, but it also raises the cost of doing business abroad.”

27 Some authors use indirect measures of transport costs based on matched partner cif/fob ratios. However, as rigorously discussed in Hummels and Lugovsky (2003), cif/fob ratios are often affected by a serious measurement error rendering them only poor measures of trade costs. In our country sample cif values are often lower than fob values. Hence, cif/fob ratios cannot be used as reliable measures of bilateral transport costs in our analysis. In an extension to our parsimonious model, we have accounted for the impact of transport costs separately.
\( \zeta_{jt} \) is the value of host \( j \)'s currency expressed in units of the parent country's currency. Accordingly, an increase in \( \zeta_{jt} \) indicates an appreciation of host \( j \)'s currency relative to the parent one. Again, we do not present theoretical hypotheses for the bilateral variable, as the focus of our model was on the third-country effects. However, the results in Blonigen (1997) and Froot and Stein (1991) show that a depreciation of the host currency should give rise to higher outbound FDI flows, indicating a negative sign of \( \beta_{S} \) at least in the FDI regressions. \( \lambda_{t} \) are fixed time effects that capture all time-specific observable and unobservable determinants of MNE activity.\(^28\)

In addition to the bilateral determinants, third-market effects are of particular interest in the present study. In line with the spatial econometrics literature, these effects are represented by weighted averages that capture the impact of changes in the determinants in foreign markets other than \( j \). Here, third-country variables are indicated by an initial letter “\( W \)”. Before presenting a detailed description of our spatial econometric approach, we repeat the theoretical hypotheses for the explanatory third-country variables. A higher \( W_{RK} \) (a lower \( \mu_{K} \)) and a lower \( W_{RS} \) (a higher \( \mu_{S} \)) can be expected to have a positive impact on the three measures of multinational activities in country \( j \) (the number of foreign affiliates, outbound FDI and FAS), i.e., we expect a positive sign of \( \gamma_{3} \) and a negative one of \( \gamma_{4} \). (See Figure 2 and the discussion in the last paragraph of Subsection 4.2.) In the theoretical model, low-skilled labor endowments can only have an impact through market size parameters \( E_{1} \) and \( E_{3} \) (at least, if diversification in the production pattern remains). As \( WSGDP_{jt} \) and \( WRGDP_{jt} \) control for absolute and relative market size effects, we would expect an insignificant impact of relative low-skilled labor endowment variable \( WRL_{jt} \). Most importantly, the theoretical analysis points to a non-trivial effect of the third-country exchange rate \( W_{\zeta} \) on MNE activity. Two possible scenarios can

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\(^{28}\)For fixed effects in regressions with data at the industry level, see Footnote 23.
be distinguished. In a multinational scenario, \( \partial h_{13} / \partial \zeta = -\partial h_{12} / \partial \zeta \) should be positive, while the associated \( FDI_{12} \) and \( FAS_{12} \) should be negative. In this case, we would expect a negative sign of coefficient \( \gamma_8 \). The opposite holds true in an exporter scenario, where a positive sign of \( \gamma_8 \) could be expected. In any case, \( \gamma_8 \) should have the same sign in all regressions for a particular economy. The theoretical model does not give clear-cut predictions for the respective signs of coefficients \( \gamma_1, \gamma_2 \) and \( \gamma_6 \). However, the respective variables \( WSGDP_{jt}, WRGDP_{jt} \) and \( WRKG_{jt} \) are introduced to render our empirical analysis directly comparable with other studies. Finally, one may associate distance with parameter \( t_3 \) of our theoretical model. A larger distance (a higher \( t_3 \)) should reduce the number of MNEs with foreign affiliate production in the host economy \( (h_{12}, \text{see Figure 1}) \). Consequently, the value of both bilateral outbound FDI \( (FDI_{12}) \) and FAS \( (FAS_{12}) \) should decline, according to our discussion in Subsection 4.2. However, as far as distance also influences the size of investment costs, there may be counteracting effects, rendering the sign of \( \gamma_7 \) ambiguous from a general point of view.

To calculate the respective third-country effects, we use inverse distances as weights, as cross-country interactions are presumed to be stronger between countries with shorter distance. For the ease of interpretation, we ensure that weights sum up to one for each host-country and year (and industry with industry-level data). Let \( N \) be the unique number of host-country pairs (host-country-industry pairs in case of industry-level data) and \( m \) the number of observations. In matrix notation, the disturbance term is assumed to be \( u = \rho Wu + \varepsilon, \varepsilon = \Delta_1 \mu + \nu \), where \( W \) is a row-normalized, block-diagonal, spatial weighting scheme of size \( m \times m \) whose entries are inversely related to bilateral distances between host countries, \( \mu \sim IID(0, \sigma^2_\mu) \) is an \( N \times 1 \) vector of random host-country (host-country-industry) effects, and \( \nu \sim IID(0, \sigma^2_\nu) \) is an \( m \times 1 \) vector of classical errors. Let \( D_t \) denote an \( N_t \times N \) matrix obtained from \( I_N \) by eliminating the rows corresponding

\footnote{Although \( WRGDP_{jt} \) should be related to parameters \( E_1 \) and \( E_3 \) in the theoretical model, it is difficult to interpret \( WRGDP_{jt} \) against the insights from our analytical results. This is, since \( E_1 \)-effects should be captured by coefficient \( \beta_1 \) (see our discussion above) and since a higher similarity index (a higher \( WRGDP_{jt} \)) may be associated with both a lower or higher \( E_1/E_3 \), depending on \( E_1/E_3 \geq 1 \).}
to host countries (or host-country-industry pairs) that are missing in year \( t \). \( \mathbf{D}_1 = 
abla \mathbf{D}_2 \cdots \mathbf{D}_T \)' is the \( m \times N \) selector matrix, which picks up the host-country effects (host-country-industry). The elements in \( \mathbf{\mu} \) and \( \mathbf{\nu} \) are assumed to be independent of each other and among themselves. According to our assumption about the error process, there is spatial dependence in \( \mathbf{u} \) through \( \mathbf{W} \), similar to the explanatory variables.

Under the present assumptions about the data generating process of the error term, neither ordinary least squares (OLS) nor traditional random effects generalized least squares (GLS) estimation gives efficient estimates. But rather, spatial dependence and random effects have to be accounted for simultaneously in the estimation. For this purpose, we estimate the model using the generalized method of moments (GMM) approach of Kapoor, Kelejian, and Prucha (2005). The moment conditions for unbalanced panel data estimation are derived in Baltagi, Egger, and Pfaffermayr (2005) and summarized in the Appendix. The model estimation proceeds as follows. First, consistent estimates of \( \mathbf{\beta}, \mathbf{\gamma}, \mathbf{\lambda}, \mathbf{W}, \mathbf{\lambda} \), and \( \mathbf{u} \) are obtained from OLS on (38). The six moment conditions listed in the Appendix make use of \( \mathbf{u} \). Estimates of \( \rho, \sigma^2_\nu \), and \( \sigma^2_\mu \) are obtained as solutions of the system of non-linear moment equations. The data are first Cochrane-Orcutt-transformed as \( \mathbf{z}^* = \mathbf{z} - \mathbf{\tilde{\rho}} \mathbf{W} \mathbf{z} \). Finally, each observation in \( \mathbf{z}^* \) is transformed according to \( \mathbf{\tilde{z}}_{jt}^* = z_{jt}^* - \hat{\theta}_j z_{jt}^* \), where ”\( \mathbf{z}_{jt}^* \)” are host-country (host-country-industry) means of Cochrane-Orcutt-transformed variables, and \( \hat{\theta}_j = 1 - [\hat{\sigma}_v^2/(T_j \hat{\sigma}_\mu^2 + \hat{\sigma}_v^2)]^{0.5} \) are host-country-specific (or host-country-industry-specific) GLS weights due to unbalancedness (i.e., the number of observed periods \( T_j \) differs among the cross-sectional units). Hence, the model is estimated by feasible GLS.

> Table 1 about here <

Table 1 summarizes the descriptive statistics for all three types of U.S. and Japanese MNE activities and the explanatory variables. Due to our weighting of third-country variables, the latter exhibit first and second moments that are similar to the bilateral ones within each panel data set. The estimation results based on spatial GMM estimation for unbalanced panel data are summarized in Tables 2 and 3.
Table 2 presents the results for bilateral aggregate data of the United States’ MNE activity. All three measures of multinational activities, namely the number of affiliates, foreign affiliate sales and outbound foreign direct investment, are available in this panel data set. The model fit is well and the spatial autocorrelation parameter is fairly high. According to a Lagrange-multiplier test, spatial pooled OLS is rejected against spatial random effects estimation throughout. According to the Hausman test, the spatial random effects model is not rejected against a standard fixed effects model which ignores spatial correlation. The relative importance of the between variance component is huge. This results in a fairly high average GLS-weight $\hat{\theta}_j$, which eliminates most of the between variation in the data and renders the estimates unbiased.

Most of the bilateral effects are well in line with previous empirical results. Economic size, physical capital and low-skilled labor endowments are particularly important for MNE activity. The significant positive impact of the capital-size interaction term points to some relevance of vertical multinationals. The empirical results indicate that a depreciation of the U.S. dollar fosters U.S. outbound MNE activity (see the positive coefficient of $\zeta_{jt}$ in Table 2). This is somewhat surprising against the background of the finding by Blonigen (1997) and Froot and Stein (1991) that inward FDI in the U.S. should be increased if the dollar depreciates. However, it must be noted that the results are not contradictory, since exchange rate effects in different countries may work in different directions. (We come back to this point later on.)

The performance of third-country effects depends critically on the measure of MNE activity. Our theoretical hypotheses seem to be well in line with the parameter estimates of the outbound FDI regression. In particular, the positive sign of $\gamma_3$ ($WRK_{jt}$) and the negative one of $\gamma_4$ ($WRS_{jt}$) support our theoretical hypotheses. An insignificant effect of relative low-skilled labor endowments seems also plausible, as we control for market size variables separately. The negative impact of similarity parameter $WRGDP_{jt}$ is more difficult to interpret since it is not directly related to our theoretical results (see
Footnote 29). The point estimates of weighted distance are well in line with our simulation results for the transport cost effects (see Figure 1 and the discussion below Proposition 3). However, the impact of distance turns out to be insignificant. This can be explained by a positive correlation of distance and investment costs (see Lipsey, 1999, and our discussion above), which may counteract the transport cost effect. The negative sign of the weighted exchange rate variable $W_{jt}$ indicates that a multinational scenario prevails. This result is robust irrespective of the measure of multinational activity (the number of foreign affiliates, foreign affiliate sales or outbound foreign direct investment).

In Table 3, we investigate the determinants of multinational activity for bilateral aggregate Japanese data. Again, we can use three measures of multinational activity, namely the number of foreign affiliates ($h_{12}$ in our theoretical model), foreign affiliate sales (labelled $FAS_{12}$ in the model), and outbound foreign direct investment ($FDI_{12}$). If foreign affiliate sales are the dependent variable, the explanatory power of the empirical model is higher for Japan than the U.S. The opposite holds true for the other two measures of multinational activities. The point estimates of the weighted relative high-skilled labor and relative physical capital endowments ($WRS_{jt}$ and $WRK_{jt}$, respectively) presented in the second and third column of Table 3 are well in line with our theoretical hypotheses but insignificant in three out of four cases.

Let us now focus on the exchange rate effects. The bilateral exchange rate variable exerts a significant negative impact on all three measures of multinational activities. This confirms the finding in Blonigen (1997, p. 447) that “real dollar depreciations make Japanese acquisitions more likely in U.S. industries”. However, in view of Tables 2 and 3, we can also conclude that Blonigen’s finding does not point to a general exchange rate effect that is equally important in all economies. Moreover, the third-country exchange rate effects for the U.S. and Japan also exhibit different signs.\footnote{The country coverage for the U.S. and Japan is slightly different. Therefore, we have investigated the robustness of our results when using the overlapping host-country sample. It turns out that the results are not affected by this modification. In particular, the different signs of the third-market exchange rate effects are robust in this regard.} While an appreciation
of the third-country currency stimulates outbound foreign activity of Japanese multinationals, opposite effects are triggered for the U.S. To interpret these results, we calculate $RK_{jt} - RS_{jt} - RL_{jt}$, according to Table 1, and obtain a rough measure of relative capital abundance ($CA$) of the U.S. and Japan, respectively. We find $CA_{U.S.} = -0.37$ and $CA_{Japan} = -0.59$, which indicates that the U.S. is the relatively more capital abundant country. From our theoretical model we know that an increase in capital abundance is associated with a higher number of multinational firms. Against the background of Propositions 1-3, we may interpret the opposing signs of the $W\zeta_{jt}$-coefficients in Tables 2 and 3 in the following way. Due to its relatively stronger capital abundance as compared to Japan, the U.S. finds itself in a multinational scenario. Then, our model hypothesizes a negative sign of the $W\zeta_{jt}$-coefficient. The opposite holds true for Japan which may find itself in an exporter scenario according to its factor composition. In this case, a positive sign of $\gamma_8$ is consistent with our theoretical predictions.

6 Robustness of the empirical results

The aim of this section is to provide insights into the robustness of our empirical results with respect to the use of alternative weighting schemes for third-country effects and the level of aggregation (bilateral aggregate versus bilateral industry-level data on MNE activity). In Table 4, we use (i) inverse squared distances and, alternatively, (ii) inverse square root distances as weights for the third-market effects. It is hard to test assumptions about the form of the weighting scheme. However, in GMM estimation the value of the criterion function or the $R^2$ could be used for guidance (with maximum likelihood estimation, one would rather stick to log-likelihood values). In our application, we find that the regressions based on inverse square root distances in Table 4 perform slightly better than others in terms of the $R^2$-values. Additionally, we consider the impact of (iii) once lagged or (iv) twice lagged exchange rates rather than contemporaneous ones to account for the possibility that a related change in investment plans takes some time to be implemented. Finally, (v) we run regressions based on bilateral industry-level data.
However, it should be mentioned that these are not always directly comparable to the aggregate bilateral ones. For instance, only 20 partner countries are available in the regressions of Japanese foreign affiliate sales at the industry level. The set of partner countries for Japanese industry-level FDI is much larger and comparable to the aggregate one.

In general, the point estimates show qualitatively similar effects to the ones reported in Tables 2 and 3, independent of which weighting scheme is considered. However, the bilateral exchange rate effects of the U.S. are always insignificant, if inverse square root distances are used as weights. This is different for Japan, where the respective bilateral exchange rate effects are always significant if spatial weights for third-country variables are based on inverse square root distances. With respect to the third-country determinants, we find that the negative impact of weighted exchange rates $W_{jt}$ identified in the U.S. data set is stronger if the inverse square root weight is used. In contrast, the respective impact is not always significant if inverse squared distances are used as weights. Moreover, the weighted exchange rates become insignificant in the outbound FDI regression on Japanese data if inverse square root distances are used as weights.

Regarding the use of once or twice lagged exchange rates, the findings are qualitatively similar to the ones in the baseline regressions. Interestingly, the associated point estimates of the lagged effects tend to be somewhat smaller than the contemporaneous ones. However, the difference is not statistically significant in most cases. This holds true for both U.S. and Japanese MNE activity.

At the industry level (11 U.S. industries and 18 Japanese industries, see the Appendix), no information on the number of foreign affiliates is available for country pairs. Thus, we restrict our analysis to FAS and outbound FDI as dependent variables. The point estimates of the bilateral determinants at the industry level are quite similar to those
obtained from aggregate data.\textsuperscript{31} The negative impact of the weighted exchange rate variable $Wx_{jt}$ seems to be robust in all regressions using U.S. data, which lends strong support to the multinational scenario in our theoretical analysis. Regarding Japanese data, we find that the industry-level results for foreign affiliate sales indicate a significant effect of the weighted exchange rate variable, while the respective effect was insignificant at the aggregate level. For outbound FDI, we obtain similar results at both the aggregate and the industry level.

\section{Conclusions}

The impact of exchange rates on multinational activity is an important issue in economic research. This paper contributes to the existing literature in several ways. It sets up a three-country model with coexisting exporters and multinationals to investigate the effects of exchange rate appreciations. Based on earlier theoretical insights, an oligopoly model with an endogenous elasticity of demand is applied. In this setting, exchange rate appreciations/depreciations exhibit real effects. We focus on the activity of complex multinationals, covering the mode of export-platform foreign direct investment. A novel feature of our model is the focus on the third-country exchange rate effects on multinational activity. The main analytical insights have been augmented by numerical simulation exercises to develop an empirical specification which can be used to assess the impact of exchange rates on multinational activities such as the number of foreign affiliates, the value of foreign affiliate sales, and the value of outbound foreign direct investment.

In the empirical part, the paper employs both aggregate and industry-level data on outbound multinational activity of the U.S. and Japan. Following the theoretical insights, country size and endowment characteristics as well as geographical distance and, especially, exchange rates are used as the main explanatory variables. Motivated by the theoretical model, the specification simultaneously uses bilateral as well as third-country

\textsuperscript{31}It is worth noting that industry-specific endowments of the respective parent economy are fully controlled for by the use of industry-time dummies, in these regressions.
determinants. To account for the cross-country dependence in general equilibrium, spatial econometric methods are applied with inverse distances as weights for the third-country effects.

It turns out that the bilateral and third-country exchange rate effects are quite different for U.S. outbound activities as compared to those of Japan. However, the theoretical model rationalizes the different effects and the driving forces behind them. Since the U.S. is relatively capital abundant as compared to Japan, the country finds itself in a scenario with a prevalence of multinational firms. In this case, the model predicts a negative impact of a weighted third-country exchange rate appreciation. The opposite holds true for Japan which may find itself in a scenario with a prevalence of exporters according to its relative factor endowments. In that case, the model predicts that a third-country exchange rate appreciation exhibits a positive impact.

Appendix

Data sources:

Data on foreign affiliate sales and outbound foreign direct investment of majority owned multinationals at the industry level are from the Bureau of Economic Analysis (USA), and UNCTAD (Japan). Explanatory variables are based on raw data from the World Bank’s World Development Indicators. Specifically, we used real GDP figures at constant parent country exchange rates to construct bilateral sum of GDP ($SGDP_{ijt}$) and similarity in GDP ($RGDP_{ijt}$). Capital stocks are computed according to the perpetual inventory method, where gross fixed capital formation at constant parent country exchange rates were used and a depreciation rate of $13.3\%$, following Leamer (1984). High-skilled labor endowments are based on the tertiary school enrolment share times a country’s labor force. Low-skilled labor endowments are defined as the difference between labor force and high-skilled labor endowments. Bilateral distance is based on the greater circle distance between two countries’ capitals (own calculations).
Country coverage

**USA:** Argentina, Australia, Austria, Brazil, Canada, Chile, China, Colombia, Costa Rica, Denmark, Dominican Republic, Ecuador, Egypt, Finland, France, Germany, Greece, Guatemala, Honduras, Hong Kong, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Korea, Malaysia, Mexico, Netherlands, New Zealand, Nigeria, Norway, Panama, Peru, Philippines, Portugal, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, Trinidad and Tobago, Turkey, United Arab Emirates, United Kingdom, Venezuela.

**Japan:** Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Costa Rica, Czech Republic, Denmark, Egypt, Finland, France, Germany, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Jamaica, Republic of Korea, Liberia, Malaysia, Mexico, Netherlands, New Zealand, Nigeria, Norway, Panama, Peru, Philippines, Poland, Portugal, Russia, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, USA, United Arab Emirates, United Kingdom, Venezuela.

Industry coverage in regressions based on disaggregated data

**USA:** Petroleum; Food and kindred products; Chemicals and allied products; Primary and fabricated metals; Machinery, except electrical; Electric and electronic equipment; Transportation equipment; Other manufacturing; Wholesale trade; Finance (except banking), insurance, and real estate; Services.

**Japan:** Agriculture, fishing and forestry; Oil and coal; Mining; Food products; Fibre and textiles; Wood, pulp, and paper; Chemicals and allied products; Steel; Non-steel metal products; Machinery, except electric, precision, and transport; Electric machinery; Transport machinery; Precision machinery; Miscellaneous machinery; Miscellaneous industries; Construction; Wholesale and retail; Services.
Moment conditions:

The generalized method of moments unbalanced random effects estimation is based on the moment conditions derived in Baltagi, Egger, and Pfaffermayr (2005). Let $m$ be the overall number of observations and $N$ the number of unique host countries (host-country-industry pairs in case of industry-level data) in the panel. Further, define $D_t$ as a $N_t \times N$ matrix which is obtained from $I_N$ by skipping the rows corresponding to missing host countries (host-country-industry pairs) in year $t$. Note that, $\sum_{t=1}^{T} N_t = m$. In matrix notation, the disturbance term is $u = \rho W u + \varepsilon$, $\varepsilon = \Delta_1 \mu + \nu$, where $\mu \sim IID(0, \sigma_\mu^2)$ is a $N \times 1$ vector of random host-country (host-country-industry) effects, $\nu \sim IID(0, \sigma_\nu^2)$ is a classical error term, and $\Delta_1 = \begin{pmatrix} D'_1 & D'_2 & \cdots & D'_T \end{pmatrix}'$ is the $m \times N$ selector matrix, which picks up the host-country (host-country-industry) effects. Both $\mu$ and $\nu$ are assumed independent of each other and among themselves. However, there is spatial dependence in $u$ through $W$ which exhibits row-normalized entries that are inversely related to bilateral distances between host countries. Further, let the projection matrix $P = \Delta_1 (\Delta'_1 \Delta_1)^{-1} \Delta'_1$ with $\Delta'_1 \Delta_1 = \sum_{t=1}^{T} D'_t D_t = \text{diag}(T_i)$, where $T_i$ indicates the number of years we observe host-country (host-country-industry pair) $i$. $Q = I_m - P$, with $tr(P) = N$ and $tr(Q) = m - N$.

\[
E((u - \rho W u)' Q (u - \rho W u) - \sigma_\nu^2 (m - N)) = 0
\]
\[
E((u - \rho W u)' P (u - \rho W u) - m \sigma_\mu^2 - N \sigma_\nu^2) = 0
\]
\[
E((Wu - \rho W^2 u)' Q (Wu - \rho W^2 u)) - \sigma_\nu^2 tr(W'QW) - \sigma_\nu^2 tr(W'QW \Delta_1 \Delta'_1) = 0
\]
\[
E((Wu - \rho W^2 u)' P (Wu - \rho W^2 u)) - \sigma_\nu^2 tr(W'PW) - \sigma_\nu^2 tr(W'PW \Delta_1 \Delta'_1) = 0
\]
\[
E((Wu - \rho W^2 u)' Q (u - \rho W u)) = 0
\]
\[
E((Wu - \rho W^2 u)' P (u - \rho W u)) = 0
\]

These can be solved for estimates of $\rho$, $\sigma_\nu^2$, and $\sigma_\mu^2$. 

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Figure 1: The impact of $\zeta$ and $t_3$ on firm structure variable $h_{12}$

Panel A: Multinational scenario (high $\bar{K}$)

Panel B: Exporter scenario (low $\bar{K}$)
Figure 2: The impact of $\zeta$ and $\mu_j, j = K, S$ on firm structure variable $h_{12}$

Panel A: $\mu_K$ -variation (Exporter scenario)

Panel B: $\mu_S$ -variation (Exporter scenario)
<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>USA</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. dev.</td>
</tr>
<tr>
<td>Number of foreign affiliates</td>
<td>5.14</td>
<td>0.94</td>
</tr>
<tr>
<td>Foreign affiliate sales</td>
<td>6.62</td>
<td>2.14</td>
</tr>
<tr>
<td>Outbound foreign direct investment (FDI)</td>
<td>5.35</td>
<td>2.22</td>
</tr>
<tr>
<td>Bilateral sum of GDP (SGDP)</td>
<td>29.66</td>
<td>0.18</td>
</tr>
<tr>
<td>Similarity in GDP (RGDP)</td>
<td>-3.19</td>
<td>1.45</td>
</tr>
<tr>
<td>Relative capital endowments (RK)</td>
<td>-3.16</td>
<td>1.46</td>
</tr>
<tr>
<td>Relative skilled labor endowments (RS)</td>
<td>-0.30</td>
<td>0.19</td>
</tr>
<tr>
<td>Relative unskilled labor endowments (RL)</td>
<td>-2.49</td>
<td>1.54</td>
</tr>
<tr>
<td>Capital-size interaction term (RKG)</td>
<td>-93.60</td>
<td>43.01</td>
</tr>
<tr>
<td>Distance (D)</td>
<td>-5.79</td>
<td>7.53</td>
</tr>
<tr>
<td>Exchange rate (ζ)</td>
<td>-2.48</td>
<td>2.84</td>
</tr>
<tr>
<td>Years</td>
<td>1994.29</td>
<td>2.73</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bilateral determinants</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral sum of GDP (WSGD)</td>
<td>29.66</td>
<td>0.14</td>
<td>29.40</td>
<td>30.00</td>
<td>29.21</td>
<td>0.18</td>
<td>28.97</td>
<td>30.25</td>
</tr>
<tr>
<td>Similarity in GDP (WRGD)</td>
<td>-3.16</td>
<td>0.68</td>
<td>-5.61</td>
<td>-1.56</td>
<td>-2.99</td>
<td>1.42</td>
<td>-9.88</td>
<td>-0.72</td>
</tr>
<tr>
<td>Relative capital endowments (WRK)</td>
<td>-3.18</td>
<td>0.59</td>
<td>-5.12</td>
<td>-1.68</td>
<td>-3.01</td>
<td>1.36</td>
<td>-7.53</td>
<td>0.58</td>
</tr>
<tr>
<td>Relative skilled labor endowments (WRS)</td>
<td>-0.28</td>
<td>0.08</td>
<td>-0.58</td>
<td>-0.07</td>
<td>-0.17</td>
<td>0.19</td>
<td>-0.84</td>
<td>0.09</td>
</tr>
<tr>
<td>Relative unskilled labor endowments (WRL)</td>
<td>-2.58</td>
<td>0.49</td>
<td>-4.09</td>
<td>-0.36</td>
<td>-2.27</td>
<td>1.33</td>
<td>-4.19</td>
<td>2.41</td>
</tr>
<tr>
<td>Capital-size interaction term (WRKG)</td>
<td>-94.24</td>
<td>17.35</td>
<td>-152.09</td>
<td>-49.91</td>
<td>-87.74</td>
<td>39.68</td>
<td>-219.70</td>
<td>17.50</td>
</tr>
<tr>
<td>Distance (WD)</td>
<td>-5.15</td>
<td>2.80</td>
<td>-12.85</td>
<td>0.48</td>
<td>8.57</td>
<td>0.53</td>
<td>6.67</td>
<td>9.35</td>
</tr>
<tr>
<td>Exchange rate (Wζ)</td>
<td>-2.42</td>
<td>0.81</td>
<td>-6.30</td>
<td>1.27</td>
<td>-2.35</td>
<td>2.28</td>
<td>-5.40</td>
<td>8.67</td>
</tr>
</tbody>
</table>

Notes: All variables are in logarithms. The corresponding numbers of observations are given in Table 2 and 3, respectively.
<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Number of foreign affiliates</th>
<th>Foreign affiliate sales</th>
<th>Outbound foreign direct investment</th>
<th>Bilateral determinants</th>
<th>Bilateral determinants</th>
<th>Bilateral determinants</th>
<th>Bilateral determinants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β std.</td>
<td>β std.</td>
<td>β std.</td>
<td>β std.</td>
<td>β std.</td>
<td>β std.</td>
<td>β std.</td>
</tr>
<tr>
<td>Bilateral sum of GDP (SGDP(_j))</td>
<td>9.193 1.310 ***</td>
<td>30.939 3.043 ***</td>
<td>18.984 2.176 ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Similarity in GDP (RGDP(_j))</td>
<td>0.165 0.084 *</td>
<td>2.277 0.209 ***</td>
<td>1.190 0.147 ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative capital endowments (RK(_j))</td>
<td>-15.097 1.658 ***</td>
<td>-32.017 4.112 ***</td>
<td>-17.473 2.854 ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative skilled labor endowments (RS(_j))</td>
<td>-0.099 0.661</td>
<td>-3.053 1.700 *</td>
<td>-4.649 1.156 ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative unskilled labor endowments (RL(_j))</td>
<td>-0.372 0.170 **</td>
<td>-1.607 0.460 ***</td>
<td>-0.958 0.290 ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital-size interaction term (RKG(_j))</td>
<td>0.531 0.055 **</td>
<td>1.115 0.137 ***</td>
<td>0.591 0.095 ***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance (D(_j))</td>
<td>-0.094 0.745</td>
<td>0.429 2.135</td>
<td>0.191 1.265</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exchange rate (C(_j))</td>
<td>0.028 0.014 *</td>
<td>0.054 0.038</td>
<td>0.052 0.026 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                                                  | Number of foreign affiliates | Foreign affiliate sales | Outbound foreign direct investment | Bilateral determinants | Bilateral determinants | Bilateral determinants | Bilateral determinants |
|                                                  | γ std.                     | γ std.                  | γ std.                           | γ std.                 | γ std.                 | γ std.                 | γ std.                 |
| Bilateral sum of GDP (WSGDP\(_j\))              | -5.290 2.655 **            | 10.337 15.178           | -1.663 7.783                     |                        |                        |                        |                        |
| Similarity in GDP (WRGDP\(_j\))                 | 0.105 0.270                | -2.592 0.743 ***        | -0.834 0.498 *                   |                        |                        |                        |                        |
| Relative capital endowments (WRK\(_j\))         | -8.268 6.889               | 18.348 18.472           | 20.010 12.138 *                  |                        |                        |                        |                        |
| Relative skilled labor endowments (WRS\(_j\))    | 0.127 1.307                | 2.092 3.629             | -6.465 2.609 **                  |                        |                        |                        |                        |
| Relative unskilled labor endowments (WRL\(_j\))  | 0.042 0.365                | 1.365 1.212             | -1.146 0.767                     |                        |                        |                        |                        |
| Capital-size interaction term (WRKG\(_j\))       | 0.267 0.228                | -0.633 0.605            | -0.627 0.404                     |                        |                        |                        |                        |
| Distance (WD\(_j\))                             | -0.426 1.004               | -4.000 3.625            | -2.243 1.889                     |                        |                        |                        |                        |
| Exchange rate (Wζ\(_j\))                         | -0.266 0.069 ***           | -0.598 0.257 **         | -0.289 0.164 *                   |                        |                        |                        |                        |

| Observations                                    | 480                        | 499                     | 530                              |                        |                        |                        |                        |
| R\(^2\)                                         | 0.689                      | 0.629                   | 0.719                            |                        |                        |                        |                        |
| Estimated ρ\(_\mu\)                             | 0.254                      | 0.689                   | 0.417                            |                        |                        |                        |                        |
| Estimated σ\(_\nu^2\)                           | 0.027                      | 0.025                   | 0.056                            |                        |                        |                        |                        |
| Estimated σ\(_\mu^2\)                           | 1.414                      | 1.891                   | 2.476                            |                        |                        |                        |                        |
| Average estimated θ\(_j\)                       | 0.956                      | 0.963                   | 0.954                            |                        |                        |                        |                        |

|                                                  | Test-statistic | p-value | Test-statistic | p-value | Test-statistic | p-value |
| Random versus fixed effects (Hausman test)       | 5.614          | 1.000   | 0.000          | 1.000   | 0.013          | 1.000   |
| Host-country effects (Lagrange multiplier test)  | 169.884        | 0.000   | 144.109        | 0.000   | 146.582        | 0.000   |
| Time effects (F-test)                            | 1.550          | 0.111   | 1.520          | 0.129   | 1.100          | 0.361   |

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%.
### Table 3 - Spatial Panel Data Estimation for Japanese Data
(Random Host-Country Effects, Generalized Moments Estimates)

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Number of foreign affiliates</th>
<th>Foreign affiliate sales</th>
<th>Outbound foreign direct investment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>std.</td>
<td>β</td>
</tr>
<tr>
<td>Bilateral sum of GDP (SGDP)</td>
<td>3.529</td>
<td>1.901</td>
<td>*</td>
</tr>
<tr>
<td>Similarity in GDP (RGDP)</td>
<td>0.256</td>
<td>0.250</td>
<td>1.171</td>
</tr>
<tr>
<td>Relative capital endowments (RK)</td>
<td>-0.552</td>
<td>8.034</td>
<td>-1.155</td>
</tr>
<tr>
<td>Relative skilled labor endowments (RS)</td>
<td>-2.527</td>
<td>1.853</td>
<td>-2.061</td>
</tr>
<tr>
<td>Relative unskilled labor endowments (RL)</td>
<td>0.139</td>
<td>0.370</td>
<td>-4.748</td>
</tr>
<tr>
<td>Capital-size interaction term (RKG)</td>
<td>0.018</td>
<td>0.274</td>
<td>0.182</td>
</tr>
<tr>
<td>Distance (D)</td>
<td>-2.531</td>
<td>1.202</td>
<td>-0.378</td>
</tr>
<tr>
<td>Exchange rate (ζ)</td>
<td>-0.179</td>
<td>0.066</td>
<td>0.242</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bilateral determinants</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>γ</td>
<td>std.</td>
<td>γ</td>
</tr>
<tr>
<td>Bilateral sum of GDP (WSGD)</td>
<td>-1.696</td>
<td>1.576</td>
<td>-2.741</td>
</tr>
<tr>
<td>Similarity in GDP (WRGD)</td>
<td>0.170</td>
<td>0.241</td>
<td>0.363</td>
</tr>
<tr>
<td>Relative skilled labor endowments (WRS)</td>
<td>0.562</td>
<td>1.157</td>
<td>-7.642</td>
</tr>
<tr>
<td>Relative unskilled labor endowments (WRL)</td>
<td>-0.020</td>
<td>0.140</td>
<td>-0.710</td>
</tr>
<tr>
<td>Capital-size interaction term (WRKG)</td>
<td>-0.228</td>
<td>0.297</td>
<td>-0.419</td>
</tr>
<tr>
<td>Distance (WD)</td>
<td>1.176</td>
<td>1.087</td>
<td>0.057</td>
</tr>
<tr>
<td>Exchange rate (Wζ)</td>
<td>0.102</td>
<td>0.042</td>
<td>0.156</td>
</tr>
<tr>
<td><strong>Third-country determinants (spatially weighted)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>378</td>
<td>174</td>
<td>396</td>
</tr>
<tr>
<td>R²</td>
<td>0.317</td>
<td>0.945</td>
<td>0.285</td>
</tr>
<tr>
<td>Estimated ρ</td>
<td>0.212</td>
<td>-0.352</td>
<td>0.254</td>
</tr>
<tr>
<td>Estimated σ²</td>
<td>0.281</td>
<td>0.199</td>
<td>0.929</td>
</tr>
<tr>
<td>Estimated σ²</td>
<td>2.521</td>
<td>32.768</td>
<td>5.467</td>
</tr>
<tr>
<td>Average estimated θ</td>
<td>0.883</td>
<td>0.974</td>
<td>0.858</td>
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Notes: *** significant at 1%; ** significant at 5%; * significant at 10%.
Table 4 - Sensitivity Analysis of the Bilateral and Third-Country Exchange Rate Effects
(Random Host-Country Effects, Generalized Moments Estimates)

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Bilateral exchange rate ($\zeta_{jt}$)</th>
<th>Third-country exchange rate ($W_{jt}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$ std.</td>
<td>$\gamma$ std.</td>
</tr>
<tr>
<td><strong>US data:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of foreign affiliates</td>
<td>0.031 0.013 **</td>
<td>-0.093 0.028 ***</td>
</tr>
<tr>
<td>Foreign affiliate sales</td>
<td>0.029 0.018 *</td>
<td>-0.066 0.051</td>
</tr>
<tr>
<td>Outbound foreign direct investment</td>
<td>0.011 0.012</td>
<td>-0.301 0.178 *</td>
</tr>
<tr>
<td>Number of foreign affiliates</td>
<td>0.009 0.008</td>
<td>-0.307 0.093 ***</td>
</tr>
<tr>
<td>Foreign affiliate sales</td>
<td>0.002 0.008</td>
<td>-0.458 0.132 ***</td>
</tr>
<tr>
<td>Outbound foreign direct investment</td>
<td>0.022 0.019</td>
<td>-0.571 0.278 **</td>
</tr>
<tr>
<td><strong>Japanese data:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of foreign affiliates</td>
<td>-0.126 0.081</td>
<td>0.142 0.069 **</td>
</tr>
<tr>
<td>Foreign affiliate sales</td>
<td>0.238 0.094 **</td>
<td>0.168 0.253</td>
</tr>
<tr>
<td>Outbound foreign direct investment</td>
<td>-0.316 0.125 **</td>
<td>0.165 0.091 *</td>
</tr>
<tr>
<td>Number of foreign affiliates</td>
<td>-0.248 0.126 *</td>
<td>0.722 0.263 ***</td>
</tr>
<tr>
<td>Foreign affiliate sales</td>
<td>0.358 0.140 **</td>
<td>-0.043 0.300</td>
</tr>
<tr>
<td>Outbound foreign direct investment</td>
<td>-0.247 0.116 **</td>
<td>0.074 0.109</td>
</tr>
<tr>
<td>Notes: *** significant at 1%; ** significant at 5%; * significant at 10%.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>