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by

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Abstract

The purpose of this paper is to empirically explore two dimensions of the firm hierarchy of international market-specific linkages using data for Swedish manufacturing firms over the 1997 to 2007 period. First, we investigate the productivity ordering with respect to importing, exporting and investing abroad. Second, we investigate the productivity ordering with respect to linkage complexity (i.e. the number of linkages at firm level). Our findings support a general productivity hierarchy from importing to exporting and then investing abroad as well as from low- to high-linkage complexity. However, an industry-by-industry examination shows that the hierarchical structure is only generally upheld for linkage complexity while the ordering of the three linkages does not exhibit the same regularity across industries. In extending the analysis, we find these irregularities to be upheld by industry characteristics. Lastly, we go beyond the productivity ordering and explore firm characteristics correlated with the linkage complexity.

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1. Introduction

Over the last decades, reduced transport and transmission costs have led firms to expand their global trade and production networks. Bernard et al. (2009) show that this expansion has been substantial, averaging to a 30 percent increase in cross-the-board combinations of importing, exporting and investing abroad (foreign direct investment, FDI, hereafter) among US manufacturing firms between 1993 and 2000. Despite the fact that firms' importing, exporting and FDI decisions have become increasingly interdependent in the process, trade-theoretic research regularly focuses on the firm's internationalization strategy along only one or two of these dimensions. We follow Bogheas and Görg (2008) in arguing that a broader approach can be required in order to gain a better understanding. For example, as shown by Altomonte and Békés (2010), a substantial part of the productivity premium of exporting firms can reflect importing behavior if firms are simultaneously engaged in two-way trade. Consequently, a limited one- or two-dimensional focus on firm internationalization may give rise to spurious empirical results.

The purpose of this paper is to explore empirically the relation between firms' performances and their international linkages. We investigate the productivity ordering with respect to 1) importing, exporting and performing FDI and 2) the number of linkages (linkage complexity) using data for Swedish manufacturing firms over the 1997 to 2007 period. In contrast to Tomiura (2007), who examines firms' productivity ordering with respect to multi-dimensional internationalization strategies from a unilateral perspective, we adopt a bilateral approach and analyze market-specific linkages. Self-selection behavior of the form described in heterogeneous firm models suggests that firms' internationalization strategies follow a hierarchical structure based on firm productivity. Such a productivity ordering reflects sunk cost discrepancies in establishing import, export and/or FDI linkages. In practice, firm hierarchies of this form may or may not prevail depending on, for example, linkage complementarities and feed-back effects.

By simultaneously estimating productivity premia of importing, exporting and performing FDI, we disentangle the productivity relationship to each linkage. Our bilateral approach reveals distinct productivity increases from importing to exporting and from exporting to performing FDI. There is, however, large sector variation that induces an extended analysis (by constructing pairwise ranking indicators and performing Probit estimations) that explores sector characteristics correlated with the general depicted productivity ordering. As for productivity ascension with respect to the number of linkages, we find that a hierarchical structure is generally upheld also at sector level. Lastly, we (run Poisson estimations to) explore firm characteristics behind the expansion into more complex market linkages.

The rest of this paper is structured as follows. Section 2 reviews related research evidence. Section 3 provides a comprised data description. In section 4, our empirical approach and analysis of firm productivity patterns is presented. The empirical investigation is extended to focus on underlying factors in section 5. Section 6 concludes.

2. The firm's internationalization strategy

A large and growing literature investigates the firm decision to open up international linkages. Following Roberts and Tybout (1997), empirical research in this field suggests that firms need to pay sunk costs to, inter alia, search for a seller or a buyer, and set up production channels in foreign markets.[1] Depending on the channel or linkage, these market entry costs can be incurred in establishing distribution networks, acquiring judicial expertise or market information, purchasing licenses, purchasing plants, fulfilling market-specific standards, marketing etc. As initially formalized by Melitz (2003), such sunk costs can lead to firm self-selecting into foreign markets based on firm productivity. Productivity sorting with respect to importing, exporting and/or performing FDI may, however, not only reflect firm self-selection but also post-entry effects. Firms can enhance their productivity by opening up FDI channels to reduce production costs. Also, there is strong evidence that importing firms accrue productivity gains from foreign market entry through learning, variety and/or quality effects.[2] The general evidence of post-entry effects of exporting is weaker though some studies identify such effects in form of production rationalization and/or product innovation.[3] The fact that post-entry effects to exporting are generally less evident in the data may be due to a tendency of firms to adopt improved technologies before they enter markets with large exposure to foreign competition. At least, this explanation is consistent with lower productivity feedback effects to exporting in markets more penetrated by arms-length trade and FDI (Greenaway and Kneller, 2003).

Kasahara and Lapham (2013) model how sector-specific cost structures can give rise to different productivity rankings of importing and exporting manufacturing firms where, as a result, importers can be more or less productive than exporters in a sector. The authors confirm the model empirically by using data on a selection of Chilean manufacturing sectors. Interestingly, several recent contributions note that the firm's decision to import indirectly can increase its incentive to become an exporter (Aristei et al. 2013; Kasahara and Lapham 2013). In particular, productivity gains from importing accruing from product innovation induce the firm to become an exporter, whereas export activity does not necessarily increase the probability of importing.[4] However, indications of such interdependency between the firm's importing and exporting decisions may also, at least to some extent, reflect cost complementarities. Estimating their structural empirical model, Kasahara and Lapham (2013) identify sunk and fixed costs to importing and exporting as well as complementarities between these cost components for the 6 manufacturing sectors that they investigate (apparel, plastics, food, textiles, wood and metals). Their results clearly indicate that, while the productivity ordering of importers and exporters may vary between sectors, more productive firms engage in two-way trade.

The firm choice of opening up a source channel for foreign inputs through importing and/or (vertical) FDI is described by the Antràs and Helpman (2004) model. Sunk costs to importing are exceeded by sunk costs to FDI in this model, which depicts that the most productive firms self-select into FDI. The basic rationale behind the

[1] See Greenaway and Kneller (2007) for a survey of the early literature in this research field.
[2] See, among others, Kasahara and Rodrigue (2008) and Kugler and Verhooven (2009).
[3] See, among others, Clerides et al. (1998) and Holmes and Schmitz (2001).
[4] In line with these results, Damijan and Kostevc (2001) explore learning from trade and they find support for a clear sequencing from imports (and innovation) to exports (and more innovation).

higher sunk costs to FDI is that firms need to streamline the production process under imperfect contracting conditions (as parties can alter unspecified details of a production agreement etc.). The model shows that, in industries where product development (formalized as 'headquarter intensity of production') is important, more productive firms self-select into sourcing through FDI. Corcos et al. (2013) and Thede (2014) provide direct empirical support of this conjecture showing that, among firms that import from a particular market, the more productive ones also engage in FDI in the same market.[5] Recent evidence also provide strong support of the model implication that firms with research-intensive production are more inclined to use combined import and FDI linkages (Antràs and Helpman 2004; Yeaple 2006; Thede 2014). Notably, the same tendency can be observed for firms with capital-intensive production in line with Antràs's (2003) evidence that a higher capital intensity reduces transaction costs of streamlining the production process (Yeaple 2006; Corcos et al. 2013; Thede 2014).

Helpman et al. (2004) extend a Melitz-type model to investigate the firm choice of opening up sales channels to foreign markets through exports or (horizontal) FDI. As sunk costs of establishing foreign subsidiary production exceed sunk costs to exporting, more productive firms self-select into foreign sales through FDI. In an empirical application based on US manufacturing firm data, the authors find evidence in support of this prediction. It has also largely been supported by subsequent empirical evidence (Greenaway and Kneller, 2007). The model by Helpman et al. (2004) comprises a proximity-concentration trade-off depicting that exporters are favored by larger economies of scale and lower trade frictions, which also receives support in their empirical analysis. Building on the Helpman et al. (2004) model, Yeaple (2009) provide supplementary empirical evidence on the firm choice to perform FDI. He reveals that the most productive firms set up affiliate production in a larger number of markets, though to a smaller extent than predicted by theory. He suggests that the latter finding can be due to diseconomies of scope across production locations. Notably, firms may be simultaneously engaged in exporting and horizontal FDI vis-à-vis a particular market. For example, products may be exported for further processing in affiliate plants abroad (to adapt its product to foreign market standards etc.) and foreign sales through exporting and FDI may be complementary under uncertain foreign demand conditions (Rob and Vettas, 2003).

Tomiura (2007) identifies firms' productivity ordering with respect to multi-dimensional internationalization strategies. Using data on Japanese manufacturing firms, he investigates the productivity ranking of outsourcers, exporters and multinationals. Overall, his findings point to the superior productivity of multinationals in line with theoretical underpinnings (Helpman et al., 2004; Antràs and Helpman, 2004). There is quite large sector variation in firm's productivity patterns and no distinct productivity rank is identified with respect to firms' unilateral outsourcing, exporting and FDI linkages. The findings, however, suggest that more productive firms are engaged in more complex internationalization strategies.

Bogheas and Görg (2008) provide a partial-equilibrium model to study firms' outsourcing, export and/or FDI decisions. They show that observed productivity sorting patterns based on a subset of these linkages can be

[5] Contrasting evidence in previous studies has been attributed to sample selection bias (Corcos et al., 2013).

misleading, supporting their argument with empirical evidence based on data for Irish manufacturing and services firms. In line with Tomiura (2007), their results suggest that multinationals are more productive than other firms but provide no clear evidence of a recursive pattern for firms that outsource, export and/or perform FDI. Again, the evidence works more in favor of a positive productivity link to complex internationalization strategies.

Lastly, in studying the complexity of the firm's internationalization strategy, it is worth noting that source and sales channels can be interdependent not only for importers and exporters but also with respect to horizontal and vertical FDI. Yeaple (2003) provides a model describing how complementarities between horizontal and vertical FDI may exist as a firm that opens up affiliate production to expand foreign sales in one market raises its gains from acquiring subsidiary production of low-cost inputs in another (source) market. He shows that trade costs play a critical role in determining whether these complementarities arise as vertical integration is favored by low trade costs and horizontal integration is favored by high trade costs.

A conclusion of the preceding discussion is that prior studies underline a distinct productivity hierarchy between firms selling only on the domestic market compared to those on the international market and also that firms engaged in FDI are found to be on the top of the productivity ladder. On the other hand, the hierarchy between importing and exporting is likely to be sector specific and vary with the cost structures. However, regarding the sequencing from imports to exports, this may suggest sunk costs to exporting exceeding those to importing. In addition, the productivity hierarchy between importing, exporting and FDI may be influenced by a complex interdependence among these linkages although a higher degree of complexity in terms of number of linkages calls for more productive firms.

3. Data

Our sample is based on census data of manufacturing firms active in the Swedish market in the 1997 to 2007 time period, which is provided by the Swedish Agency for Growth Policy Analysis under a strict confidentiality agreement. The data contains direct information of the firm's international linkages to a particular country, reporting imports and exports as well as FDI in form of foreign employment. To capture regular firm behavior, the sample is restricted using three criteria. First, we include firms with basic survival skills that can stand domestic market exposure for at least two subsequent years. Second, we include firms with well-established production platforms in Sweden as indicated by at least 10 domestic employees. Third, we restrict the sample to include firms with Swedish headquarter location as approximated by (at least 50 percent) Swedish ownership.

In Table 1, the sample composition of importers, exporters and multinationals is reported by sector. The average sector trading firm composition consists of 74.6 percent importers and 84.6 percent exporters, displaying that Swedish manufacturing firms are generally well exposed to foreign competition. Most sectors contain a majority of two-way trading firms, indicating that importing and exporting form adjacent decisions.

This pattern conforms to prior descriptive evidence showing that the typical manufacturing trading firm in a small open economy both imports and exports (see, e.g., Andersson et al. 2008). The average share of multinationals is 3.8 percent, indicating that relatively few firms undertake FDI. This pattern, which is also in line with multitude evidence from earlier studies, can be attributed to costs incurred of forming and sustaining global networks. The large variation in composition of importers, exporters and multinationals across sectors indicates that the firm decision to set up international linkages depends on sector-specific factors.

Table 1: The number of importers, exporters and multinationals by sector (period mean)

Manufacturing industry	Firm total	Importers	Exporters	Multinationals
15&16: Food, beverage & tobacco products	426.7	186.8 (43.8%)	178.4 (41.8%)	8.2 (1.9%)
17: Textiles & textile products	80.7	72.6 (90.0%)	76.0 (94.2%)	5.9 (7.3%)
18: Wearing apparel	27.2	24.5 (90.1%)	25.5 (93.8%)	2.1 (7.7%)
19: Leather & leather products	16.8	14.5 (86.3%)	15.5 (92.3%)	1.1 (6.5%)
20: Wood & wood products	398	180.5 (45.4%)	307 (77.1%)	5.7(1.4%)
21: Pulp, paper & paper products	130.3	113.1 (86.8%)	125.9 (96.6%)	6 (4.6%)
22: Publishing & printing,	470.4	123.1 (26.2%)	308.7 (65.6%)	2.7 (0.6%)
23: Coke, ref. petroleum prod. & nuclear fuel	10.2	9.7 (95.1%)	9.2 (90.2%)	0
24: Chemicals & chemical products	173.6	165.8 (95.5%)	168 (96.8%)	9.1 (5.2%)
25: ubber& plastic products	269.2	228 (84.7%)	251.7 (93.5%)	5.4 (2.0%)
26: Other non-metallic mineral products	123.6	93 (75.2%)	100.2 (81.1%)	1 (0.8%)
27: Basic metals	98.6	85.3 (86.5%)	91 (92.3%)	3.3(3.3%)
28: Fabricated metal products	1063	478.6 (45.0%)	683.8 (64.3%)	11.8 (1.1%)
29: Other machinery and equipment	737.4	445.8 (60.5%)	611 (82.9%)	34.3 (4.7%)
30: Office machinery and computers	27.9	24.5 (87.8%)	24.9 (89.2%)	2.1 (7.5%)
31: Electrical machinery and apparatus	203.7	161.3 (79.2%)	170.7 (83.8%)	4.9 (2.4%)
32: Radio, television & communication	73.6	67.3 (91.4%)	66.4 (90.2%)	6.5 (8.8%)
33: Medical, precision and optical instruments	173.8	133.9 (77.0%)	145.9 (83.9%)	11.2 (6.4%)
34: Motor vehicles, trailers & semi-trailers	190.7	129.5 (74.8%)	169.7 (89.0%)	2.2 (1.2%)
35: Other transport equipment	79.3	58.2 (69.7%)	65.6 (82.7%)	0.9 (1.1%)
36: Other manufacturing	253.8	168.5 (66.4%)	214.5 (84.5%)	10.9 (4.3%)

4. Productivity patterns

In this section, we estimate productivity premia to identify firms' productivity ordering with respect to international linkages. Productivity premia are obtained by regressing dummies capturing the firm's international linkages on its productivity using domestic firms as benchmarks. In this respect, we adopt the standard technique of premia estimation in a way that simultaneously takes account of different aspects of firm internationalization. This allows us to capture the separate effect of each international linkage. Our productivity measure is the total factor productivity (TFP) estimated by using the Olley and Pakes (1996) method, where firm productivity is computed in relation to other firms in the sector based on capital stock, employment, and value added data.[6] Our main results are confirmed by alternative productivity measures such

[6] We use investment as a proxy and we used the opreg command in Stata in order to estimate TFP. Data on capital stocks and value added, which are reported in thousand SEK, are adjusted by sectoral producer price indices provided by Statistics Sweden.

as labor productivity (sales divided by the number of employees) and TFP based on an OLS estimation of the production function without addressing endogeneity biases as in the method of Oley and Pakes.[7]

4.1 Unilateral productivity premia in manufacturing

As a benchmark result, we first investigate unilateral aggregate productivity premia of importing, exporting and performing FDI in manufacturing. To do so, we run the following productivity regression equation for firm i at time t:

$$lnTFP_{it} = \alpha_1 D_j + \alpha_2 D_t + \beta_1 D_{it}^{Imp} + \beta_2 D_{it}^{Exp} + \beta_3 D_{it}^{FDI} + \varepsilon_{it}, \quad (1)$$

where $lnTFP_{it}$ is the firm's total factor productivity, D_j and D_t capture industry- and time-specific effects (i.e. 3-digit industries and annual dummies), D_{it}^{Imp}, D_{it}^{Exp} and D_{it}^{FDI} are dummy variables taking the value one if the firm imports, exports and performs FDI, respectively, at the time of observation and ε_{it} is an error term. The β_1, β_2 and β_3 parameters constitute the productivity premia of the three internationalization modes.

The obtained productivity premia are presented in Table 2. The premia are all positive and highly significant indicating that there is a productivity premium within each industry related to each linkage. The estimated premia are slightly lower compared to earlier studies on Swedish firms,[8] which can be attributed to the fact that we disentangle the particular effect linked to each internationalization mode. In studies that estimate the productivity premium in a one-dimensional manner (with respect to, for example, exporting), the obtained premium will often capture multi-dimensional gains from internationalization. This is because firms that import often export and multinational firms typically both import and export to sustain their international production networks. Paired t-tests performed to compare productivity premia show however rather modest differences between the three internalization modes. The only significant difference is the premium of importing exceeding that of exporting.

Table 2. Unilateral productivity premia – mode of internationalization

Internationalization mode	**Productivity premium**
Importer	0.118***
Exporter	0.097***
FDI	0.076***
T-test of premia differences	F-stat (p-value)
H0: Import equals export premium	3.98 (0.05)
H0: Import equals FDI premium	2.12 (0.14)
H0: Export equals FDI premium	0.60 (0.43)

Note: * p < 0.10, ** p < 0.05, *** p < 0.01 based on robust standard errors.

[7] These results are available from the authors upon request.

[8] For example, the exporter premium ranges between 0.10 and 0.16 in Andersson et al.'s (2008) investigation of the Swedish manufacturing industry.

As our results clearly show that each internationalization linkage is associated with higher productivity compared to being domestic but do not provide any clear hierarchical pattern, we turn to investigate whether more linkages compared to less correlates with higher productivity level. To do this, we run the following equation:

$$lnTFP_{it} = \alpha_1 D_j + \alpha_2 D_t + \beta_1 D_{it}^{1L} + \beta_2 D_{it}^{2L} + \beta_3 D_{it}^{3L} + \varepsilon_{it}, \quad (2)$$

where D_{it}^{1L}, D_{it}^{2L}, and D_{it}^{3L} are dummy-variables taking the value one if the firm has 1, 2 or 3 international linkages at the time of observation. The results from this regression are presented in Table 3. The productivity premium increases with the number of linkages as expected, and this pattern is confirmed by highly significant pairwise t-test outcomes. Thus, there is a strict productivity hierarchy from being a purely domestic firm to being a firm with a complex set of international linkages, while, as suggested by our prior result, it is less clear-cut that firm productivity is strongly linked to the mode of internationalization.

Table 3. Unilateral productivity premia – number of linkages

Number of linkages	**Productivity premium**
1	0.082***
2	0.209***
3	0.302***
T-test of premia differences	F-stat (p-value)
H0: One equals two linkages	444.61 (0.00)
H0: Two equals three linkages	12.39 (0.00)

Note: * p < 0.10, ** p < 0.05, *** p < 0.01 based on robust standard errors.

4.2 Bilateral productivity premia in manufacturing

It is important to notice that the above results may be affected by the fact that many of the decisions made by firms are market or country specific due to market-specific sunk costs. Hence a unilateral investigation of linkage premia equalizes the decision of having few and many linkages across markets, as well as the decision of having linkages in close and in distant markets. This calls for estimating the productivity premia on a bilateral level, i.e. for each foreign market. To start, we investigate bilateral productivity premia with respect to importing, exporting and FDI. Thus, we run a firm-productivity regression incorporating market linkages:

$$lnTFP_{it} = \alpha_1 D_j + \alpha_2 D_k + \alpha_3 D_t + \beta_1 D_{ikt}^{Imp} + \beta_2 D_{ikt}^{Exp} + \beta_3 D_{ikt}^{FDI} + \varepsilon_{ikt}, \quad (3)$$

where *k* denotes market, D_k capture market-specific effects (defined by UN's 21 geographical sub-regions) and D_{ikt}^{Imp}, D_{ikt}^{Exp} and D_{ikt}^{FDI} are dummy variables taking the value one if the firm imports from, exports to or performs FDI in the particular market at the time of observation. The market, or sub-regional specific effect, controls for a variation in difficulties to uphold international linkages in different locations, which enable us to compare premia across different markets. Due to technical restraints based on sample size limitations, the estimation

was performed for a random sample of 40 percent of the firm-market combinations amounting to more than 3.6 million observations. The resulting premia estimates are presented in Table 4. The market-based productivity premia of importing, exporting and performing FDI are positive and highly significant. In comparison, the estimated premia display the following ascending productivity ordering: domestic firms without own linkages, importers, exporters and firms performing FDI. The ascending productivity ordering is coherent with self-selection theories depicting that internationalization entails market entry costs that are higher for FDI than trade linkages. The productivity ordering of importers, exporters and firms performing FDI is supported by highly significant t-test results in Table 4. Notably, the importing premium is exceeded by the exporter premium in line with the view that (on-average) market entry costs to exporting exceed those of importing. Hence the bilateral dataset seems to better support a hierarchical pattern compared to the unilateral one.

Table 4. Bilateral productivity premia – mode of internationalization

Internationalization mode	**Productivity premium**
Importer	0.032***
Exporter	0.142***
FDI	0.317***
T-test of premia differences	F-stat (p-value)
H0: Import equals export premium	1702 (0.00)
H0: Import equals FDI premium	164 (0.00)
H0: Export equals FDI premium	62 (0.00)

Note: * p < 0.10, ** p < 0.05, *** p < 0.01 based on robust standard errors. Total number of observations amounts to 3,665,940 and the R-squared is 0.18.

In addition, we run a firm productivity regression incorporating the number of market linkages for the same sample. The resulting premia estimates are presented in Table 5. As in the unilateral dataset, the productivity premium of having 1, 2 or 3 market linkages is positive and highly significant and the pattern is the same as before. That is, the productivity premium increases with the number of market linkages, which is a ranking verified by highly significant t-test results.

Table 5. Bilateral productivity premia – number of linkages

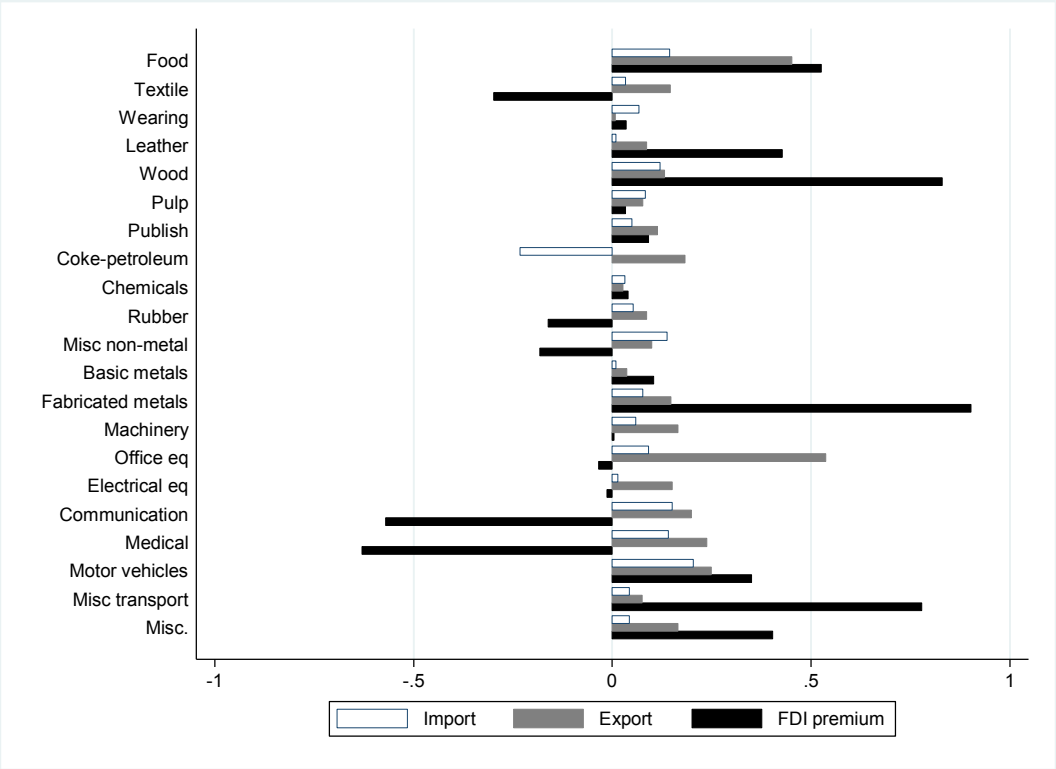
Number of linkages	**Productivity premium**
1	0.138***
2	0.164***
3	0.552***
T-test of premia differences	F-stat (p-value)
H0: One equals two linkages	108 (0.00)
H0: Two equals three linkages	122 (0.00)

Note: * p < 0.10, ** p < 0.05, *** p < 0.01 based on robust standard errors. Total number of observations amounts to 3,665,940 and the R-squared is 0.18.

4.3 Bilateral productivity premia by manufacturing sector

Previous work has suggested large sector variation in the productivity patterns of firms (e.g. Tomiura 2007; Kasahara and Lapham 2013). Therefore, we continue by examining productivity premia by estimating equation (3) for each sector using the bilateral dataset. The obtained (statistically significant) premia are displayed in Figure 1, revealing a discrepant productivity pattern with respect to linkages. In particular, there is only weak indication of a systematic productivity ordering of importers, exporters and firms performing FDI at sector level.

Figure 1: Bilateral productivity premia by sector – mode of internationalization



In Table 6, more detailed information of premia estimates are reported together with productivity ranking patterns indicated by pairwise t-test outcomes. Most of the estimated premia are positive and highly significant. Notably, the FDI productivity premium is significantly negative in a few cases. Possible explanations for a negative FDI market premium could be productivity shocks or other factors affecting the multinational firm's location choices. For example, the textile sector (17) in Sweden has experienced increased competitive pressure inducing firms to increase FDI engagements in countries that have a comparative advantage in labor-intensive production. Also, firms with R&D intensive production, such as those in the medical, precision and optical instruments sector (33), are more prone to undertake tax-planning activities.[9]

The pairwise t-test statistics support that the productivity premium increases from importing to exporting in a majority of cases. This result underpins prior market-based evidence at aggregate manufacturing level. The fact

[9] See Gruber (2003) and Azémar and Corcos (2009).

that this pattern is not uniform across sectors is also consistent with the evidence provided by Kasahara and Lapham (2013). However, our earlier result that the market-based productivity premium increases from exporting to performing FDI is not generally upheld at sector level.

Table 6. Bilateral productivity premia by manufacturing sector – mode of internationalization

Industry	Importer	Exporter	FDI	Nobs	R^2	Imp < Exp	Exp < FDI
15&16	0.143***	0.452***	0.525***	781144	0.23	Yes	No
17	0.033***	0.146***	- 0.298***	148092	0.18	Yes	No
18	0.067***	0.007	0.034	49913	0.15	No	No
19	0.010	0.087***	0.427***	30828	0.34	Yes	Yes
20	0.119***	0.131***	0.830***	729094	0.10	No	Yes
21	0.083***	0.077***	0.033	238732	0.26	No	No
22	0.050***	0.114***	0.092***	861604	0.03	Yes	No
23	- 0.233***	0.183***	-	18693	0.14	Yes	-
24	0.032***	0.027***	0.040	317800	0.48	No	No
25	0.052***	0.086***	- 0.162***	493140	0.11	Yes	No
26	0.137***	0.099***	- 0.182	226254	0.45	No	No
27	0.009*	0.036***	0.104***	180578	0.49	Yes	Yes
28	0.077***	0.148***	0.903***	1946441	0.17	Yes	Yes
29	0.059***	0.166***	0.005	1350929	0.11	Yes	No
30	0.091***	0.537***	- 0.034	51076	0.53	Yes	No
31	0.014*	0.150***	- 0.014	373268	0.20	Yes	No
32	0.150***	0.199***	- 0.571***	134838	0.07	No	No
33	0.141***	0.238***	- 0.630***	318364	0.03	Yes	No
34	0.204***	0.249***	0.350***	348905	0.16	Yes[a]	No
35	0.043**	0.075***	0.778***	145213	0.16	No	Yes
36	0.044***	0.164***	0.403***	465208	0.15	Yes	Yes

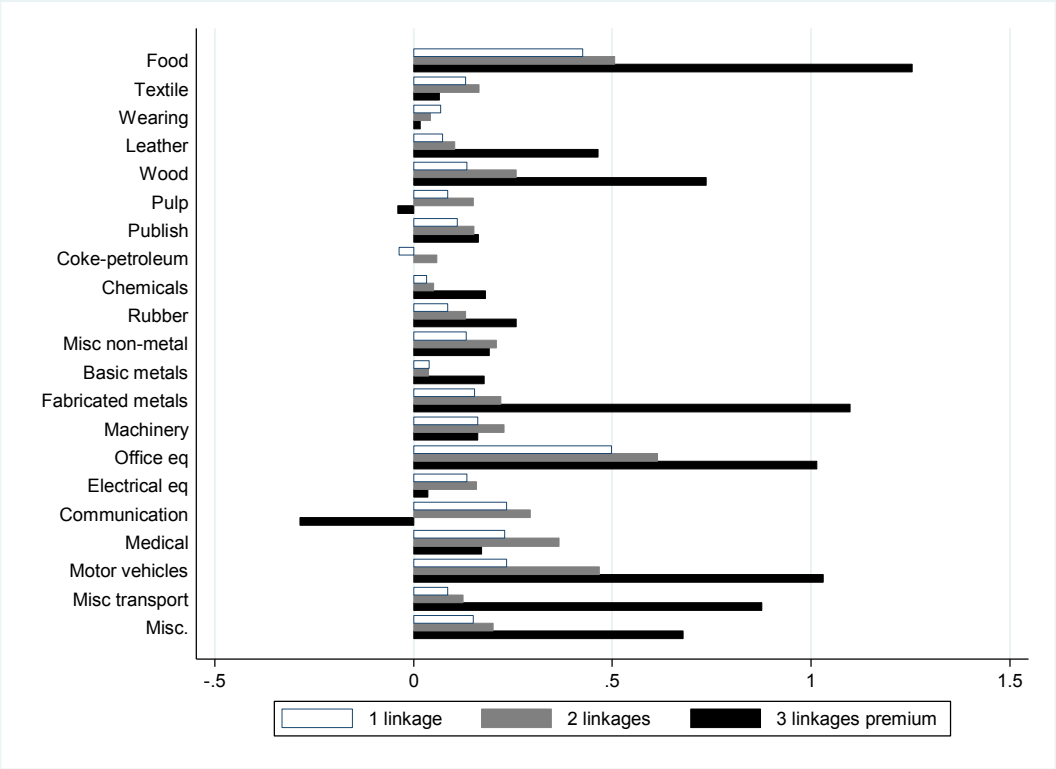
Note: * p < 0.10, ** p < 0.05, *** p < 0.01.
Discrepant parameter coefficients are statistically confirmed at one percent level unless otherwise stated.
[a] Discrepant parameter coefficients are statistically confirmed at five percent level.

The hierarchical pattern is, however, more stable on sector level when we use the number of linkages instead of classifying them by imports, exports and FDI, which is given by the following specification:

$$lnTFP_{it} = \alpha_1 D_j + \alpha_2 D_k + \alpha_3 D_t + \beta_1 D_{ikt}^{1L} + \beta_2 D_{ikt}^{2L} + \beta_3 D_{ikt}^{3L} + \varepsilon_{ikt}, \qquad (4)$$

where D_{ikt}^{1L}, D_{ikt}^{2L} and D_{ikt}^{3L} are dummy variables taking the value one if the firm has 1, 2 or 3 linkages to the particular market at the time of observation. The obtained (statistically significant) productivity premia are displayed in Figure 2, showing that more linkages are generally associated with larger productivity.

Figure 2: Bilateral productivity premia by sector – number of linkages



In Table 7, more detailed information of the estimated productivity premia is presented together with pairwise t-tests. The premia are positive and highly significant for 1 and 2 market linkages in almost all cases and for 3 market linkages in many cases. The pairwise t-test statistics provide general support of a productivity premium increase from 1 to 2 market linkages and evidence of a further ascension from 2 to 3 market linkages for a slight majority of the sectors. These results support our previous result that more productive manufacturing firms engage in more complex market-entry strategies. In particular, there is evidence of a first and second step on a productivity ladder that starts out from a position without market access. The weaker general support of a third step on the productivity ladder correlates with weak support that the highest market-based productivity premium is accrued by firms that perform FDI. For example, for the office machinery and computer sector (29), a productivity ladder is statistically confirmed only with respect to market linkage complexity. This evidence accentuates that the firm's market entry mode is strongly influenced by sector factors.

Table 7. Bilateral productivity premia by manufacturing sector – number of linkages

Industry	1L	2L	3L	Nobs	R^2	1L < 2L	2L < 3L
15&16	0.425***	0.506***	1.255***	781144	0.23	Yes	Yes
17	0.130***	0.165***	0.064*	148092	0.18	Yes	No
18	0.069***	0.042***	0.017	49913	0.15	No	No
19	0.072***	0.103***	0.464***	30828	0.34	Yes[b]	Yes
20	0.134***	0.257***	0.735***	729094	0.10	Yes	Yes
21	0.085***	0.150***	- 0.043	238732	0.26	Yes	No
22	0.110***	0.151***	0.163***	861604	0.03	Yes	No
23	- 0.370*	0.058*	-	18693	0.13	Yes	-
24	0.033***	0.050***	0.180***	317800	0.48	Yes[a]	Yes
25	0.085***	0.130***	0.258***	493140	0.11	Yes	Yes[a]
26	0.133***	0.208***	0.190***	226254	0.45	Yes	No
27	0.040***	0.038***	0.177***	180578	0.49	No	Yes
28	0.154***	0.219***	1.099***	1946441	0.17	Yes	Yes
29	0.162***	0.277***	0.161***	1350929	0.11	Yes	No
30	0.497***	0.614***	1.014***	51076	0.53	Yes	Yes
31	0.134***	0.158***	0.036	373268	0.20	Yes[a]	No
32	0.233***	0.293***	- 0.287	134838	0.07	Yes[b]	No
33	0.123***	0.365***	0.172	318364	0.09	Yes	No
34	0.233***	0.466***	1.030***	348905	0.16	Yes	Yes
35	0.086***	0.125***	0.877***	145213	0.16	Yes[b]	Yes
36	0.150***	0.200***	0.678***	465208	0.15	Yes	Yes

Note: * p < 0.10, ** p < 0.05, *** p < 0.01.
Discrepant parameter coefficients are statistically confirmed at one percent level unless otherwise stated.
[a] Discrepant parameter coefficients are statistically confirmed at five percent level.
[b] Discrepant parameter coefficients are statistically confirmed at ten percent level.

5. Extension: Exploring underlying factors

5.1 Sector characteristics and the mode of internationalization

Since there is large sector variation in the productivity pattern with respect to identified linkages, we continue to explore whether sector characteristics correlate with productivity ascension from importing (*I*) to exporting (*E*) and from exporting to performing FDI (*F*), respectively. To do so, we construct pairwise rank indicators ($RI_{lt}^{I<E}$, $RI_{lt}^{E<F}$) taking the value one if the depicted increase is observed. A dichotomous model is used to assess the probability of observing the productivity ranking *Z* in sector *l* at time *t*:

$$Pr(RI_{lt}^{Z}=1)=\Phi(\alpha_1 D_l+\alpha_2 D_t+\gamma_1 SCALE_{lt}+\gamma_2 CAPI_{lt}+\gamma_3 RESI_{lt}+\gamma_3 MCON_{lt}+\delta_1 WGDP_{lt}+\delta_2 WPOP_{lt}+\delta_3 WDIST_{lt}), \quad (5)$$

where $SCALE_{lt}$, $CAPI_{lt}$, $RESI_{lt}$ and $MCON_{lt}$ is the sector's production scale, capital intensity, research intensity and market concentration at the time of observation and $WGDP_{lt}$, $WPOP_{lt}$ and $WDIST_{lt}$ is the sector's trade-weighted foreign market GDP, population and distance at the time of observation. Equation (5) is identified using a Probit estimation.

The independent variables in equation (5) are measured as follows. The sector's production scale, capital intensity and research intensity is captured by firm averages of total sales, capital stocks per employee and

researcher employment shares.[10] The sector's market concentration is measured in a standard way by the Herfindahl index, which takes the form of sum of squared market shares (calculated from firm sales data). Foreign market GDP, population and (agglomeration-weighted) distance measures comes from the CEPII data set.[11] Trade weights are constructed using bilateral trade data (of total imports and exports) aggregated up from firm level.[12]

In Table 8, we present the elasticities of equation (5) with respect to depicted productivity ascensions. Overall, the results show a rather weak indication of that sector characteristics are behind the productivity increase from importing to exporting and from exporting to performing FDI. The only sector characteristic correlated with a productivity ascension from importing to exporting is the production scale, which indicates that the higher trading premium to exporting is found in production characterized by limited economies of scale or with a high degree of product differentiation. On the other hand, the productivity increase is strongly correlated with several sector-market characteristics. It is observed that sectors linked to smaller, less populated and more distant markets are more likely to uphold the hierarchical productivity pattern. To sum up, our results indicate that a higher trading premium to exporting is found in production with limited economies of scale and low foreign market exposure. That the productivity gap diminishes in more integrated markets where importing firms face similar competitive pressure to exporting firms echoes Greenaway and Kneller's (2003) result that exporting productivity gains can disappear in markets well penetrated by also arms-length trade and FDI.

The estimation results also provide some evidence for the importance of sector characteristics for a productivity ascension from exporting to performing FDI. The productivity increase is moderately or highly correlated with foreign market characteristics and the hierarchical pattern is more likely to be observed in sectors linked to larger, more populated and more proximate markets. These results indicate that the higher FDI premium is found in well-integrated sectors, suggesting that there are larger productivity gains to multinational than trading activity under strong foreign market exposure. Our evidence, which points to firm gains of setting up subsidiaries in more integrated markets, is coherent with the restructuring of the Swedish manufacturing industry (into larger and more competitive firms based within the EU common market) during the period. However, the proximity-concentration trade-off portrayed in the Helpman et al. (2004) paper is largely contradicted by our results. While it is coherent with what could perhaps be regarded as tentative evidence that larger scale economies increase firm gains of foreign sales through exporting relative to FDI, it contrasts to the highly significant result that a distinct FDI to exporting premium gap is more likely observed in more proximate markets. Possibly, this contrasting evidence can be explained by a favorable impact of trade liberalization on cross-border mergers (Neary, 2009).

[10] Data on capital stocks and sales, which is reported in thousand SEK, are adjusted by sector-specfic producer price indices provided by Statistics Sweden.
[11] GDP data is reported in million USD, population data is reported in million inhabitants, bilateral distance data is reported in kilometers.
[12] Descriptive statistics for manufacturing sector characteristics are provided in appendix.

Table 8: Probit estimation results – productivity ascension

Variable/Prod. Rank	Imp < Exp	Exp < FDI
SCALE	- 0.189 (0.006)	- 0.269 (0.112)
CAPI	- 0.004 (0.940)	0.176 (0.232)
RESI	- 0.020 (0.432)	0.039 (0.522)
MCON	0.025 (0.655)	0.130 (0.327)
WGDP	- 0.373 (0.008)	1.357 (0.000)
WPOP	- 0.734 (0.000)	1.073 (0.013)
WDIST	1.577 (0.000)	- 2.614 (0.000)
R2-P	0.836	0.472
Nobs	210	210

Note: P-values in parenthesis based on robust standard errors.

5.2 Firm characteristics and the number of market linkages

Since productivity patterns of market linkage complexity only partly map into those of identified market linkages, our evidence provides no clear indication of a conform sequencing into international engagements. We therefore continue to explore firm characteristics correlated with a higher number of market linkages using a poisson model on firm *i*'s number of linkages to market *k* at time *t*, NL_{ikt}, takes the integer value n:

$$\Pr\left(NL_{ikt} = n\right) = \frac{\boldsymbol{\lambda}_{ikt}^{n} e^{-\lambda_{ikt}}}{n!}, \qquad n = 0, 1, 2, 3 \tag{6}$$

$$\boldsymbol{\lambda}_{ikt} = \alpha_1 D_j + \alpha_2 D_t + \theta_1 lnTFP_{it} + \theta_2 lnSIZE_{it} + \theta_3 lnCAP_{it} + \theta_4 lnRES_{it} + \vartheta_1 lnGDP_{kt} + \vartheta_2 lnPOP_{kt} + \vartheta_3 lnDIST_{kt},$$

where $lnSIZE_{it}, lnCAP_{it}$ and $lnRES_{it}$ is the firm's size, capital stock and research employment at the time of observation and $lnGDP_{kt}, lnPOP_{kt}$ and $lnDIST_{kt}$ is the foreign market GDP, population and distance at the time of observation. The firm's size is measured by its number of employees, and $lnCAP_{it}$ and $lnRES_{it}$, capture the firm's capital and research intensity. Robust-errors Poisson estimations are used to identify equation (6) by sector.

The estimation results are presented in Table 9. These provide general evidence that the firm's number of market linkages depends positively on its productivity, size and capital stock. The strong positive correlation between firm productivity and more complex market-entry strategies confirms our prior results. The result that a firm with larger capital stock establishes more market linkages is in line with previous (two-dimensional) findings that capital-intensive firms are more likely to open up simultaneous import and FDI linkages to integrate foreign input provision in the production chain. Less clear-cut evidence is obtained for the firm's research employment, which receives different parameter signs in a slight majority of significant cases. This discrepant evidence suggests that more detailed information about the firm's R&D investments is needed to pinpoint the implications for its foreign market-entry strategy. Indeed, this strategy is likely to depend on the extent to which research is performed in innovative product development as advocated by Antràs (2005). The estimation results also show that the number of linkages is larger to markets that are larger, less populated and more proximate. These results are highly significant cross-the-board of sectors, providing strong evidence of sequencing into markets with respect to linkage complexity.

Table 9: Poisson estimation results – number of market linkages

Industry	lnTFP	lnSIZE	lnCAP	lnRES	lnGDP	lnPOP	lnDIST	Nobs	LL
15&16	0.37***	0.28***	0.47***	-0.01	0.86***	-0.43***	-0.99***	773141	$-4.5\cdot10^{4}$
17	0.15***	0.56***	0.10***	0.24***	0.92***	-0.31***	-0.79***	146526	$-2.7\cdot10^{4}$
18	0.59***	0.40***	0.18***	-0.24	0.96***	-0.41***	-1.11***	49378	$-8.0\cdot10^{3}$
19	0.18	0.47***	0.09	0.01	1.06***	-0.39***	-0.54***	30498	$-4.1\cdot10^{3}$
20	0.20***	0.58***	0.26***	0.17***	0.83***	-0.32***	-1.07***	721534	$-5.6\cdot10^{4}$
21	0.04***	0.63***	-0.02	-0.18***	0.68***	-0.16***	-0.74***	236238	$-5.6\cdot10^{4}$
22	0.08***	0.56***	0.16***	0.05	0.87***	-0.37***	-0.66***	852673	$-4.9\cdot10^{4}$
23	0.16*	-0.33**	0.15**	-0.21**	0.98***	-0.38***	-0.77***	18504	$-3.1\cdot10^{3}$
24	0.01	0.38***	0.08***	0.01	0.74***	-0.19***	-0.61***	314528	$-8.3\cdot10^{4}$
25	0.11***	0.56***	0.17***	-0.03	0.90***	-0.35***	-0.84***	488038	$-7.8\cdot10^{4}$
26	0.07***	0.48***	0.12***	-0.03	0.88***	-0.37***	-0.85***	223936	$-3.1\cdot10^{4}$
27	0.11***	0.61***	0.07***	0.02	0.82***	-0.21***	-0.68***	178710	$-3.9\cdot10^{4}$
28	0.11***	0.65***	0.10***	0.31***	0.86***	-0.33***	-0.79***	1926385	$-1.5\cdot10^{5}$
29	0.07***	0.68***	0.07***	-0.03**	0.78***	-0.25***	-0.48***	1336897	$-2.4\cdot10^{5}$
30	0.32***	0.35***	0.24***	-0.14***	0.73***	-0.26***	-0.35***	50559	$-1.2\cdot10^{4}$
31	0.04***	0.62***	0.15***	0.05**	0.82***	-0.28***	-0.59***	369361	$-6.2\cdot10^{4}$
32	0.02***	0.38***	0.10***	0.21***	0.84***	-0.29***	-0.40***	133431	$-3.0\cdot10^{4}$
33	0.09***	0.43***	0.08***	0.07***	0.77***	-0.23***	-0.33***	315065	$-7.6\cdot10^{4}$
34	0.04***	0.46***	0.11***	0.07***	0.91***	-0.35***	-0.73***	345365	$-4.4\cdot10^{4}$
35	0.04***	0.35***	0.14***	-0.01	0.94***	-0.41***	-0.48***	143710	$-2.1\cdot10^{4}$
36	0.23***	0.45***	0.22***	0.40***	0.95***	-0.45***	-0.92***	460330	$-5.3\cdot10^{4}$

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6. Main conclusions

In this paper, we investigate the hierarchy of international linkages with respect to importing, exporting and performing FDI as well as linkage complexity. In contrast to prior work by Tomiura (2007), we focus on market-specific or bilateral linkages. Using Swedish manufacturing firm data for the 1997 to 2007 period, we find strong evidence of hierarchical structures based on productivity ascension from importing to exporting and then to performing FDI and an increasing linkage complexity. This evidence is in line with self-selection theories devising that higher market entry costs are entailed in opening up FDI compared to trade linkages (Antràs and Helpman 2004; Helpman et al. 2004). However, the hierarchy from importing to performing FDI is not generally upheld at sector level. Our evidence confirms a productivity ascension from importing to exporting and from exporting to performing FDI for a majority of sectors but, interestingly, these productivity gaps often prevail in different sectors. Indeed, there is a lot of sector variation in productivity ordering patterns. For example, in coherence with evidence provided by Kasahara and Lapham (2013), the importing premia exceeds the exporting premia in a few sectors.

The sector-specific productivity ordering patterns that prevail with respect to importing, exporting and performing FDI highlights the importance of disentangling premia of these linkages in the analysis. In fact, as the productivity ordering increases with market-entry complexity, a basic estimation of importing, exporting or FDI premia that does not take other linkages into account will clearly be upward biased. The sector variation in productivity ordering with respect to identified linkages motivated the further exploration of sector

characteristics underlying a productivity ascension from importing to exporting and from exporting to performing FDI, respectively. Interestingly, our indicative evidence suggests that different characteristics underlie importing-exporting and exporting-FDI productivity gaps. In particular, the superior trading premium to exporting is less likely to be found in more integrated markets where the probability is higher of observing an FDI to exporting premium gap.

The hierarchical structure with respect to linkage complexity is generally upheld at sector level. Combined with the more discrepant results obtained with respect to identified linkages, this result suggests that there is no conform sequencing into internationalization strategies. For this reason, we extend the analysis to explore firm characteristics behind the expansion of market linkages. Besides supporting prior evidence that firm productivity is a key factor behind linkage complexity, the estimation results indicate that larger and more capital-intensive firms engage in more complex market entry strategies. Capital intensity has been revealed to be a key factor behind the use of foreign subsidiaries in vertical production chains (Yeaple 2006; Corcos et al. 2013; Thede 2014), but there is little evidence of that this factor plays a role for more complex internationalization strategies.

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Appendix

Table A1: Manufacturing sector characteristics (period mean)

Ind/Var	$RI^{I<E}$	$RI^{E<F}$	SCALE	CAPI	RESI (10^{-4})	MCON (10^{-3})	WGDP (10^{-5})	WPOP (10^{-1})	WDIST (10^{-2})
15&16	1.0	0.3	468.0	3.9	14.9	28.8	19.1	7.0	26.9
	(0.0)	(0.2)	(16.8)	(0.2)	(0.9)	(1.2)	(0.7)	(6.7)	(0.6)
17	1.0	0.1	192.6	2.8	23.2	52.6	14.3	7.4	21.8
	(0.0)	(0.1)	(2.0)	(0.1)	(1.1)	(2.0)	(0.7)	(0.4)	(0.3)
18	0.0	0.6	100.7	1.1	2.2	66.6	8.5	6.7	15.6
	(0.0)	(0.2)	(7.9)	(0.0)	(1.3)	(5.1)	(0.4)	(0.8)	(0.4)
19	0.8	0.8	150.6	1.4	5.1	249.6	12.7	6.8	24.0
	(0.1)	(0.1)	(5.4)	(0.1)	(2.1)	(7.7)	(0.6)	(0.6)	(1.2)
20	0.7	1.0	296.3	5.1	4.5	18.0	14.4	5.5	21.0
	(0.2)	(0.0)	(9.5)	(0.1)	(0.4)	(2.4)	(0.7)	(0.1)	(0.5)
21	0.2	0.6	2018.1	13.5	31.7	44.8	12.8	6.5	19.3
	(0.1)	(0.2)	(47.8)	(0.7)	(1.3)	(1.7)	(0.7)	(0.3)	(0.2)
22	0.7	0.2	192.2	2.2	38.4	9.5	9.2	6.0	15.3
	(0.2)	(0.1)	(3.0)	(0.0)	(1.7)	(0.4)	(0.5)	(0.9)	(0.7)
23	1.0	0.2	1452.6	11.9	178.1	230.7	19.8	7.2	32.6
	(0.0)	(0.1)	(145.0)	(1.2)	(19.9)	(13.9)	(1.7)	(0.3)	(2.1)
24	0.6	0.8	1176.2	6.7	491.8	205.5	24.2	8.9	31.1
	(0.2)	(0.1)	(138.0)	(0.2)	(15.1)	(30.8)	(2.4)	(0.5)	(0.9)
25	1.0	0.5	246.6	2.9	13.8	12.2	14.6	6.2	19.8
	(0.0)	(0.2)	(4.0)	(0.1)	(0.4)	(0.4)	(0.5)	(0.1)	(0.3)
26	0.9	0.4	432.3	2.5	16.5	31.8	14.9	6.1	17.8
	(0.1)	(0.2)	(11.5)	(0.0)	(1.1)	(0.9)	(0.5)	(0.2)	(0.3)
27	0.5	0.7	949.7	4.8	47.2	60.4	17.7	26.9	24.9
	(0.2)	(0.2)	(15.2)	(0.2)	(4.2)	(5.2)	(0.7)	(1.5)	(0.3)
28	1.0	0.5	182.8	2.3	12.6	28.7	16.1	8.1	23.7
	(0.0)	(0.2)	(2.3)	(0.1)	(0.8)	(4.5)	(0.6)	(0.3)	(0.4)
29	1.0	0.2	426.4	1.9	32.2	12.6	21.0	10.1	33.8
	(0.0)	(0.1)	(21.7)	(0.0)	(3.4)	(1.1)	(0.8)	(0.5)	(0.3)
30	1.0	0.3	384.4	3.5	105.6	113.1	27.3	12.4	38.8
	(0.0)	(0.2)	(11.9)	(0.3)	(2.1)	(1.5)	(1.7)	(1.1)	(0.5)
31	0.9	0.2	363.0	1.8	50.3	68.8	14.9	14.1	32.8
	(0.1)	(0.1)	(8.4)	(0.1)	(2.7)	(9.4)	(0.3)	(1.4)	(1.3)
32	0.8	0.2	2180.8	1.7	152.7	510.0	18.9	21.1	50.3
	(0.1)	(0.1)	(369.6)	(0.2)	(18.9)	(74.3)	(1.4)	(0.7)	(1.2)
33	0.9	0.2	590.6	1.8	143.0	94.2	27.9	13.3	41.0
	(0.1)	(0.1)	(22.7)	(0.0)	(5.7)	(6.4)	(2.0)	(0.7)	(0.6)
34	0.4	0.2	1899.6	4.9	44.7	158.2	23.3	8.2	26.7
	(0.2)	(0.1)	(63.8)	(0.2)	(5.6)	(10.7)	(1.0)	(0.2)	(0.6)
35	0.7	1.0	779.5	1.8	77.7	142.6	41.9	14.5	42.1
	(0.2)	(0.0)	(40.8)	(0.0)	(6.7)	(7.5)	(1.8)	(0.5)	(1.3)
36	0.9	1.0	250.5	1.1	3.7	40.8	14.3	7.3	19.8
	(0.1)	(0.0)	(12.8)	(0.1)	(0.6)	(9.9)	(0.6)	(0.2)	(0.8)

Note: Standard errors are reported in parenthesis.