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Core product competence and productivity gains: the role of foreign ownership

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ABSTRACT
Recent theoretical contributions provide predictions about the effects of core product competence on firms' productivity. However, we know little about the influence of foreign ownership on core product competence that might also lead to productivity gains across firms. This paper uses firm-level data for 137 countries to investigate how foreign ownership affects firms' decision to become specialised at core products and the subsequently firm productivity gains. To tackle the possible endogeneity of foreign ownership, the instrumental variable approach and the propensity score matching technique are employed. The results show that foreign ownership has a positive and significant effect on firms' core product competence and this positive effect leads to productivity gains, especially for the most productive firms. We further reveal that foreign competition within an industry encourages firms to become specialised at core products, which could further lead to productivity gains across firms.

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1. Introduction

UNCTAD (2019) records that the global flows of foreign direct investment (FDI) reached \$1.3 trillion in 2019, just one year right before the COVID-19 shock, with 54% of that amount flowing into developing countries. The large volume of FDI inflows received by developing countries suggests the importance of the participation of multinational firms in their economic development. Indeed, existing studies often suggest productivity spillovers from multinational firms in developing countries. These facts can be explained via input sourcing linkages between the firms (see, Javorcik 2004; Newman et al. 2015; Mei 2021; Alfaro, Manelici, and Vásquez 2022, among others). Studies by Arnold and Javorcik (2009), Chang, Chung, and Moon (2013), and Ç. Bircan (2019) also find that foreign ownership leads to greater productivity gains for foreign acquired firms and that these firms ultimately

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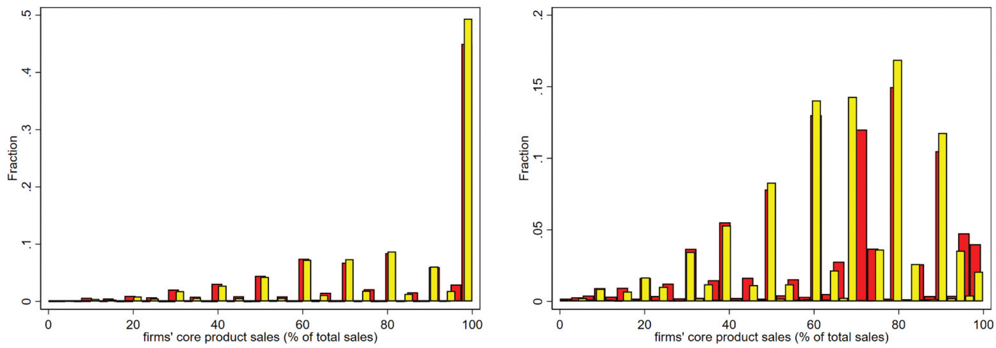

Figure 1. Distribution of Core Product Competence: Foreign vs Domestic Firms.
Notes: Core product competence is measured by the core product sales over total sales. The figureshows the fraction of core product competence between foreign-owned firms (the red bar-chart) anddomestic-owned firms (the yellow bar-chart).

outperform local firms. There is, however, a less emphasised explanation concerning how foreign ownership and the core product concentration, under the multi-product firm framework, raise firms' productivity.

Most firms offer multiple products; Hottman, Redding, and Weinstein (2016) shows that 69% of firms supply more than one product type and that these firms account for more than 99% of output in their sectors. From our data, we also find that most firms have core product sales of less than 90% of total sales. It indicates that multi-product firms are the norm rather than the exception. As Eckel and Neary (2010) suggest, the technology of multi-product firms is characterised by a core competence and flexible manufacturing, and that the marginal cost is assumed to be the lowest for the core product with the most efficient production process. By assuming that multi-product firms have their own core competencies and that they are less efficient in the production of varieties outside these competencies, Eckel and Neary (2010) find that productivity increases as firms concentrate on their core product lines following a decrease in product variety. When opening up to the international market, firms have been found to respond to foreign competition by dropping their worst-performing products and reallocating resources towards the most competitive product lines (Bernard, Redding, and Schott 2011; Mayer, Melitz, and Ottaviano 2014).

In an attempt to shed light on the matter, this paper focuses on the mechanisms of productivity gains resulting from the skewed focus on firms' core product competence induced by foreign ownership. To visualise the idea that foreign ownership induces firms to become specialised at core products, we plot the distribution of core product competence across foreign-owned firms and domestically owned firms in Figure 1. The figure on the left shows that the foreign-owned firms indeed focus more on their core product lines, compared to the domestically owned firms; on average, the trend (red-bar) is skewed towards the right-hand side of the distribution for foreign-owned firms. We further plot the density distribution of the core product competence by dropping those firms with 100% core product sales (figure on the right). This figure shows more clearly that the distribution is more skewed for the foreign-owned firms. The stylised fact motivates this paper to exploit the potential channels for explaining productivity gains through foreign ownership and core product concentration.

To measure core product competence, we use data on firms' reported core product sales over the total sales, and construct a *two-step* strategy to estimate the impact of core competence originating from foreign ownership on productivity. As there is a difficulty to identify the causal effect when foreign ownership is potentially correlated with other unobservable factors, namely the selection issue, our estimation strategy comprises instruments and matching technique to ease the concern. Besides, in order to rule out the unobservable effects and several alternative explanations for the findings, we control for foreign inputs, R&D investment, foreign technology acquisition, and all time-invariant and specific-time trends throughout the specifications. Based on the firm-level data across 137 countries through the period 2006–2017, our results show that foreign ownership exhibits a positive and statistically significant effect on core product competence, and that this positive effect ultimately leads to productivity gains. We also find that foreign competition within an industry encourages firms to become specialised at core products, which could further lead to productivity gains across firms.

The paper proceeds as follows. Section 2 provides an overview of FDI and the literature on multi-product firms. Section 3 describes the data and variables employed to estimate the core product competence and foreign ownership. Section 4 describes the empirical method and the exogeneity of foreign ownership. Section 5 provides the empirical results and the conclusions are presented in Sections 6.

2. Relationship to the literature

Over past decades, exploring productivity differences across firms has become the focus of a still-expanding literature. It is generally believed that multinational subsidiaries generally outperform domestic firms. Guadalupe, Kuzmina, and Thomas (2012) find that multinationals provide fundamental links that allow foreign acquired firms to access product innovations and market access, resulting in productivity gains. Such input materials supplied by local firms to foreign firms via backward linkages also have substantial effects on local firms productivity. Focusing on Lithuania, Javorcik (2004) shows that the presence of foreign ownership generates positive externalities via backward linkages to local input suppliers. Blalock and Gertler (2008) find evidence of productivity gains for firms that supply inputs to multinationals in Indonesian manufacturing. While Arnold and Javorcik (2009) focus on the causal relationship between foreign ownership and plant performance, Haskel, Pereira, and Slaughter (2007) focus on whether the productivity of domestic plants is correlated with foreign ownership. Both studies confirm productivity improvement through foreign acquisition.

However, the multi-product firms and trade theories, such as Eckel and Neary (2010), Bernard, Redding, and Schott (2011), and Mayer, Melitz, and Ottaviano (2014), for instance, have provided predictions regarding how core product competence responds to product market competition for multi-product firms have proven to be alternative mechanisms to explain firm productivity. Broadly speaking, increased competition in the domestic market reduces firms' product scope, which encourages firms reallocate resources towards higher-attribute product lines and simultaneously leads to productivity gains. In the studies Eckel and Neary (2010) and Mayer, Melitz, and Ottaviano (2014), each firm is characterised by a core competence and flexible manufacturing and assumed to have a core product that uses the most efficient production process. The marginal cost varies across varieties but is constant over the quantity produced. As illustrated, the firm's core product uses the most efficient production process so that the marginal cost is the lowest for the core variety. Each additional variety entails an additional marginal[1] and customisation costs and pulls a firm away from its core competence. Eckel and Neary (2010) further emphasise that varieties further from the firm's core competence have higher labour requirements and, in the context of price-weighted output, lower productivity.

Bernard, Redding, and Schott (2011) reach a similar conclusion, developing a model in which firms respond to trade liberalisation through product market competition. Bernard, Redding, and Schott (2011)show that increased product-market competition coming from international trade enhances the zero-profit cut-off and reduces the average prices of varieties supplied by competing firms, which lowers mark-ups and increases within-firm productivity. The surviving firms respond to this market adjustment by dropping the products that have lower values in terms of product attributes and so experience increases in productivity. Mayer, Melitz, and Ottaviano (2014) also highlight that increases in the market size, technology improvement (which may occur through the presence of foreign ownership) and product substitutability (within the expanded product range) lead to tougher competition and thus further encourage firms to skew their production towards their better-performing products. Further, Eckel and Neary (2010) show that the net effect of globalisation is a fall in product scope, i.e. it encourages firms to prune their product lines by concentrating on their core competencies in order to respond to the greater market competition effects. Thus, tougher market competition shifts down the distribution of mark-ups across all products and induces firms to reallocate resources towards their better-performing products; this constitutes an improvement in productivity.

While the literature has emphasised the impact of competition pressure linked to multi-product firms and international trade, similar effects from FDI with ownership advantages (e.g. firm-specific assets and knowledge capital) accruing to the local firms in the host country may also be expected (Markusen 1995). A number of studies have thus attempted to assess the effect of multinational firms on mark-ups. For instance, in the study by Stiebale and Vencappa (2018), the authors look at the relationship between foreign acquisition, mark-ups, marginal costs and product quality. Using firm product-level data for India, they find that while foreign multinational firms increase the quality of products produced by the firms they acquire, acquisitions are associated with higher mark-ups and lower marginal costs, on average. This result implies that productivity spillovers may occur through an increase in the quantities of existing products. Using Turkish data, in contrast, Ç. Bircan (2019) finds that foreign competition leads to a reduction in prices following acquisition but that the evidence regarding mark-ups is insignificant. Focusing on the competitive effects of trade and FDI on mark-ups, Weche (2018), who uses six European countries comprising 145,477 firm-year observations for 34,895 individual firms through 2006 to 2013, finds no significant effect of FDI penetration on domestic mark-ups. On the other hand, Chung (2001) finds that a foreign presence introduces additional competitors and leads to lower mark-ups in the domestic market. However, Aitken and Harrison (1999) argue that multinational firms have both positive and negative influences on market competition based on an empirical analysis of Venezuelan plants. By introducing additional competitors, foreign firms harm incumbents' productivity by spreading their fixed costs across fewer, increasing the average cost and compressing mark-ups.[2]

However, the existing empirical findings on the effect of increased competition induced by the presence of multinational firms remain ambiguous, and how foreign ownership of firms alters product market competition and further alters firms' core product production, which may result in productivity improvement, is still unclear. As mentioned, firms respond to increased foreign competition by dropping their worst-performing products, as the increased competition lowers mark-ups across all product lines. Firms' productivity declines when the product variety increases, as increased variety pulls firms away from their core competencies due to the additional cannibalisation effect. Each additional product diminishes the demand for a firm's existing products and thus firms are encouraged to focus on their core competencies and drop marginal high-cost varieties, resulting in productivity improvement as firms become more concentrated on their core product lines (Mayer, Melitz, and Ottaviano 2014; Eckel and Neary 2010).[3]

Given that firms may reallocate resources towards higher-attribute products and change product compositions because of increased foreign competition, Alfaro and Chen (2018) offer empirical support to emphasise the mechanisms by which multinationals influence the performance of domestic firms through product reallocations. They find that the entry of multinationals into a domestic product space leads to a negative market reallocation effect. However, due to the absence in the analysis of a direct link to firms' core product competence, their finding may only provide evidence of an indirect mechanism for adjusting product composition through multinationals. As mentioned above, the existing literature on FDI has rarely focused on firms' core product competence to explain the features of foreign ownership and core product concentration on productivity gains. To the best of our knowledge, there is no evidence on how foreign ownership affects a firm's core product competence and results in productivity improvement.

3. Data and variables

We investigate empirically the impact of foreign ownership on firm productivity via core product competence. We use firm observations in manufacturing and services through 137 countries[4] during the period 2006–2017 compiled by the World Bank Enterprise Surveys (WBES). Because there is a very small proportion of firms that are repeatedly surveyed in a different years (also see Webster and Piesse 2018), the nature of the data restricts our analysis to cross-section rather than a panel. However, the database provides variables that have been identified in the recent empirical literature, e.g. Gorodnichenko, Svejnar, and Terrell (2010), Schiffbauer and Ospina (2010), Commander and Svejnar (2011), Gorodnichenko and Schnitzer (2013), Godart and Görg (2013), and Gorodnichenko, Svejnar, and Terrell (2014), as determinants of productivity at the firm level.[5] This allows us to isolate the effects of foreign ownership and core product concentration on measures of productivity. While the recent use of other micro datasets also allows for detailed empirical analysis that helps reduce the problem of unobserved

Table 1. Core product competence, firm size, and foreign ownership.

	All	Small	Medium	Large
Firms with core product sales ≥90%	55,202	25,682	18,944	10,576
→Foreign-owned firms (foreign ownership ≥50%)	3,897	1,012	1,305	1,580
→Firms with at least 1% foreign ownership	5,060	1,271	1,702	2,087
→Domestic-owned firms (foreign ownership <50%)	51,305	24,670	17,639	8,996
Firms with core product sales <90%	60,044	27,219	20,533	12,292
→Foreign-owned firms (foreign ownership ≥50%)	5,169	1,276	1,773	2,120
→Firms with at least 1% foreign ownership	7,152	2,194	1,811	2,969
→Domestic-owned firms (foreign ownership <50%)	54,875	25,943	18,760	10,172

This table reports the number of firms in each category. Firm size is consistently stratified by the WEBS. See https://www.ecb.europa.eu/events/pdf/conferences/ws_surveydata/Session_3paper_Rodriguez_Mesa.pdf?dc3e120720dcc2b8adcfd5baebfcf707, World Bank Enterprise Survey Data Report for more details.

heterogeneity across firms, the lack of disaggregate information on core product information limits the scope of the analysis. As WBES not only provides detailed information on the degree of core product sales but also provides other firm-level characteristics, it is believed to be a better environment to answer the research question in this paper.

3.1. Foreign ownership and core product competence

The WBES provides information on foreign ownership across firms, measured in percentage. We follow Kokko (2004), Sembenelli and Siotis (2008), Guadalupe, Kuzmina, and Thomas (2012),[6] and Weche (2018) to define a firm as a foreign-owned if it has foreign ownership of at least 50%; otherwise, it is defined as a domestic firm. The data do not cover any further information related to the types of FDI projects.

Another key variable is the firm's core product competence. The WBES contains information on the main product sales recorded as a proportion of a firm's total sales. This crucial feature allows us to examine the alteration of firms' core product competence through foreign ownership. Overall, 115,246 firms are observed with information on core product competence (see Table 1); of which, 55,202 firms' core product sales are large than 90%. 46.5% of 55,202 firms are small firms (with the number of employees less than 20), and about 19.1% are large firms (with the number of employees large than 100). Of all 55,202 firms, about 7% (3,897/55,202) are foreign-owned, and 9.16% (5,060/55,202) acquire foreign ownership (foreign ownership ≥1%). For the large firms of 55202 firms, about 15% (1,580/10,576) are foreign-owned and almost 19.7% (2,087/10,576) acquire foreign ownership (foreign ownership ≥1%). By contrast, 45.3% of 60,044 firms (i.e. firms with core product sales less than 90%) are small firms, and about 20.47% are large firms. Of all 60,044 firms, 8.6% are foreign-owned, and 12% acquire foreign ownership at least 1%. For the small firms of 60,044 firms, 4.7% are foreign-owned, while 17.2% of large multi-product firms are foreign-owned. Given that both firms with core product sales below and above the cut-off 90% are dominated by small firms, it infers that a firm's size might not be the determinant of core product selection. In contrast, there are more firms with foreign ownership that have core product sales less than 90%, implying the potential relationship between production reallocation and foreign acquisition across firms.

The dataset follows a four-digit International Standard Industrial Classification Revision 3.1 and provides product description over each core product code. The product codes describe narrow product categories. Examples can be found as follows: (1) coke, chemicals, and plastics (sectors 23–25) producing the products HDPE pipe (product code 6) and Fundas plastic (product code 15,218); (2) electrical, machinery, communication (sectors 31–33), with products including watches (product code 81,239), etc. Table C1 of Appendix C provides examples of the product codes with descriptions. The core product description shows details of the core product each firm engages in other than a broader category instead. In overall, there are 78,987 unique core products and 36,259 repeated core products reported throughout the firms. Of 78,987 unique core products, 42454 products belong to firms having core product sales less than 90%. Of 36,259 repeated core products, 17590 products belong to firms having core product sales less than 90%. As these product codes are highly disaggregate and the repeated core products reported by firms are dominated by both domestic and foreign firms, we employ these codes in the matching estimation to mitigate the selection issue in foreign ownership (further discussed in section 4.1).

3.2. Further variables

The dataset covers other characteristics of a firm, such as its size and whether it is a part of a large establishment. In terms of firm size, 17% of firms report being part of a large establishment, and 15% of large establishments are attributed to foreign-owned firms. About 20% of firms are large firms, 46% are small firms, and the rest are medium-sized. The dataset also contains other information regarding firms' activities. For example, the number of employees that each firm had during the survey year and three years before the survey, the total sales each firm had three years before the survey took place, firms' core product production location[7] and headquarters. Additionally, following Webster and Piesse (2018) we merged WBES data with the World Bank Development Indicators including FDI net inflows (*fdini*), the growth rate of GDP (*gdpg*), the trade openness (*trade*), and the share of natural resource rents over GDP (*tnrr*). These country-level variables are implemented for the matching procedure, discussed further below. The summary statistics are provided in Table 2.

4. Empirical framework

4.1. Exogeneity of foreign ownership: 2SLS and matching

A particular concern around the use of foreign ownership in the analysis is the possible endogeneity (i.e. self-selection) based on unobserved characteristics. For instance, a network of specialised domestic suppliers of intermediate inputs might be an attractive choice for a multinational to invest in, and domestic firms with a good network might have a capacity to select key product lines, and so might end up with higher performance levels. While product location choice might depend upon the trade-off faced in choosing where to produce close to their customers and where production costs are lower (Arkolakis et al. 2018), firms who locate production outside of their home markets might have better networks compared to others. When firms operate through a network in multiple areas, technological improvement developed in one location may be shared with other sites for efficiency gains. The more a firm establishes a network across industries, the higher the probability that it

Table 2. Summary statistics.

Variable	Mean	SD	Min	Max	Obs
Foreign Ownership Share	7.699	24.716	0	100	115,246
Foreign Dummy	0.078	0.269	0	1	115,246
Core Product Competence	82.310	22.800	0	100	115,246
lnSales	16.790	3.180	−0.219	33.845	94,238
lnSales3years	16.625	3.349	−1.093	37.132	81,915
Markups	2.701	0.999	−2.985	11.367	34,116
lnTFP1	4.190	1.252	−12.893	22.711	34,530
lnTFP2	4.047	1.274	−13.296	22.708	34,451
lnK	12.532	5.350	−1.093	28.815	44,777
lnM	12.259	3.539	−0.377	30.166	83,678
lnL	14.726	3.076	−0.377	30.420	92,085
Sector	7.439	4.496	1	12	114,960
Size	1.739	0.767	1	3	115,246
Age	24.855	15.889	1	348	113,733
Headquarters	0.169	0.375	0	1	115,246
mplinelocat	1.645	0.654	0	1	76,950
Sibling	0.176	0.380	0	1	112,133
DExport	7.475	22.063	0	100	114,229
emp	127.598	8,904.385	0	999,999	101,367
emp3years	98.033	802.991	0	170,000	105,133
foreign licencing	1.856	0.350	1	2	78,232
R&D	0.220	0.414	0	1	75,944
tnrr	7.093	8.080	0	54.169	112,300
trade	68.944	31.498	19.458	183.405	113,097
Nat_Sales	89.525	25.842	0	100	114,525
gdp_g	4.510	4.067	−14.814	20.880	113,749
fdini	3.542	4.124	−5.670	37.249	113,484
lnemp_3y	3.197	1.429	0	12.043	104,892

ForeignOwnershipShare is measured in percent from 0 to 100%). *ForeignDummy* is a dummy variable equals one if the firm has at least 50% foreign ownership. *CoreProductCompetence* is measured in a share of core product sales over the total sales (in %). *lnSales3years* is a natural logarithm of real sales. *Markups* is a natural logarithm of real sales three years ago. *lnK* is measured in the natural logarithm (see Appendix A). *lnM* is a natural logarithm of capital stock. *Sector* is a natural logarithm of material uses. *lnL* is a natural logarithm of labour cost. *Sector* is the ISIC 4-digit sectors classified. *Size* is 1 if small firm (<emp20); 2 if medium firm (emp20–99); 3 if large firm (>=emp100). *Age* is measured as the survey year minus the year the firm established. *Headquarters* equals 1 if headquarters and 0 otherwise. *mplinelocat* is 0 if Local (products sold mostly in the same municipality where the establishment is located) and National (products sold mostly across nations where the establishment is located), 1 if International (products sold mostly to nations outside the country where the establishment is located). *Sibling* measures the number of siblings the firm has. For the Matching Procedure: *DExport* is the share of direct export over total sales. *emp3years* is the number of employees three years ago. *tnrr* is the total natural resources rents (% of GDP). *trade* represents trade openness. *Nat_Sales* represents national sales. *gdp_g* is the GDP growth rate. *fdini* is the net inflow of FDI (% of GDP). *lnemp_3y* is the number of employees three years ago. All real variables are deflated by the consumer price index (2010 = 100), provided by the World Bank World Development Indicators database.

will be selected by a multinational. Furthermore, Brambilla (2009) points out that foreign firms might choose the location that provides a more favourable environment for the innate characteristics of the product and industry-specific regulations, while Stiebale and Vencappa (2018) show that technology transfer involves a network connection; these are all correlated with selection by a foreign multinational. Such operation strategies might potentially be reflected by firm productivity levels, and might be highly correlated with selection by a multinational, too. This interdependence across firms may explain a part of the variation in the foreign ownership variable and should be filtered out beforehand.

To address the endogeneity issue, we run a variety of checks with three potential determinants of foreign ownership, explained above and further below, prior to estimating the relationship between foreign ownership and the outcome variable. First, a Durbin – Wu–Hausman endogeneity test[8] is performed under a two-stage estimation. The *first-stage* is given below:

$$F_{i,s,c,t} = \beta_0 + \beta_{Sib} Sib_{i,s,c,t} + \beta_{CPL} CPL_{i,s,c,t} + \beta_{HQ} Headquarters_{i,s,c,t} + f_s + f_c + f_t + f_s \times Year + f_c \times Year + \xi_{i,s,c,t} \tag{1}$$

where F represents the *Foreign Ownership Share* and, alternatively, the *Foreign Dummy* for each firm i across sector S in country c at time t. The former is measured in percentage terms (%), while the latter is defined as a dummy which is equal to 1 if the firm has foreign ownership of at least 50%. $Sib_{i,s,c,t}$ indicates whether the firm is a part of large establishment. More siblings (i.e. whether the firm is a part of establishment) might simply indicate that a firm has a good industrial network. This helps us to isolate the potential selection effect from multinationals and the reverse causality from foreign ownership. $CPL_{i,s,c,t}$ represents the location of a firm's main product line (main product line located in domestic 0; in foreign origin 1). As mentioned, this variable helps us to isolate the potential effect exerted by multinationals that might choose to invest in firms which have core product lines located abroad to favour their core product introduction and techniques implemented. $Headquarters_{i,s,c,t}$ indicates whether the firm involves headquartered (1 if a firm is headquartered and 0 otherwise). Since foreign affiliate and headquarters exhibit a strong positive co-movement (Cravino and Levchenko 2017), and headquartered firms are more likely to be financially independent of the rest of the establishment, multinationals might therefore be attracted by this feature, hence further influencing multinationals' selection decisions. It is also important to control for the possibility that particular sector and country might be more prone for FDI than another. Hence, the rest of the variables f_s, f_c, and f_t refer to the sector, country and time fixed effects. The specification also adds country- and sector-specific time-trends that not only allow for the dynamic response through countries and sectors, but also control for the effect of unobservables that might exist through market conditions and common technology over time (Stiebale and Vencappa 2019).[9]

After the regression has proceeded, we extract the residual $F\_res_{i,s,c,t}$ from the regression and then perform an augmented regression (*second-stage*):

$$CoreProdCom_{i,s,c,t} = \beta_0 + \beta_F F_{i,s,c,t} + \beta_{F\_res} F\_res_{i,s,c,t} + f_s + f_c + f + f_s \times Year + f_c \times Year + \in_{i,s,c,t} \tag{2}$$

where the small p-value (0.0006 and 0.0009 for the residuals of *ForeignOwnership* and *ForiegnDummy*) indicates a rejection of the null hypothesis that $\beta_{F\_res} = 0$, suggesting the potential correlation between the error term and the foreign ownership variable. The assumption of foreign ownership being exogenous is thus problematic.

Based on the evidence, we begin our analysis by taking into account the endogeneity of foreign ownership in Eq. (1) using two different strategies. First, we apply a two-stage least squares (thereafter, 2SLS)[10] with instruments *Sib*, *CPL* and *Headquarters* to mitigate the potential endogeneity of foreign ownership variable. Figures 2, 3 and 4 provide the distributions across the three variables, showing that firms with high foreign ownership are highly associated with core product production located outside the home country, with more plants operating through locations, and with a high probability of being a headquartered firm. These findings are remarkable given that the exogeneity of foreign ownership is mitigated under the correlated variables. The figures further support the

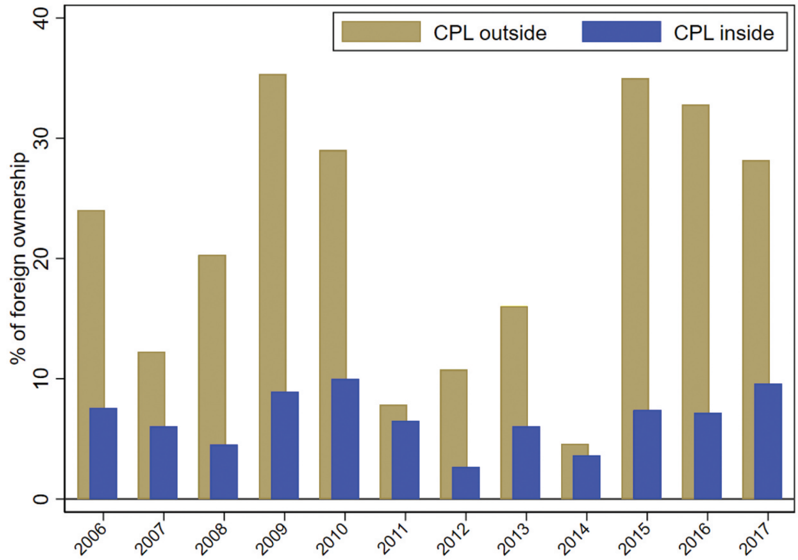

Figure 2. Distribution of the core product location.
Notes: Core product location is measured as 0 if the core product production lines are located domestically, whereas 1 if located in foreign origin. We checked if the mean is driven by the 100% foreign ownership. By dropping out the 100% foreign ownership, we find no change for the trend.

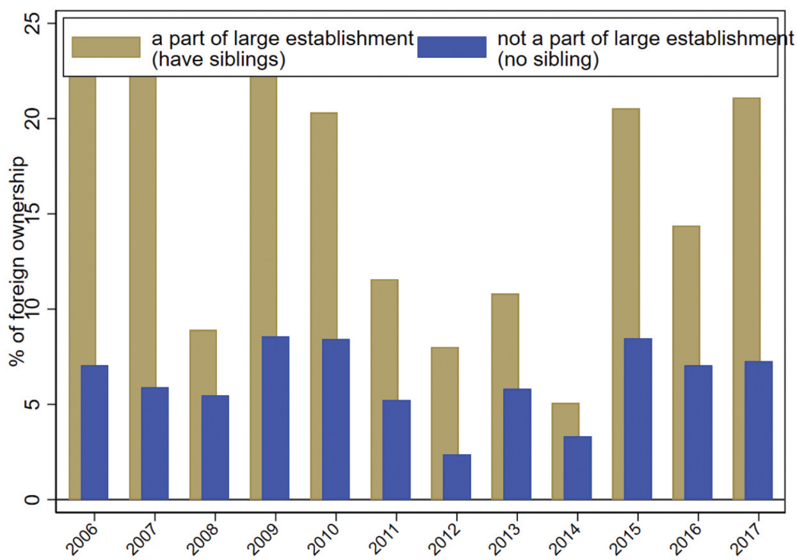

Figure 3. Distribution of the siblings.
Notes: *Sib* is measured as 1 if the firm is a part of a large establishment and 0 otherwise.

idea that foreign ownership is determined by these instruments; all of these are likely to affect multinationals' selection and might indirectly contribute to firms' core product selection. Although these instruments are not perfect, they are reasonably appropriate and relevant to the endogenous variable itself. While some of the instruments closely

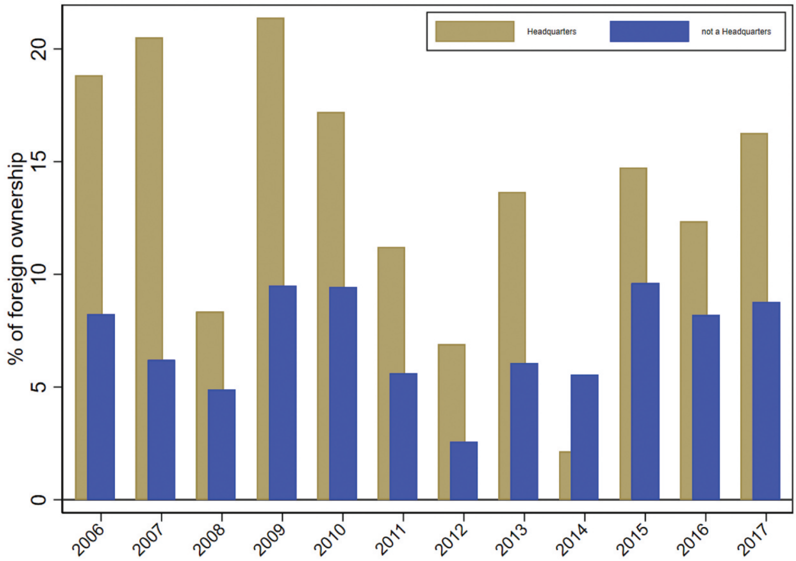

Figure 4. Distribution of the headquarters across firms.
Notes: Headquarters is 1 if the firm is headquartered and its financial statement is independent of the rest of Establishment and 0 otherwise.

Table 3. Foreign ownership and core product competence.

	Foreign Ownership Share			Foreign Dummy		
	(1)	(2)	(3)	(4)	(5)	(6)
Siblings	9.358 ***	8.459 ***	7.652 ***	0.095 ***	0.086 ***	0.077 ***
	(0.258)	(0.321)	(0.350)	(0.003)	(0.004)	(0.004)
Main product location		15.683 ***	15.680 ***		0.160 ***	0.160 ***
		(0.443)	(0.443)		(0.005)	(0.005)
Headquarters			1.693 ***			0.017 ***
			(0.352)			(0.004)
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector×Year-trend	Yes	Yes	Yes	Yes	Yes	Yes
Country×Year-trend	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.0956	0.1305	0.1308	0.0899	0.1187	0.1190
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000
observations	114,891	75,126	75,126	114,891	75,126	75,126

The dependent variables are foreign ownership share and the foreign dummy that equals one if the firm has at least 50% foreign ownership. Robust standard errors clustered by main products are provided in the parentheses. *, **, *** denote significance at 10%, 5% and 1% levels, respectively.

follow the key literature,[11] the weak instrument issue, the exclusion condition and the relevant condition are examined and the results can be found in Table 3.

In column (1) of Table 3, we find that the variable of the number of siblings has a positive and statistically significant effect on foreign ownership of core product firms. Column (2) then indicates that locating core product lines in foreign locations attracts more foreign firms to come with the core products. Column (3) shows that the core products of headquartered firms are positively associated with foreign ownership.

Columns (4) to (6) repeats the estimations and we find that all variables statistically significant. In other words, firms which have core products that experience foreign origin production, are part of a large establishment, and are produced by a headquartered firm exhibit a greater likelihood of being owned by a foreign multinational. Taken together, the results suggest that the potential endogeneity concerns around foreign ownership variables might be mitigated by the instruments.

However, in common with statistical model the 2SLS approach has limitations. A potential concern would be that the instruments might also correlate with firm productivity in other ways and might not serve as valid instruments. This would lead to a situation in which the selection problem might not be properly addressed. One way to alleviate this threat is to implement the propensity score matching and the inverse probability weighting (henceforth, IPW) approaches that allow firms to have the same probability of being foreign-owned based on observables. While the propensity score matching reduces selection bias by adjusting for observable differences and creating a carefully matched group (Mallick and Yang 2013; Webster and Piesse 2018), the IPW is an extension of the matching approach to correct for non-random sampling (Cattaneo et al. 2013).

In doing so, the foreign ownership variable is set to be the *treatment* variable and the core product share and TFP are the *outcome* variables, respectively. In this setting, we compare a sample that contains foreign-owned firms to a sample that contains domestic-owned firms. We test whether there is a statistically significant difference in the outcome between the two. Following Cattaneo et al. (2013) and Wooldridge (2010), the matching strategy follows a three-step. In step one, we estimate the propensity score P of each firm by a multinomial logit model.[12] For this matching procedure,[13] we select variables that can be included in the propensity score. As highlighted by Khandker, Koolwal, and Samad (2010), the samples of treated and non-treated firms should be pooled and the treatment should be estimated on all the observed covariates in the data that are likely to determine the treatment. The selection of variables used for the matching procedure is guided by the recent studies of Javorcik and Poelhekke (2017) and Webster and Piesse (2018). The following variables are therefore selected: firm size, age, direct export, national sales, foreign licencing, product code, the net inflow of FDI (% of GDP), GDP growth rate, trade openness, the total natural resources rents (% of GDP), and our instruments *Sib*, *CPL* and *Headquarters*, firm sales growth rate (in log), and employment three years ago. We also consider the transformations of age-square and age-cube (Mallick and Yang 2013; Javorcik and Poelhekke 2017) in order to obtain a more precise correspondence in the matching procedure. We performed a balancing test to make sure that all covariates are balanced between foreign-owned and domestically owned firms in Table B1 in Appendix B.

As the matching covariates for both treatment and non-treatment stem from the same data provider, it is expected to credibly justify the conditional independence assumption (CIA)[14] and the matching procedure (Heckman, LaLonde, and Smith 1999).[15] The second step is to compute inverse-probability weights and fit weighted regression models of the outcome for each treatment level and obtain the treatment-specific predicted outcomes for each subject. The final step is to compute the means of the treatment-specific predicted outcomes. For robustness, we report results from matching groups and the IPW.[16]

4.2. Foreign ownership and productivity evolution

To determine how much of the variation in firm productivity is associated with variation in core product reallocation originating from foreign ownership, we use a *two-step* strategy and start by estimating the effect of foreign ownership on core product competence as *step-one*. The specification is written as follows:[17]

$$\begin{aligned} CoreProdCom_{i,s,c,t} &= \beta_0 + \beta_F \hat{F}_{i,s,c,t} + \beta_{size} size_{i,s,c,t} \\ &+ f_s + f_c + f + f_s \times Year + f_c \times Year + \xi_{i,s,c,t} \end{aligned} \tag{3}$$

where the dependent variable is the core product competence measured by the sales of firm's core product over the total sales. $\hat{F}_{i,s,c,t}$ represents the predicted variables of foreign ownership and the foreign dummy variables, respectively. The *size* denotes the size of each firm *i*. The variables f_s capture permanent differences among sectors, while f_c and f_t capture the differences among countries and years. The dynamic time-trends from sectors $f_s \times Year$ and countries $f_c \times Year$ are also controlled for in the specification. Firm-level clustering is used to allow for correlations of errors within each firm, following Alfaro and Chen (2018). To rule out the possibility that firms specialise because they can better access to foreign input but not being necessarily caused by foreign ownership, we control for the firm-level foreign input in an alternative specification throughout the analysis.

In the *second-step*, we estimate the effect of core product competence on firm performance, taking into account the effect of foreign ownership on core product competencies specified as follows:

$$\begin{aligned} TFP_{i,s,c,t} &= \beta_0 + \beta_{core} Core\widehat{Prod}Com_{i,s,c,t} + \gamma X'_{i,s,c,t} \\ &+ f_s + f_c + f + f_s \times Year + f_c \times Year + \xi_{i,s,c,t} \end{aligned} \tag{4}$$

where the $CoreProdCom_{i,s,c,t}$ is the core product competence extracted from the *first-step* regression. The vector X denotes the covariates, including the firm age, total sales and sales lagged by three years. The *TFP* is the productivity at the firm-level measured by using a Cobb-Douglas production function and the OLS estimation following a two-step procedure (Marin and Sasidharan 2010; Van Beveren 2012; Gorodnichenko, Svejnar, and Terrell 2014).[18] Additionally, in order to rule out other mechanisms such as increased R&D or technology spillover from multinational that might happen simultaneously to influence firm productivity, we include R&D expenditures (a dummy equals to 1 if a firm invests in R&D and 0 otherwise) and foreign licencing variables in the specification too.

Note that it is important to ensure that the core product competence is not determined by the TFP but by foreign ownership (and the foreign dummy) before processing the estimation so that we can eliminate potential reversal. To address this concern, we regress firms' core product competence on TFP and foreign ownership, controlling for firm sales three years ago, age, and size. The results provided in Table B2 of Appendix B show that firm productivity is never confirmed as a significant determinant of core product competence. Hence, we might be confident that a firm's core product competence is not determined by its TFP and so the reverse causality is likely to be less acute in our analysis. Additionally, it is important to address the potential relationship between foreign ownership and TFP, as a direct link between the two would make our estimation strategy invalid. To rule out this concern, we perform a test regressing TFP on foreign ownership, core product competence, and other controls. The results are provided in Table B3 of Appendix B. We find that foreign ownership is never confirmed to be a significant determinant of the TFP. This suggestive finding thus helps to validate the validity of our *two-step* strategy and we might be confident that such concerns can be eased.

5. Results

5.1. Core product competence and foreign ownership

Our analysis starts by estimating Eq. (3) to see how foreign ownership affects core product concentration. Panel A of Table 4 provides the results. In columns (1a) and (2a), we find that foreign ownership exerts, on average, a positive and significant effect on core product competence at the 1% significance level. However, by comparing the results in the two columns, we find that failure to account for the endogeneity of foreign ownership would lead to an under-estimation of the effect on core product competence. According to column (2a), the estimated coefficient of foreign ownership is 0.108, whereas in column (1) it is just 0.009. The same results are found in columns (4a) and (5a), where the foreign-owned firm dummy is employed to replace the foreign ownership variable. Given that we use multiple instruments for one endogenous variable, the limited information maximum likelihood (LIML)[19] estimates are also reported in columns (3a) and (6a). As LIML is less precise than 2SLS but also less biased in over-identified model, it is reassuring that both estimators provide similar results (Angrist and Pischke 2009).

While the results indicate economically important effect of foreign ownership on core product competence, as we highlighted previously the limitation of the instruments might still leave the time-varying selection unsolved. Hence, in the last two columns we process to the matching estimation, where in column (7a) the propensity score matching approach is implemented and in column (8a) the IPW is used. Based on the matched groups, where all firms are equally selected being foreign-owned or domestic-owned, the result for foreign dummy provided in column (7a) remains highly statistically significant and implies that foreign-owned firms are still more specialised at the core product lines compared to domestic-owned firms. The result remains highly significant when IPW is introduced in column (8a), with a more pronounced coefficient estimated.

A more restrictive test of the effects of foreign ownership on core product competence is whether firms are more likely to specialise because they have better accessed to foreign input but not necessarily associated with foreign ownership. To assess this possibility, we include foreign inputs used by each firm to the model. Identification in this specification is limited to firms that report information on their foreign inputs (% of total inputs). The estimated effects, which are reported in Panel B of Table 4, become even stronger. For instance, the coefficient 1.900 in column (7b) is higher compared to the coefficient 1.335 in column (7a). While the coefficients are larger in Panel B than that of in Panel A, the magnitude of the impact of foreign ownership (or foreign dummy) is rather similar.

Note that the relationship between foreign ownership and core product competence may vary substantially across countries, e.g. because of the business or institutional environment. Given that our data cover countries from Albania to Zimbabwe, we do a leave-one-out robustness check to make sure that the estimates are not driven by a specific subset of countries. We do so by excluding all African and European countries

Table 4. Foreign ownership and core product competence.

	Core product competence: share over total sales							
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)
Panel A								
Foreign Ownership Share	0.009 **							
	(0.004)							
Foreign Ownership Share(predicted)		0.108 ***						
		(0.015)						
Foreign Ownership Share(LIML)			0.176 ***					
			(0.019)					
Foreign Dummy				1.106 ***				
				(0.329)				
Foreign Dummy(predicted)					10.667 ***			
					(1.438)			
Foreign Dummy(LIML)						17.239 ***		
						(1.922)		
Foreign Dummy(matched groups)							1.335 **	
							(0.535)	
Foreign Dummy(IPW)								1.145***
								(0.444)
F-test	56.03	79.41	427.01	58.91	79.85	378.01	13.89	7.29
Prob>F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-squared	0.1676	0.1681	0.1373	0.1676	0.1681	0.1343	0.1512	0.1542
observations	73,646	73,646	73,646	73,646	73,646	73,646	24,084	30,830
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)
Panel B								
Foreign Ownership Share	0.014 ***							
	(0.004)							
Foreign Ownership Share(predicted)		0.122 ***						
		(0.017)						
Foreign Ownership Share(LIML)			0.185 ***					
			(0.022)					
Foreign Dummy				1.605 ***				
				(0.359)				
Foreign Dummy(predicted)					12.072 ***			
					(1.628)			
Foreign Dummy(LIML)						18.369 ***		
						(2.137)		
Foreign Dummy(matched groups)							1.900 ***	
							(0.558)	
Foreign Dummy(IPW)								1.504 ***
								(0.493)
F-test	60.25	48.45	353.08	65.12	48.54	310.84	15.80	5.57
Prob>F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-squared	0.1609	0.1615	0.1285	0.1610	0.1615	0.1239	0.1476	0.1744
observations	56,864	56,864	56,864	56,864	56,864	56,864	21,006	24,548
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(*Continued*)

Table 4. (Continued).

	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector×Year-trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country×Year-trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The dependent variable is the share of core product sales over total sales. We control for firm-level foreign inputs and firm size in all regressions. Robust standard errors clustered by firms are provided in the parentheses. *, **, *** denote significance at 10%, 5% and 1% levels, respectively.

from the estimation, respectively. The results are provided in Table B4 of Appendix B and it is reassuring that the main estimates are confirmed to be similar when these countries are excluded from the sample.

Existing studies indicate that trade liberalisation leads to a substantial reduction in the number of varieties managed by firms, on average (Bernard, Redding, and Schott 2011; Eckel and Neary 2010). However, to the best of our knowledge, this is the first study to demonstrate empirically the effect of foreign ownership on core product competence in the FDI literature. Our finding suggests that a skewed focus on core product competence reflects an underlying complementarity with foreign ownership. As we will show in the rest of the analysis, this finding has economically significant implications for the theory of FDI and productivity improvement. In order to proceed to the *second-step* to see how the effect of a skewed focus on core product competence induced by foreign ownership could be passed onto firm productivity, we extract the predicted values of the core product competence based on the specifications in Table 4. We further checked the robustness for the instruments and find that the null hypothesis of weak instrument can be rejected, as the p-values are less than 1% throughout. The relevant condition is also satisfied, as the instruments are statistically significant at the 1% significance level too. These checks confirm that our identification strategy is appropriate.

5.2. Productivity improvement and core product competence

In Table 5, panel A provides the results based on the impact of core product competence predicted from column (2a) of Table 4 on productivity, while panel B provides the results based on core product competence predicted from column (4a) of Table 4 on productivity. Results provided in Panel C and Panel D are based on the matching groups. We control for firm age and sales three years ago throughout the specifications. These controls can help us narrow down the differences across firms to improve the limitation of the data. Additionally, we remove the possibility that firm becomes productive because of the R&D investment and foreign technology authorised directly from foreign firms through other channels but not directly through foreign ownership acquisition. Given that the we use predicted regressors for core product competence in the analysis, the bootstrap standard errors are employed to take into account the fact that estimation is based on various steps. Column (1a) suggests that, on average, the core product competence has a positive but statistically insignificant impact on firm productivity. It reveals that failing to take into account the impact of foreign ownership on core products makes the estimated coefficient inefficient and underestimated. By contrast, we find a positive and statistically significant effect of *CoreProdCom* on firm productivity at the 1% significance level in column (2a), where the effect from foreign ownership on product concentration is taken into account. This implies that a 1% increase in core product

Table 5. Core product competence and firm productivity.

	Firm-level TFP					
	All		Bin 1 (<25%)	Bin 2 (<50%)	Bin 3 (<75%)	Bin 4 (>75%)
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)
Panel A: foreign ownership						
CoreProdCom	−0.0001					
	(0.0003)					
CoreProdCom(predicted)		0.086***	0.003	0.004***	0.015***	0.085***
		(0.013)	(0.017)	(0.001)	(0.005)	(0.030)
Observations	15,373	15,329	3,493	3,999	4,169	3,668
R-squared	0.2743	0.2776	0.1618	0.0888	0.0736	0.1970
		All(2b)	Bin 1 (<25%) (3b)	Bin 2 (<50%) (4b)	Bin 3 (<75%) (5b)	Bin 4 (>75%) (6b)
Panel B: foreign dummy						
CoreProdCom(predicted)		0.085***	0.003	0.004***	0.015***	0.085***
		(0.011)	(0.018)	(0.001)	(0.004)	(0.019)
Observations		15,329	3,493	3,999	4,169	3,668
R-squared		0.2776	0.1618	0.0888	0.0736	0.1970
		All(2c)	Bin 1 (<25%) (3c)	Bin 2 (<50%) (4c)	Bin 3 (<75%) (5c)	Bin 4 (>75%) (6c)
Panel C: matched groups						
CoreProdCom(predicted)		0.137 ***	0.010	0.010 ***	0.024 ***	0.083 ***
		(0.018)	(0.038)	(0.001)	(0.005)	(0.016)
Observations		14,937	3,388	3,897	4,078	3,574
R-squared		0.2892	0.1504	0.0929	0.0738	0.1989
		All(2d)	Bin 1 (<25%) (3d)	Bin 2 (<50%) (4d)	Bin 3 (<75%) (5d)	Bin 4 (>75%) (6d)
Panel D: IPW						
CoreProdCom(predicted)		0.150***	0.014	0.011***	0.030***	0.085***
		(0.023)	(0.036)	(0.005)	(0.007)	(0.048)
Observations		15,471	3,532	4,030	4,209	3,700
R-squared		0.2783	0.1606	0.0881	0.0731	0.1974
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector×Year-trend	Yes	Yes	Yes	Yes	Yes	Yes
Country×Year-trend	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes

In Panel A core product competence is instrumented by the predicted foreign ownership share and firm size, while it is instrumented by the predicted foreign dummy and firm size in Panel B. Other controls are firm age, sales three years ago in the logarithm, R&D, and foreign licencing. Bootstrap standard errors clustered at the firm-level are provided in the parentheses. *, **, *** denote significance at 10%, 5% and 1% levels, respectively.

competence leads to a 8.6% increase in productivity. Turning to column (2b), it shows that the estimated coefficient remains highly statistically significant and almost identical to the results provided in panel A.

Panel C and Panel D test for the selection issue across firms by the matched groups. The results in columns (2c) and (2d) reveal a positive association between *CoreProductCom* and TFP, consistent with our previous findings. The estimated coefficients from the two specifications are similar and close to the previous results. There are all at the 1% significance level and

Table 6. Core product competence and firm productivity.

	Labour productivity per worker			
	(1a)	(2a)	(3a)	(4a)
Panel A				
CoreProdCom(foreign ownership)	0.333***			
	(0.008)			
CoreProdCom(foreign dummy)		0.331***		
		(0.008)		
CoreProdCom(matched groups)			0.454***	
			(0.020)	
CoreProdCom(IPW)				0.677***
				(0.016)
Observations	39,532	39,532	14,934	41,045
R-squared	0.8568	0.8567	0.8895	0.8602
	Productivity measured in value added			
	(1b)	(2b)	(3b)	(4b)
Panel B				
CoreProdCom(foreign ownership)	0.094***			
	(0.013)			
CoreProdCom(foreign dummy)		0.094***		
		(0.012)		
CoreProdCom(matched groups)			0.151***	
			(0.019)	
CoreProdCom(IPW)				0.168***
				(0.022)
Observations	15,293	15,293	14,907	15,435
R-squared	0.2817	0.2817	0.2918	0.2825
	New product introduced			
	(1c)	(2c)	(3c)	(4c)
Panel C				
CoreProdCom(foreign ownership)	−0.016***			
	(0.004)			
CoreProdCom(foreign dummy)		−0.016***		
		(0.004)		
CoreProdCom(matched groups)			−0.010	
			(0.010)	
CoreProdCom(IPW)				−0.018**
				(0.008)
Observations	12,822	12,822	5,551	13,234
R-squared	0.0644	0.0644	0.0767	0.0666
Sector FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Sector×Year-trend	Yes	Yes	Yes	Yes
Country×Year-trend	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes

All specifications control for firm age, sales three years ago in the logarithm, R&D, and foreign licencing. The labour productivity per worker is defined as $Sales_{i,s,c,t}$ / $Employees_{i,s,c,t}$. Bootstrap standard errors clustered at the firm-level are provided in the parentheses. *, **, *** denote significance at 10%, 5% and 1% levels, respectively.

indicating that core product concentration effects brought by the foreign ownership indeed positively associated with productivity improvement, and the results are less likely driven by the selection issue.

Next, we distinguish our regressions by the quantiles from Bin1 (TFP <25%) to the Bin4 (TFP >75%). The results reveal that firms in the upper middle of the productivity distribution experience substantially more productivity gains from the specialisation in core products compared to the firms in the middle of the productivity distribution. For example, in columns (4a), (4b), (4c) and (4d) a 0.4–1% increase in the core product competence is associated with an increase of roughly 1% in the middle productivity group, while in columns (6a), (6b), (6c) and (6d) a 1% increase in core product competence would increase approximately 8.5% TFP in the most productive group. We further investigate the robustness of the effect of core product concentration on productivity measured by labour productivity per worker (Görg and Seric 2016) and value-added (Commander and Svejnar 2011).[20] If the significance of coefficients for *CoreProdCom* differed dramatically through the measures, then it would be a signal that heterogeneity across firms was not well addressed and the empirical strategy of the two-step would be inappropriate. However, the results provided in Table 6 suggest that we might be confident to leave this concern, as the estimates remain highly significant at the 1% significance level throughout the specifications. In particular, the estimated coefficients in Panel B of Table 6 are qualitatively similar to the estimates provided in Table 5.

So far, we have assumed that our core product measure reflects on a true product scope across firms. However, the distribution of core product sales might or might not truly represent the basket of products offered by the firm. The product scope measured by the number of products could be one step further to quantify the productivity improvement raised from core product competence. For example, focusing on the supply side in the theoretical model of multi-product firms, Eckel and Neary (2010) suggest that the productivity of a multi-product firm will be reduced by increasing product range. Similarly, Mayer, Melitz, and Ottaviano (2014) assume that firms face a product ladder, where productivity declines discretely for each additional variety produced. Hence, we experiment with one alternative specification estimating whether core product concentration introduced by foreign ownership would indeed lead to a low possibility for firms to introduce any new products. Panel C of Table 6 provides suggestive evidence of decreasing possibility on introducing product scope upon increasing effect of core product concentration.[21] While this could mean that firms are experiencing productivity gains through focusing on the current core product lines, still we cannot distinguish the effects between the possibilities of dropping existing product lines and/or the changes in real product space due to the data constraints.

5.3. Additional channel: intra-industry competition

Section 5.2 shows that productivity improvement can arise from the core product concentration introduced by foreign ownership across firms. However, the literature also suggests that foreign ownership may enhance product-market competition by increasing costs and decreasing the average prices of the varieties supplied by competing firms, and by dropping mark-ups across all products. Foreign ownership is likely to affect firms' decisions in terms of product-market expansion and/or product innovation, which would further increase product-market competition. As illustrated in the model of multi-product firms, by assuming a Cournot competition greater competition results in a negative correlation between industry output and equilibrium output. Given its total output and the symmetric structure of demand, a firm charges higher prices for products when less of each variety is produced. However, greater product market competition from rival firms reduces the prices that firms can charge for their varieties. Therefore, this effect encourages firms to concentrate on their most valuable product lines, based on the assumption that a firm uses the most efficient production process to produce its core products with the lowest marginal cost (Eckel and Neary 2010). This idea may be amplified once we consider the multinational competition in the host country, as highlighted in Mayer, Melitz, and Ottaviano (2014), market, which increases the market size, technology improvements (which may occur through the presence of foreign ownership) and product substitutability (within the expanded product range), all of which lead to tougher competition and thus further encourage firms to skew their production towards their better-performing products.[22] Therefore, it is likely that foreign ownership may induce product market competition and then lower mark-ups across all products, as the firm with the high foreign ownership may be more able to access external assistance from its multinational company (getting access to the export market and/or product innovation, for example), which may increase competition within an industry.

Taking together, we therefore isolate intra-industry competition from firms' foreign ownership and assess the potential implication of core variety concentration across firms by regressing core product competence against the foreign ownership share, mark-ups and the within-industry foreign competition. In so doing, we first define the variable 'within-industry foreign competition' labelled $FM_{s,c,t}$ as follows:

$$FM_{s,c,t} = \frac{\sum_{i}^{n} \hat{F}_{i,s,c,t} \times Markup_{i,s,c,t}}{\sum_{i}^{n} Markup_{i,s,c,t}} \tag{5}$$

where s, c, and t respectively index sector, country and time, and F represents foreign ownership and a dummy variable that takes value 1 if foreign ownership is equal or above 50%, respectively. *Markups* is the variable mark-ups that measures the competition across firms. This is a preferred competition indicator following the empirical literature (e.g. Weche 2018). We follow the approach developed by De Loecker and Warzynski (2012) to estimate our firm-level mark-ups and detail the estimation strategy in Appendix A. Next, to isolate the impact of the within-industry competition and then look at how mark-ups corresponds to core product competence, we estimate the following equation:

$$\begin{aligned} CoreProdCom_{i,s,c,t} &= \beta_0 + \beta_F \hat{F}_{i,s,c,t} + \beta_{Markup} Markups_{i,s,c,t} \\ &+ \beta_{fm} FM_{s,c,t} + \gamma X'_{i,s,c,t} + f_s + f_c + f + f_s \times Year + f_c \times Year + \xi_{i,s,c,t} \end{aligned} \tag{6}$$

where $\hat{F}$ represents the instrumented foreign ownership variable, and the vector X is as defined above. As before, the firm-level clustering is used in all regressions and the specific trends are also controlled for across countries, sectors, and time.

The results are provided in Table 7. In column (1a), mark-ups is identified as negative and statistically significant. Then, in column (2a) we control for foreign ownership in the specification and find that mark-ups remains negative and significant, but this negative effect on core product competence is stronger compared to the result provided in column (1a). To assess within-industry competition, in column (3a) we add the variable *FM* and find that tougher foreign competition within an industry is indeed associated with the

Table 7. Competition effects through mark-ups on core product competence.

	Core product competence			
	(1a)	(2a)	(3a)	(4a)
Panel A				
Markups	−0.474 ***	−0.590 ***		−0.593 ***
	(0.161)	(0.172)		(0.172)
ForOwnShare(predicted)		0.168 ***	0.102 ***	0.145 ***
		(0.027)	(0.017)	(0.028)
FM			0.206 ***	0.192 ***
			(0.038)	(0.070)
Prob>F	0.000	0.000	0.000	0.000
R-squared	0.1451	0.1470	0.1557	0.1473
Observations	24,442	22,089	51,653	22,089
		(2b)	(3b)	(4b)
Panel B				
Markups		−0.590 ***		−0.592 ***
		(0.172)		(0.172)
ForeignDummy(predicted)		16.596 ***	10.074 ***	14.395 ***
		(2.648)	(1.710)	(2.761)
FM			19.924 ***	18.429 ***
			(3.720)	(6.824)
Prob>F		0.000	0.000	0.000
R-squared		0.1470	0.1557	0.1473
Observations		22,089	51,653	22,089
		(2c)	(3c)	(4c)
Panel C: matched groups				
Markups		−0.672 ***		−0.675 ***
		(0.174)		(0.174)
ForeignDummy		1.786 ***	2.056 ***	1.952 ***
		(0.562)	(0.586)	(0.590)
FM			−1.849	−1.783
			(1.808)	(1.819)
Prob>F		0.000	0.000	0.000
R-squared		0.1484	0.1476	0.1484
Observations		20,804	21,002	20,804
		(2d)	(3d)	(4d)
Panel D: IPW				
Markups		−0.688 **		−0.681 **
		(0.291)		(0.290)
ForeignDummy		0.479	1.595 ***	0.723
		(0.600)	(0.505)	(0.636)
FM			−1.980	−3.198
			(1.799)	(2.500)
Prob>F		0.000	0.000	0.000
R-squared		0.1739	0.1698	0.1741
Observations		21,221	23,812	21,221
Sector FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Sector×Year-trend	Yes	Yes	Yes	Yes
Country×Year-trend	Yes	Yes	Yes	Yes

The firm-level foreign inputs and firm size is controlled for in columns (1) to (4). Robust standard errors clustered at the firm-level are provided in the parentheses. *, **, *** denote significance at 10%, 5% and 1% levels, respectively.

skewness of core production across firms, with a positive and statistically significant coefficient at the 1% significance level. In column (4a), we repeat our exercise with all variables included and find that lower mark-ups across product lines force firms to concentrate more on their core product (the 1% significance level). With respect to this regression, the following mechanism emerges. The variable associated with the mark-ups indicates that the lower mark-ups across all product lines force firms to concentrate more on their core product, as the 1% decrease in mark-ups increases core product competence by approximately 0.006% (0.593/100, level to log) at the 1% significance level. An alternative explanation for the compressed mark-ups could be the distant investment. If multinationals decide to locate distantly from incumbent firms, such agglomeration benefits might not be available and the competitiveness might reduce mark-ups across firms (Myles Shaver and Flyer 2000). It might also be the case that the investment mode causes the variation in mark-ups; Chang, Chung, and Moon (2013) suggests that this mode alters firms' output capacity, which might further influence costs and price, and result in a shrink in markups. On the other hand, we find that within-industry foreign competition has a positive and significant effect on core product competence, revealing that foreign competition forces firms to concentrate on their core products. The results reveal that the early empirical literature overlooks the impact of competition effects from foreign ownership on core product competence.

6. Conclusion

This paper analyzes the effects of foreign ownership on core product competence and productivity level across countries. Our identification strategy exploits the exogeneity of foreign ownership by using instruments and matching approach and highlights empirically that foreign ownership is a significant source of motivation for firms to skew their production towards the better-performing products. Based on recent theoretical advances in the prediction of productivity gains, we find that core product concentration induced by foreign ownership is positively associated with firm productivity improvement. Crucially, we prove that our estimation strategy is valid by performing a regression of TFP on foreign ownership and a regression of core product competence on TFP and show in Table B5 of Appendix B that foreign ownership does not directly link to TFP and TFP does not determine the core product competence. In addition to productivity gains, we further find that such an increase in specialisation would narrow down the possibility of introducing new product lines across firms. A possible mechanism behind this is that an increase in within-industry competition might raise the marginal costs and reduce mark-ups across all products. To validate this explanation and eliminate others, we provide an additional channel to assess how competition induced by foreign ownership across industries influences core product concentration. Our finding suggests that firms respond to competition by focusing more on core product lines, and an increase in overall core product competence leads to productivity gains across firms.

Our findings are related to Eckel et al. (2015), who highlight that multi-product firms have cost-based and quality-based competence in which the two effects might have opposite implications for productivity gains. On the one hand, firms might engage in reducing product costs and selling their core products at lower prices. On the other hand, firms might engage in investing more in the quality of their core products and selling them at high prices. It might be likely that firms with foreign ownership might have more incentives to invest in the quality of core products because of the potential external resource linkages, and so they might be more able to experience productivity gains. Our results point to the possibility of both types of core competencies being the result of increased productivity, but due to the robustness the R&D activities have been ruled out from the explanation and no further information is available to examine the two effects on productivity gains in this paper. Another potential mechanism that goes beyond our paper is whether the productivity improvement is partly caused by market competition. Greater market competition from rival firms could reduce the prices that firms can charge for their product varieties, and this effect could encourage firms to concentrate on their most valuable product lines, which could result in productivity improvement at the firm-level. Future work could examine the productivity spillovers from these angles. In addition, we acknowledge that the nature of the WBES dataset restricts our analysis and such results should be interpreted with caution.

Notes

1. Eckel and Neary (2010) assume that the marginal production cost of each variety is a strictly increasing function of the mass of products produced, while Mayer, Melitz, and Ottaviano (2014) assume that the marginal cost for the varieties produced by a firm with a core marginal cost increases with customisation costs (competence ladder).
2. Sembenelli and Siotis (2008) also note that foreign-owned firms (foreign ownership higher than 50%) increase market competition, but the results are limited to R&D-intensive industries in Spain. They suggest that there is no short-run effect of market competition that can be transferred to productivity improvement.
3. By using a panel data from Brazilian multi-product exporters, Arkolakis and Muendler (2010) also find that firms' productivity declines with each additional variety supplied to a market.
4. See Appendix C for the countries covered.
5. The surveys use standardised instruments and a uniform sampling methodology to minimise measurement errors and yield data comparable across developing economies. Firms in rural areas and cities with populations of under 50,000 as well as firms with sizes from 20 employees upwards are included.
6. Guadalupe, Kuzmina, and Thomas (2012) note that a sufficient indicator of foreign control is that at least 50% of a firm's capital is owned by a foreign company.
7. Production location follows the information gleaned from the following survey question: '*From the beginning to the end of the fiscal year, what was the main market in which this establishment sold its main product line or main line of services? 0 if Local (products sold mostly in the same municipality where the establishment is located) and National (products sold mostly across the nation where the establishment is located), 1 if International (products sold mostly to nations outside the country where the establishment is located)*'.
8. The test was first proposed by Durbin (1954) and separately by Wu (1973) and Hausman (1978).
9. We add country-year fixed-effects $f_c \times Year$ to control for countries where more than one wave of Enterprise Surveys was conducted between 2006 and 2016.
10. We admit the GMM estimator's advantages for addressing endogeneity issue. However, this approach is beyond the reach of this paper due to the data structure limitation, i.e. the panel units and time length. Please visit Roodman (2009) for more details.
11. For instance, Brambilla (2009) addresses the endogeneity of foreign ownership by controlling for location and industry choices effects.
12. Following Mallick and Yang (2013), the propensity score is calculated as $P = Pr(T = 1|X_{i,s,c,t}) = \frac{exp^{\lambda X_{i,s,c,t}}}{1+exp^{\lambda X_{i,s,c,t}}}$, where P is the probability of being a foreign-owned firm based on the given firm characteristics $X_{i,s,c,t}$.

13. Since the nearest neighbour matching faces the risk of bad matches, we impose a caliper (i.e. the maximum propensity score distance) matching to avoid bad matches and hence rises the matching quality (Caliendo and Kopeinig 2008).
14. Conditional on the observable variables, the performance of the control firms must be equal to that of the treated firms had it not been treated.
15. Nevertheless, we should note that the data may vary across countries as it is not always based on the universe of the business population. For example, the foreign ownership information is not part of the explicit survey stratification strategy of Enterprise Surveys (where the strata are based on firm size, business sector, and geographic region within the country, see https://www.enterprisesurveys.org/en/methodology for more details). This potential concern, however, goes behind our current study.
16. We apply psmatch2 in Stata 16. See Emsley et al. (2008) and Leuven and Sianesi (2018).
17. Since we take into account the endogeneity of foreign ownership, the main identifying assumption is that $E[\xi_{i,s,c,t}|\hat{F}_{i,s,c,t}] = 0$.
18. See Appendix A for information on estimating firm productivity.
19. The LIML estimator is approximately median-unbiased in over-identified 2SLS models. It has the same large-sample distribution as 2SLS and reduces the bias that might exist in finite-sample and over-identified 2SLS models. See Angrist and Pischke (2009) for more details.
20. The value-added has also been employed as output measure in Olley and Pakes (1992), Nickell (1996), and Schiffbauer and Ospina (2010).
21. In column (4c) of Table 6, the insignificance of the coefficient might subject to the data attrition that leads to a few observation available to be estimated, resulting in a high standard error.
22. It can also be seen in Eckel and Neary (2010) that the net effect of globalisation is a fall in product scope, i.e., it encourages firms to prune their product lines by concentrating on their core competencies in order to respond to greater market competition effects.
23. One additional study closely related to De Loecker and Warzynski (2012) is the study De Loecker, Goldberg, Khandelwal, and Pavcnik (2016). They provide a simple framework to address the so-called input price bias based on De Loecker and Warzynski (2012). See De Loecker et al. (2016) for more details.
24. This follows closely De Loecker (2011) on p.1425 and De Loecker and Warzynski (2012) on p.2447.
25. Note that as pointed out by L. Alfaro and Chen (2018), the relationship between prices and markups would still be unclear even if the price or physical output information were observable. De Loecker and Warzynski (2012) also show that only the level of the markups is potentially affected when such data on physical output are not available.

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Appendix A
Estimated Mark-up based on Output Elasticity

A preferred market competition indicator in the literature is the measured mark-ups at the firm-level (Weche 2018). However, markup estimation developed in the industrial organization often relies on the availability of very detailed market-level data in terms of input prices, physical output, and quantities of firms' products, which makes the mark-ups estimation an intractable and demanding task. To overcome the difficulty, early studies such as Hall, Blanchard, and Hubbard (1986) and Klettle (1999), for example, developed a simple way to estimate markups using production data with information on the firm or industry-level usage of inputs and the total value of shipments. Then, a new framework developed by De Loecker and Warzynski (2012) provides a way to calculate markups by using the share of expenditures on material inputs in the total value of production. This approach has been widely applied in the recent FDI literature.[23] For instance, Stiebale and Vencappa (2018) study the effects of the domestic and foreign acquisition on markups, Weche (2018) studies the competitive effects of FDI focusing on the change in markups, and Javorcik and Poelhekke (2017) study the determinants of foreign divestments by estimating the impact of markups, TFP, and output.

The approach contains a two-step strategy. First, we calculate the output elasticity of labour, capital, and material based on the translog production function specified as follow:

$$\begin{aligned} y_{i,s,c,t} &= \beta_l l_{i,s,c,t} + \beta_{ll} l^2_{i,s,c,t} + \beta_l k_{i,s,c,t} + \beta_{kk} k^2_{i,s,c,t} + \beta_m m_{i,s,c,t} \\ &+ \beta_{mm} m^2_{i,s,c,t} + \beta_{lk} l_{i,s,c,t} k_{i,s,c,t} + \beta_{lm} l_{i,s,c,t} m_{i,s,c,t} + \beta_{mk} m_{i,s,c,t} k_{i,s,c,t} \\ &+ \beta_{lmk} l_{i,s,c,t} k_{i,s,c,t} m_{i,s,c,t} + \omega_{i,s,c,t} + \varepsilon_{i,s,c,t} \end{aligned} \tag{A1}$$

where we obtain estimates of expected output ($\hat{y}_{i,s,c,t}$) and an estimate of $\varepsilon_{i,s,c,t}$. The expected output is then estimated alongside variables potentially affecting input demand, described below:

$$\begin{aligned} &\hat{y}_{i,s,c,t} = \hat{\beta}_l l_{i,s,c,t} + \hat{\beta}_{ll} l^2_{i,s,c,t} + \hat{\beta}_l k_{i,s,c,t} + \hat{\beta}_{kk} k^2_{i,s,c,t} + \hat{\beta}_m m_{i,s,c,t} + \hat{\beta}_{mm} m^2_{i,s,c,t} + \\ &\hat{\beta}_{lk} l_{i,s,c,t} k_{i,s,c,t} + \hat{\beta}_{lm} l_{i,s,c,t} m_{i,s,c,t} + \hat{\beta}_{mk} m_{i,s,c,t} k_{i,s,c,t} + \hat{\beta}_{lmk} l_{i,s,c,t} k_{i,s,c,t} m_{i,s,c,t} + \\ &h_t(m_{i,s,c,t}, k_{i,s,c,t}, z_{i,s,c,t}) \end{aligned} \tag{A2}$$

where $\omega_{i,s,c,t} = h_t(m_{i,s,c,t}, k_{i,s,c,t}, z_{i,s,c,t})$.[24] The output elasticities for labour, capital and material can then be computed using the estimated coefficients and the current inputs after the first stage estimation:

$$\hat{\theta}^M_{i,s,c,t} = \hat{\beta}_m + 2\hat{\beta}_{mm} m_{i,s,c,t} + \hat{\beta}_{lm} l_{i,s,c,t} + \hat{\beta}_{mk} k_{i,s,c,t} + \hat{\beta}_{lmk} l_{i,s,c,t} k_{i,s,c,t} \tag{A3}$$

$$\hat{\theta}^L_{i,s,c,t} = \hat{\beta}_l + 2\hat{\beta}_{ll} l_{i,s,c,t} + \hat{\beta}_{lk} k_{i,s,c,t} + \hat{\beta}_{lm} m_{i,s,c,t} + \hat{\beta}_{lmk} k_{i,s,c,t} m_{i,s,c,t} \tag{A4}$$

$$\hat{\theta}^K_{i,s,c,t} = \hat{\beta}_m + 2\hat{\beta}_{kk} k_{i,s,c,t} + \hat{\beta}_{km} m_{i,s,c,t} + \hat{\beta}_{kl} l_{i,s,c,t} + \hat{\beta}_{lmk} m_{i,s,c,t} l_{i,s,c,t} \tag{A5}$$

Following De Loecker and Warzynski (2012), the markups estimation at the firm-level can then be described as follows:

$$\mu_{i,s,c,t} = \hat{\theta}^X_{i,s,c,t} \frac{P_{i,s,c,t} Q_{i,s,c,t}}{P_{i,s,c,t} X_{i,s,c,t}} = \hat{\theta}^X_{i,s,c,t} (\alpha^X_{i,s,c,t})^{-1} \tag{A6}$$

where $X_{i,s,c,t}$ denotes the firm's expenditure on inputs. $\alpha^X_{i,s,c,t}$ is the share of expenditures on input $X_{i,s,c,t}$ in total sales, $P_{i,s,c,t} X_{i,s,c,t}$ denotes the input allocation, and $\hat{\theta}^X_{i,s,c,t}$ is the output elasticity for firm i in sector S, country C at time t.

As noted by De Loecker and Warzynski (2012), input allocation $P_{i,s,c,t}X_{i,s,c,t}$ is unobservable due the fact that firms do not report this information. No price data are available either.[25] Therefore, following De Loecker and Warzynski (2012), we replace it by using data on input expenditure shares $\left(\alpha^X_{i,s,c,t}\right)$ and only estimate markups using production data with output elasticity of one input (material) of production and data on the material expenditures share of total revenue. Note that this is important to add one more stage to eliminate any variation in expenditure shares $\left(\alpha^X_{i,s,c,t}\right)$ that comes from variation in output not related to the elasticity of demand and productivity (De Loecker and Warzynski 2012). We follow De Loecker and Warzynski (2012) to correct this variation as follows:

$$\hat{\alpha}^X_{i,s,c,t} = \alpha_{i,s,c,t} \times exp\left(\tilde{\in}_{i,s,c,t}\right) \quad (A7)$$

where the $\in_{i,s,c,t}$ is provided by the first stage of the procedure from Eq. (A1). We take the correction into account by multiplying the expected value of estimated productivity residual and then use the above equations to compute the markups, based on material, labour, and capital elasticities, respectively:

$$\mu^M_{i,s,c,t} = \hat{\theta}^M_{i,s,c,t}\left(\hat{\alpha}^M_{i,s,c,t}\right)^{-1} \quad (A8)$$

$$\mu^L_{i,s,c,t} = \hat{\theta}^L_{i,s,c,t}\left(\hat{\alpha}^L_{i,s,c,t}\right)^{-1} \quad (A9)$$

$$\mu^K_{i,s,c,t} = \hat{\theta}^K_{i,s,c,t}\left(\hat{\alpha}^K_{i,s,c,t}\right)^{-1} \quad (A10)$$

Equations (A8) to (A10) are therefore the mark-up estimation from the material elasticity, labour elasticity, and capital elasticity. We prefer to use the mark-up estimation from materials Eq. (A8), as highlighted by Bircan (2019) that material elasticity is less likely to be adjusted compared with the labour's share of expenditure, capital's share of expenditure as well as labour and capital's elasticities. The results of the estimated mark-up are provided in Tables A1 and A2.

Table A1. Average Output Elasticities.

ISIC 3.1 Rev	ISIC-Sector code	Observations in Production Function	Labour $\hat{\theta}^l$	Materials $\hat{\theta}^m$	Capital $\hat{\theta}^c$	Returns to Scale
Sector	#	(1)	(2)	(3)	(4)	(5)
15–16 Food, beverages and tobacco	1	5,206	0.628	0.195	0.127	0.950
			[0.144]	[0.044]	[0.147]	
17–19 Textile and apparel	2	5,103	0.653	0.183	0.105	0.941
			[0.141]	[0.040]	[0.143]	
20–22 Wood, paper and printing	3	1,741	0.622	0.186	0.142	0.950
			[0.139]	[0.041]	[0.133]	
23–25 Coke, chemicals and plastics	4	3,293	0.635	0.189	0.139	0.963
			[0.136]	[0.044]	[0.134]	
26 Nonmatallic mineral products	5	1,394	0.612	0.186	0.140	0.938
			[0.122]	[0.044]	[0.132]	
27 Basic metals	6	462	0.591	0.201	0.174	0.966
			[0.108]	[0.043]	[0.098]	
28 Fabricated metal products	7	2,116	0.615	0.186	0.146	0.947
			[0.130]	[0.043]	[0.121]	
29–30 Machinery and equipment	8	1,093	0.618	0.184	0.142	0.944
			[0.123]	[0.043]	[0.117]	
31–33 Electrical machinery and communications	9	852	0.633	0.186	0.138	0.957
			[0.127]	[0.043]	[0.126]	
34–35 Motor vehicles, trailers	10	353	0.594	0.189	0.179	0.962
			[0.092]	[0.039]	[0.061]	
36–37 Furnitures and recycling	11	1,286	0.642	0.186	0.093	0.921
			[0.149]	[0.041]	[0.152]	
45-Others	12	1,543	0.621	0.184	0.154	0.959
			[0.140]	[0.048]	[0.129]	

This table reports the output elasticities from the production function. Estimation is based on the translog production function used in De Loecker et al. (2016) and Bircan (2017). Product-sector code 45-others includes Construction, Sales, maintenance and repair, Whole trade and commission trade, Retail and household goods, Hotel and restaurant, Land, water and air transport, Auxiliary transport, Telecommunication, insurance, and others. Column (1) reposts the number of observations for each production function estimation. Columns (2) to (4) report the average estimated output elasticity with respect to each factor of production for the translog production function for all firms. Standard deviation of the output elasticities is reported in the bracket. Column (5) reposts the average returns to scale, which is the sum of the three preceding columns. Sector code 45-others includes Construction, Sales, maintenance and repair, Whole trade and commission trade, Retail and household goods, Hotel and restaurant, Land, water and air transport, Auxiliary transport, Telecommunication, insurance, and others. The product classification follows ISIC Rev. 3.1. Data version follows WBES November 6th, 2017. The product description follows the data initial record. Sectors are 12 in total; the Table only shows some examples throughout the sectors. Source: Authors' calculation.

Table A2. Markups, by ISIC Product-Sector.

ISIC 3.1 Rev Sector	Markups	
	(Mean)	(Median)
15–16 Food, beverages and tobacco	2.495	2.452
17–19 Textile and apparel	2.721	2.740
20–22 Wood, paper and printing	2.756	2.742
23–25 Coke, chemicals and plastics	2.555	2.557
26 Nonmatallic mineral products	2.652	2.598
27 Basic metals	2.270	2.267
28 Fabricated metal products	2.713	2.710
29–30 Machinery and equipment	2.773	2.754
31–33 Electrical machinery and communications	2.663	2.669
34–35 Motor vehicles, trailers	2.554	2.581
36–37 Furnitures and recycling	2.826	2.805
45-Others	2.883	2.846
Total	2.653	2.645

Table displays the mean and median markups by ISIC product-sector for the sample 2006–2017. Sector code 45-others includes Construction, Sales, maintenance and repair, Whole trade and commission trade, Retail and household goods, Hotel and restaurant, Land, water and air transport, Auxiliary transport, Telecommunication, insurance, and others. The product classification follows ISIC Rev. 3.1. Data version follows WBES November 6th, 2017. The product description follows the data initial record. Sectors are 12 in total; the Table only shows some examples throughout the sectors.
Source: Authors' calculation.

Estimating TFP

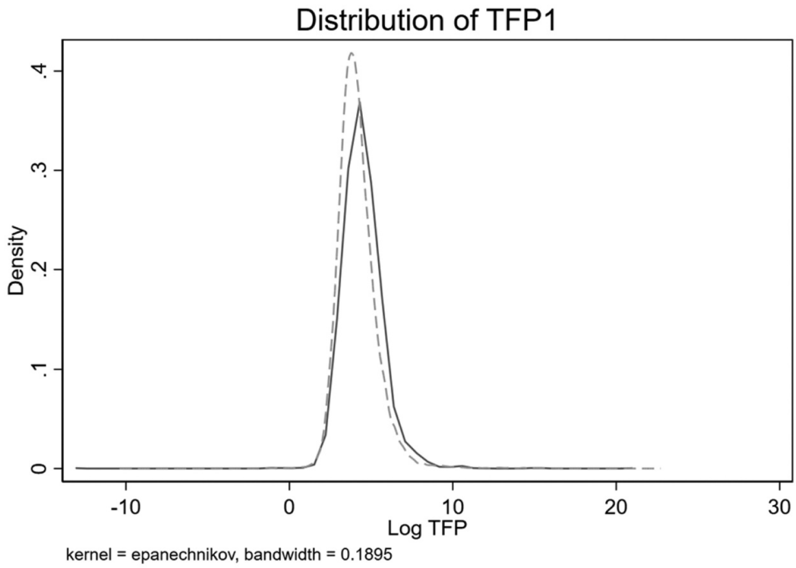
Our analysis requires the estimation of firm-level productivity. The standard approach assumes a Cobb-Douglas production function and uses OLS estimation following a two-step procedure. Although there are debates over OLS estimation regarding its assumption of the independence of inputs from firm's efficiency, data constraints restrict our analysis to rely on OLS estimation. Hence, we follow the studies Javorcik and Poelhekke (2017) and Bircan (2019) to estimate the firm-level productivity based on Eq. (A1), including squared terms, all interactions and year, sector, and country fixed-effects at the *first-step* to control for any heterogeneity over time in the production function. In the second step, we extract the predicted productivity $\hat{\varpi}_{i,s,c,t}$ once we obtain consistent estimators for each factor by running the following equation

$$\begin{aligned}\hat{\omega}_{i,s,c,t} = lny_{i,s,c,t} - \hat{\beta}_l l_{i,s,c,t} - \hat{\beta}_{ll} l^2_{i,s,c,t} - \hat{\beta}_l k_{i,s,c,t} - \hat{\beta}_{kk} k^2_{i,s,c,t} - \hat{\beta}_m m_{i,s,c,t} - \hat{\beta}_{mm} m^2_{i,s,c,t} - \\ \hat{\beta}_{lk} l_{i,s,c,t} k_{i,s,c,t} - \hat{\beta}_{lm} l_{i,s,c,t} m_{i,s,c,t} + \hat{\beta}_{mk} m_{i,s,c,t} k_{i,s,c,t} - \hat{\beta}_{lmk} l_{i,s,c,t} k_{i,s,c,t} m_{i,s,c,t}\end{aligned} \quad (A11)$$

Alternatively, as highlighted by the studies Commander and Svejnar (2011) and Newman et al. (2015), we can use the natural logarithm of value-added to check for the robustness of the results. In doing so, the variable $lny_{i,s,c,t}$ will be replaced by the log value-added, which is defined as the difference between total sales and the material inputs (Commander and Svejnar 2011, 313):

$$ValueAdded_{i,s,c,t} = y_{i,s,c,t} - m_{i,s,c,t}$$

We take the natural logarithm of *ValueAdded* and re-estimate Eqs. (A1) and (A11) to obtain the firm-level productivity estimate. For simplicity, we denote the productivity provided by Eq.(A11) as lnTFP1, whereas the one provided by the value-added is denoted as lnTFP2. Figure A1 shows the distribution. Borin and Mancini (2016), who show the Kernel-density estimates for multinational companies, domestic-exporters, and domestic non-exporters, provide graphical evidence of the presence of a productivity premium along with the entire distribution. Their results indicate that the TFP distribution of multinationals stochastically dominates that of exporters, which in turn dominates the productivity distribution of domestic firms. Our estimates of TFP are in line with the literature, as it shows that foreign-owned firms are more skewed towards the right-tail of the productivity distribution with higher productivity performance, regardless of which the TFP measure is used.



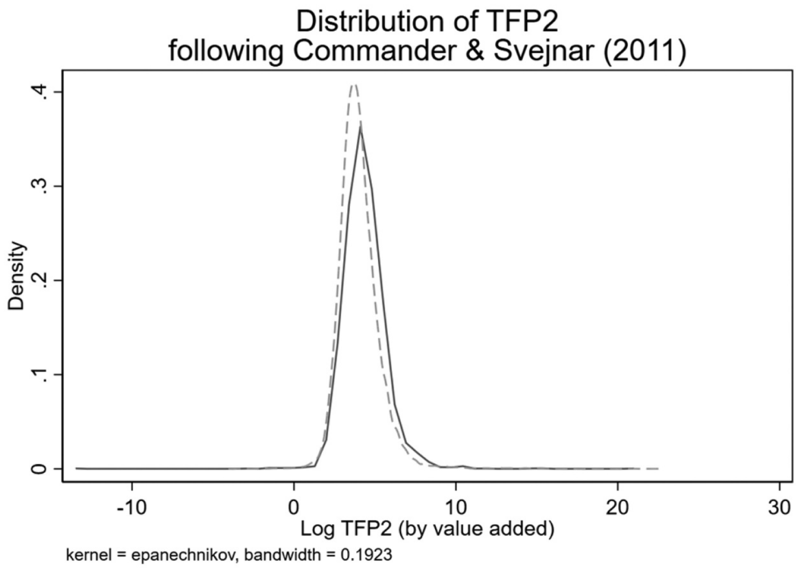


Figure A1. The Kernel density of productivity across foreign-owned firms (solid line) and domestically-owned firms (dash line).

Appendix B

Table B1. Balancing test of the caliper matching exercise.

	(1) (Foreign-owned)	(2) (Domestically-Owned)	(3) (*t*-test)	(4) (*p*-value)
Dir_Exp	28.318	27.556	0.67	0.502
f_li	1.6465	1.6492	−0.19	0.851
size	2.3904	2.3757	0.68	0.498
tnrr	7.4436	8.225	−2.96	0.003
trade	76.85	76.813	0.04	0.969
Nat_Sales	65.425	66.629	−1.01	0.313
gdp_g	4.4327	4.6393	−1.54	0.124
age	28.812	29.604	−1.44	0.150
age_sq	1177.2	1210.9	−0.57	0.569
age_cub	68591	68903	−0.04	0.967
fdini	4.3373	4.2873	0.37	0.710
product_code	39872	39964	−1.30	0.194
lng_sales	−0.67241	−0.7771	1.77	0.077
lnemp_3y	4.4566	4.3673	1.94	0.053
Sibling	0.31169	0.30769	0.29	0.772
mpline_locat	2.0415	2.0119	1.27	0.204
Head_firms	0.18364	0.15829	2.26	0.024

This table reports means and *t*-tests of equality of means for variables used in the logit estimation for predicting foreign-owned firms after constructing our caliper matching control group. Column (1) reports means for foreign-owned firms; column (2) reports means for their matched controls. Columns (3)-(4) report the results of a *t*-test between the two groups in (1) and (2) for each row.

Table B2. Foreign ownership and core product competence.

	Core product competence			
	(1)	(2)	(3)	(4)
Foreign Ownership Share	0.008	0.010 **	0.008	0.010 **
	(0.005)	(0.005)	(0.005)	(0.005)
lnTFP1	−0.033	−0.137		
	(0.123)	(0.124)		
lnTFP2			−0.032	−0.139
			(0.121)	(0.122)
R-squared	0.1507	0.1654	0.1510	0.1656
Sector FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Sector×Year-trend	No	Yes	No	Yes
Country×Year-trend	No	Yes	No	Yes
observations	30,446	30,446	30,380	30,380

The dependent variable is the share of core product sales over total sales. The firm's sales three years ago in the logarithm, age, and size are always controlled for in all columns. Robust standard errors clustered at the firm-level are provided in the parentheses. *, **, *** denote significance at 10%, 5% and 1% levels, respectively.

Table B3. Foreign ownership and core product competence.

	lnTFP1		lnTFP2		Labour pw	
	(1)	(2)	(3)	(4)	(5)	(6)
Foreign Ownership Share	0.0002	0.00002	0.00005	0.0001	−0.0005	−0.0004
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)
CoreProdCom	−0.0001	−0.0001	−0.0001	−0.0001	0.0001	0.0001
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0002)	(0.0002)
R-squared	0.2718	0.2743	0.2749	0.2772	0.8443	0.8446
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector×Year-trend	No	Yes	No	Yes	No	Yes
Country×Year-trend	No	Yes	No	Yes	No	Yes
observations	15,373	15,373	15,338	15,338	40,660	40,660

Firm's sales three years ago in the logarithm, age, *R&D*, and foreign licencing are always controlled for in the specifications. Robust standard errors clustered at the firm-level are provided in the parentheses. *, **, *** denote significance at 10%, 5% and 1% levels, respectively.

Table B4. Foreign ownership and core product competence - African countries excluded.

	Core product competence: share over total sales							
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)
Panel A								
Foreign Ownership Share	0.011***							
	(0.004)							
Foreign Ownership Share(predicted)		0.117***						
		(0.015)						
Foreign Ownership Share(LIML)			0.166***					
			(0.021)					
Foreign Dummy				1.313***				
				(0.354)				
Foreign Dummy(predicted)					11.513***			
					(1.495)			
Foreign Dummy(LIML)						16.563***		
						(2.084)		
Foreign Dummy(matched groups)							1.922***	
							(0.587)	
Foreign Dummy(IPW)								1.556***
								(0.480)
F-test	63.41	87.38	417.08	66.06	87.82	369.56	19.43	14.38
Prob>F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-squared	0.1700	0.1706	0.1447	0.1701	0.1706	0.1411	0.1554	0.1603
observations	66,099	66,099	66,099	66,099	66,099	66,099	20,922	26,785
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)
Panel B								
Foreign Ownership Share	0.017***							
	(0.004)							

(*Continued*)

Table B4. (Continued).

	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)
Foreign Ownership Share(predicted)		0.131 ***						
		(0.017)						
Foreign Ownership Share(LIML)			0.180 ***					
			(0.024)					
Foreign Dummy				1.802 ***				
				(0.391)				
Foreign Dummy(predicted)					12.940 ***			
					(1.712)			
Foreign Dummy(LIML)						18.118 ***		
						(2.355)		
Foreign Dummy(matched groups)							2.574 ***	
							(0.617)	
Foreign Dummy(IPW)								1.800 ***
								(0.538)
F-test	59.46	79.33	344.72	62.61	79.73	303.03	22.72	9.10
Prob>F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-squared	0.1646	0.1653	0.1355	0.1648	0.1654	0.1305	0.1530	0.1795
observations	49,549	49,549	49,549	49,549	49,549	49,549	17,865	20,977
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector×Year-trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country×Year-trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Firm's sales three years ago in the logarithm, age, *R&D*, and foreign licencing are always controlled for in the specifications. Robust standard errors clustered at the firm-level are provided in the parentheses. *, **, *** denote significance at 10%, 5% and 1% levels, respectively.

Table B5. Foreign ownership and core product competence - European countries excluded.

	Core product competence: share over total sales							
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)
Panel A								
Foreign Ownership Share	0.006 *							
	(0.004)							
Foreign Ownership Share(predicted)		0.097 ***						
		(0.015)						
Foreign Ownership Share(LIML)			0.164 ***					
			(0.022)					
Foreign Dummy				0.918 ***				
				(0.337)				
Foreign Dummy(predicted)					9.562 ***			
					(1.470)			
Foreign Dummy(LIML)						14.601 ***		
						(2.162)		

(*Continued*)

Table B5. (Continued).

	Core product competence: share over total sales							
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)
Foreign Dummy(matched groups)							1.118 **	
							(0.550)	
Foreign Dummy(IPW)								1.008 ***
								(0.461)
F-test	63.41	87.38	417.08	66.06	87.82	369.56	19.43	6.75
Prob>F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-squared	0.1693	0.1698	0.1430	0.1694	0.1698	0.1462	0.1523	0.1502
observations	71,630	71,630	71,630	71,630	71,630	71,630	23,062	29,589
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)
Panel B								
Foreign Ownership Share	0.013 ***							
	(0.004)							
Foreign Ownership Share(predicted)		0.112 ***						
		(0.017)						
Foreign Ownership Share(LIML)			0.178 ***					
			(0.024)					
Foreign Dummy				1.488 ***				
				(0.367)				
Foreign Dummy(predicted)					11.056 ***			
					(1.663)			
Foreign Dummy(LIML)						17.660 ***		
						(2.438)		
Foreign Dummy(matched groups)							1.778 ***	
							(0.571)	
Foreign Dummy(IPW)								1.344 ***
								(0.507)
F-test	59.46	79.33	344.72	62.61	79.73	303.03	22.72	4.75
Prob>F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-squared	0.1646	0.1653	0.1355	0.1648	0.1654	0.1305	0.1530	0.1702
observations	55,501	55,501	55,501	55,501	55,501	55,501	20,329	23,802
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector×Year-trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country×Year-trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Firm's sales three years ago in the logarithm, age, *R&D*, and foreign licencing are always controlled for in the specifications. Robust standard errors clustered at the firm-level are provided in the parentheses. *, **, *** denote significance at 10%, 5% and 1% levels, respectively.

Appendix C

Sample coverage of the WBES 2006-2016 core4: Afghanistan, Albania, Angola, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, Bahamas, Bangladesh, Barbados, Belarus, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, BurkinaFaso, Burundi, Cambodia, Cameroon, CapeVerdem, Central African Republic, Chad, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Côte d'Ivoire, DRC, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, ElSalvador, Eritrea, Estonia, Ethiopia, Fiji, Fyr Macedonia, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, GuineaBissau, Guyana, Honduras, Hungary, India, Indonesia, Iraq, Israel, Jamaica, Jordan, Kazakhstan, Kenya, Kosovo, Kyrgyz Republic, LaoPDR, Latvia, Lebanon, Lesotho, Liberia, Lithuania, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Micronesia, Moldova, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Romania, Russia, Rwanda, Samoa, Senegal, Serbia, SierraLeone, Slovak Republic, Slovenia, Solomon Islands, South Africa, South Sudan, SriLanka, StKittsandNevis, StLucia, St. Vincent and Grenadines, Sudan, Suriname, Swaziland, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, West Bank And Gaza, Yemen, Zambia, Zimbabwe.

Table C1. Example of sector and product classification.

ISIC Rev 3.1	ISIC-sector	4-digit	ProductCode	Description
15	Food, beverage and tobacco, sector(*S*)			
	1	1541	15	bread production
	1	1541	75916	production of oil
17–19	Textile and apparel, sector(*S*)			
	2	1712	9	Manufacture yarn
	2	1810	11	Manufacturing Leather Jackets
	2	1810	14857	Female wears
	2	1920	10	Manufacturer of plastic footwear
23–25	Coke, chemicals and plastics, sector(*S*)			
	4	2519	6	HDPE pipe
	4	2520	15218	Fundas plastics
	4	2520	26535	Manufacturer of plastic materials
26	Nonmetallic mineral products, sector(*S*)			
	5	2692	3	Constructing Parasitical Products
	5	2695	18	Iron Pieces
27	Basic metals, sector(*S*)			
	6	2720	16	copper smelt production
	6	2720	58132	Tin frame
28	Fabricated metal products, sector(*S*)			
	7	2893	7	Iron processing
31–33	Electrical machinery, communications, sector (*S*)			
	9	3150	4	Devices for illumination
	9	3330	81239	Watch
45-other	Others, sector(*S*)			
	12	4520	20	roads construction
	12	5122	2	Whole sales of dairy products
	12	5121	62376	Export of Agricultural Products

Sector code 45-others includes Construction, Sales, maintenance and repair, Whole trade and commission trade, Retail and household goods, Hotel and restaurant, Land, water and air transport, Auxiliary transport, Telecommunication, insurance, and others. The product classification follows ISIC Rev. 3.1. Data version follows WBES November 6th, 2017. The product description follows the data initial record. Sectors are 12 in total; the Table only shows some examples throughout the sectors.