ADJUSTING TO CHINA COMPETITION: EVIDENCE FROM JAPANESE PLANT-PRODUCT-LEVEL DATA

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Adjusting to China competition: Evidence from Japanese plant-product-level data

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Abstract

This study examines how the product mixes of Japanese manufacturing plants have been impacted by the rise of China imports over the period 1997-2014, and the extent that plants' local embeddedness mitigate this causal relationship. We find evidence that China import competition induced both product downsizing and product exit within Japanese manufacturing plants. Moreover, we find that those negative effects differ across plants according to various plant characteristics including the spatial organization of their parent firm. Finally, we show that both product survival and product sales are positively impacted by external agglomeration economies, but these effects are strong for standalone plants only, and almost non-existent for plants affiliated to spatially compact multi-unit firms.

Keywords: Import competition, Product Portfolio, Local Product Relatedness.

JEL codes: F61, L25, D22.

1 Introduction

The surge of imports from China has attracted policymakers' attention in many developed countries. One of the main concerns is related to the pressure Chinese imports put on manufacturing plants and jobs both at national

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and local levels. Indeed, a lot of uncertainty exists about the prospects for manufacturing activities within high-wage countries facing new competition from low-wage countries.

Until now, research has mainly focused on the labor markets impacts of Chinese imports and striking evidence has started to be accumulated from a large variety of countries[1]. Most of these previous evidence shows severe and spatially uneven impacts on jobs in high-wage countries. By contrast, much less is known about how firms and plants are finely adjusting their production capacities, and especially their product range to Chinese competition[2]. Our paper fills this gap by taking advantage of the richness of a plant-level dataset, which covers detailed product level information on the universe of Japanese manufacturing plants operated over the period 1997-2014. In this dataset, we investigate the response of Japanese manufacturing plants to the surge of imports from China in terms of product exit and sales. Our key questions of interest are the following: did manufacturing plants in Japan downsize or drop products because of the new competitive pressure of China imports? If so, have some plants been more resilient than others, and why? Answering these questions allows us to make a twofold contribution to the literature. First, we provide the first micro evidence on the impact of China competition on product churning in the case of Japan. Second, we explore two new mitigating factors on plant-level adjustment to China competition which are related to the local environment of the plant and to the spatial organization of the parent firm owning the plant.

Our theoretical prior is that plant-level adjustments to China competition can show a high degree of diversity depending altogether on plant, firm, and location characteristics. Firstly, acknowledging that firms are highly heterogeneous, previous literature has shown that incumbent firms might react differently to common aggregate shocks and in particular to trade liberalization shocks (see in particular Bernard et al. (2011) and Mayer et al. (2014)). Specifically, more productive firms might be more resilient to new competitive challenge than less productive firms. More recently, Fort et al. (2018) provided striking evidence that the decline in US manufacturing employment has been driven over the last decades by a rich variety of firm dynamics in terms of both plants and main industry activity churning. They show that the manner by which firms add or shed workers offers clue not only about the nature of the shocks they face, but also about the specificities of their structure and transition costs. In this paper, we distinguish plants that are owned by single-unit firms from plants that are owned by multi-unit firms. Moreover, within the latter category, we further distinguish firms operating from a single location from firms operating from multiple locations. Indeed,

[1]See in particular, Autor et al. (2013), Acemoglu et al. (2016), Feenstra and Sasahara (2018), Dai et al. (2019), and Bloom et al. (2019) for the U.S.; Malgouyres (2017) for France; Balsvik et al. (2015) for Norway; Utar (2018) for Denmark; Donoso et al. (2015) for Spain; Branstetter et al. (2019) for Portugal; Mion and Zhu (2013) for Belgium; Tomiura (2003) and Taniguchi (2019) for Japan.

[2] Notable exceptions, which we will review in more detail below, include Bernard et al. (2006), Liu (2010), and Bloom et al. (2015) for the U.S; Behrens et al. (2019) for Canada; Utar (2014) for Danemark; Martin and Mejean (2014) and Fontagné et al. (2018) for France.

we expect plants owned by these different types of organizations to face different transition costs and then to respond differently to China competition pressure.

Secondly, we also expect that plants operating in different local environments could also respond differently to similar shocks. Indeed, if cross-product and cross-firm interdependencies matter, regional capabilities can be key for explaining why some plants localized in more favorable environments are able to maintain their product range, while other ones have to drop some product lines or even are doomed to close. A couple of previous studies have shown that firm export performance as well as firm product churning decisions were impacted by how those products were embedded in their local environment (see in particular Poncet and Starosta de Waldemar (2015) for evidence on China and Hazir et al. (2019) for evidence on France). A natural extension of this line of research is to investigate how the local environment impact a plant's resilience to adverse shocks[3] and whether this impact varies across different types of plants.

On methodological grounds, we mainly build on two previous contributions in the literature. First, to identify import competition pressure at the product level and to deal with its endogeneity, we follow Autor et al. (2013) and use the shares of Chinese import to the U.S. and to Europe to instrument the import competition variable. Second, to examine what kind of plants are more likely to reorganize their product portfolio and their production facilities, and how they do so, we build on Iacovone et al. (2013), who examine the impact of Chinese imports on the product churning of Mexican manufacturing firms. As regards those previous papers, our study has two main innovations. First, we investigate the heterogeneous response of plants not only in relation to their own characteristics, but also in relation to the type of corporate organizations they belong to. Second, we put new emphasis on the local environment of plants as a mitigating factor of their product portfolio dynamics.

The rest of the paper is organized as follows. In section 2, we review the relevant literature in greater detail. In section 3, we present our data sources and provide key figures on our sample of plants. In section 4, the econometric specification, variable construction procedures, and estimation are explained. In section 5, we present the estimation results and robustness checks. Finally, we conclude this paper in section 6.

2 Overview of the relevant literature

Our paper primarily relates to the literature that investigates, through the lens of microdata, the impact of import competition from low-wage countries on manufacturing activities operated in high wage countries. In this research line, the bulk of the literature has focused on labor market outcomes. For

[3]A notable exception is Behrens et al. (2019), who specifically investigate the role played by geographical clusters in the resilience of plants operating in the textile and clothing (T&C) industries in Canada to the increase of low wage country competitive pressure over the 2001-2013 period.

example, a series of studies by David Autor and his colleagues have relied on large scale workers dataset to reveal that rising Chinese import to the U.S. had a substantial negative impact on the local labor markets (Autor et al., 2013; Acemoglu et al., 2016). More specifically, Autor et al. (2013) demonstrate that 55% of the decline in the US manufacturing employment from 2000 to 2007 can be explained by rising exposure to imports from China and that the exposure to Chinese imports induced altogether a decline in wages, a higher unemployment ratio, and increases in transfer payments through multiple federal and state programs. By relying on firm and plant level datasets, Bloom et al. (2019) complement these findings on the U.S. economy by showing that the negative effect of Chinese import penetration on local manufacturing employment is primarily driven by large importing firms that simultaneously expand employment in non-manufacturing and that a third of this negative manufacturing effect is accounted for by plants switching their reported industry affiliation to non-manufacturing. On other advanced economies, Malgouyres (2017) finds that import competition from China has induced a decline in manufacturing employment in France along with a polarization of the local labor markets in the manufacturing sector. Similar patterns of the impact of Chinese imports on local employment are found by Balsvik et al. (2015) for Norway, and by Donoso et al. (2015) for Spain [4].

Existing studies about the effect of imports from China on employment in Japan present somewhat different results as compared to the U.S. or European case. For example, Tomiura (2003) investigates the impact of the increase in imports from low wage countries using Japanese detailed industry-level data and finds a negative impact on the employment in some industries, but he reports that the economic impact is not so large. A more recent study by Taniguchi (2019) examines the impact of rising Chinese imports on the Japanese local labor market at the prefecture-level following the methodology used in Autor et al. (2013). She finds that the impact of imports from China is not negative, it is rather a positive effect in case of intermediate goods import. However, although the labor market effect of rising Chinese import is not significant, fierce competition from low wage countries might have forced some firms to switch their products or give up producing existing products.

Considering the impact of Chinese imports on the production mix of firms located in high wage countries, some earlier literature has shown that US manufacturing firms have changed their activity mix in response to import from low wage countries even before the accession of China to WTO. For example, Bernard et al. (2006) show that over the 1977-1997 period, US manufacturing plants were more likely to switch industries in response to trade with low-wage countries than in response to trade with high wage countries. Liu (2010) confirmed this finding for the U.S. public firms, by

[4] Branstetter et al. (2019) also found a strong and negative impact of the rise of imports from China on Portugal Manufacturing employment. However, they report that this significant negative impact didn't work through a direct import competition channel. Instead, it came from the competition of Chinese products to Portuguese ones sold on exports markets, and through the exit of Portuguese exporting manufacturing firms.

showing that large multi-industry U.S. firms tend to exit from their most peripheral production lines and to concentrate on their core production activities as a response to increased trade liberalization. However, this paper does not focus on China competition *per se*, and does not provide direct evidence at the product level.

More recently, a bunch of papers has shown that some manufacturing firms in high wage countries upgraded their technology in response to Chinese competition (Bloom et al., 2015; Mion and Zhu, 2013; Utar, 2014). More specifically, these papers show that increased competitive pressures from China make firms to adopt production processes that are more intensive in skilled and non-production workers (Mion and Zhu, 2013; Utar, 2014), and to rely more on innovation (Bloom et al., 2015; Utar, 2014). A last series of papers investigates how exporting firms in high wage countries adapt their exported product portfolio as a response to higher China competitive pressure. In particular, Martin and Mejean (2014) show that French manufacturing firms responded by upgrading the quality of their exported products. Fontagné et al. (2018) find that French and Italian firms responded by dropping some products from their export basket. They also show that more stable products within a firm export basket are also more resilient to China competition [5].

However, none of these previous contributions scrutinize the overall product mix of manufacturing firms, and how it has been impacted by the rise of Chinese imports[6]. By contrast, Iacovone et al. (2013) addresses this issue on a large sample of manufacturing plants operating in a middle-income country, namely Mexico. The paper examines the impact of Chinese import on within-firm reallocation at the plant-product level. They show that sales of smaller Mexican plants and more marginal products were compressed and were more likely to cease, whereas those of larger plants and core products seemed relatively impervious to the shock. However, the way China competition impact manufacturing firms in a high wage country, such as Japan, can be very different from the way it impacts firms in an emerging economy such as Mexico [7].

Considering the role that the local environment plays in supporting the competitiveness of firms or products, some earlier work in economic geography has already brought useful insights. First, a couple of recent studies have shown that firms' export performances as well as their decisions to start and stop exporting some products were impacted by how those products were embedded in their local environment (see Poncet and Starosta de

[5] A stable product refers to the product that is more prevalent over time across firm' export destinations. It is not necessarily the core product of the firm, which is defined as the product with the highest share in firm' total sales at a given time.

[6] Utar (2014) shows some partial evidence of product churning in Danish Textile&Clothing (T&C) firms facing the removal of quotas on Chinese imports of T&C products in 2002.

[7] For instance, Dang (2017) investigates to what extent Vietnamese manufacturing firms have been incited to introduce product innovations following the increase in Chinese imports. He shows that contrary to what has been found for the U.S. by Bloom et al. (2015), there is no systematic evidence that rising imports from China make Vietnamese domestic firms adopt new technologies or innovations in their products.

Waldemar (2015) for evidence on China and Hazir et al. (2019) for evidence on France). These two previous studies rely on the so called methodology of product space developed by Hidalgo et al. (2007) to assess to what extent a product is embedded into its local environment. This methodology has been extensively used in the recent literature on related diversification. In particular, Hausmann and Hidalgo (2011) show that product relatedness plays an important role in product diversification and product upgrading at the country level. More recent studies link the product relatedness measure with regional comparative advantages and examine its impact on the growth path at the regional level (Boschma et al., 2012) or at the firm level, as the two studies cited above. In this study, we push this research avenue by relying on the product-space methodology to investigate to what extent local product relatedness matters in driving product downsizing and dropping by plants.

Second, another strand of the economic geography literature emphasizes that the spatial organization of the firm is not random and that firms, especially multi-unit ones, face complex location trade-offs related to the use of both internal and external resources (Woo et al. (2019), Alccer and Delgado (2016), Behrens and Sharunova (2015)). In particular, Behrens and Sharunova (2015) argue that because interacting at a distance is costly, multi-unit firms should be geographically compact, and also that plants belonging to multi-unit firms should depend less on external agglomeration benefits than comparable standalone plants. Dissecting the micro-geographic location patterns of Canadian plants, they find robust evidence for the predictions that multi-unit firms are compact and their plants locate in areas offering potentially less external agglomeration benefits. In our own research framework, we take the spatial organization structure of firms as given, and we investigate how their incumbent plants react to new competitive shocks. However, because firms that exhibit different spatial organization patterns are likely to face different adjustment costs and different trade-offs as regards the use of their internal and external resources, we expect their plants to exhibit some differences in the way they respond to competitive shocks. More specifically, following Behrens and Sharunova (2015), we question whether standalone plants, plants owned by compact multi-unit firms, and plant owned by dispersed multi-unit firms react differently to competitive shocks. On the one hand, we could expect local plants owned by large multi-unit firms to be more resilient to negative shocks as they can benefit from internal resources, including internal agglomeration economies especially for the case of compact multi-unit firms. On the other hand, we could expect product lines operated by plants owned by large corporations to be more sensitive to negative competitive shocks as the opportunity costs of reallocating exposed resources to alternative uses can be smaller within a large corporation.

Finally, closer to our research question, a recent paper by Behrens et al. (2019) assesses the role played by geographical clusters in the resilience of Textile and Clothing (T&C) plants in Canada following the end of the Multi Fibre Arrangement (MFA) in 2000 and the consecutive rise of Chinese imports to Canada. Interestingly, Behrens et al. (2019) find that while being in a cluster didn't make Canadian T&C plants more resilient to China import competition, it made those plants more likely to switch into different industries following the end of the MFA. Their results suggest that the local environment might matter in more complex ways than one could *a priori* think of. Related to this line of inquiry, our paper provides broader evidence on how local product spaces are impacting product churning within Japanese manufacturing plants facing China import competition in a large variety of industries.

3 Data

3.1 Data sources

Our primary data are the longitudinal data sets of the Census of Manufacture (COM)[8]. The COM is a comprehensive plant-level data set compiled by the Ministry of Economy, Trade, and Industry (METI). It covers all plants with more than four or more employees located in Japan. Compared with the number of employment and sales in the System of National Accounts, our data set covers 57% and 74% in terms of employment and sales as of 2014. On the one hand, it includes information on plant characteristics, such as their location, number of employees, amount of tangible assets, value of shipments, and 4-digit level sector classification[9]. On the other hand, it includes information on plant-product level shipments at 6-digit level commodity classification. In this study, we use the plant-product level data over the period from 1997 to 2014.

In addition to the COM, we use trade data from Japanese customs at the HS 9-digit level to obtain information on China import competition. Since HS 9-digit classification is often revised, we use the concordance table of HS 9-digit codes constructed by Aoyagi and Ito (2019). Then, the concordant HS 9-digit import data are matched with the product code of the Census of Manufacture at 6-digit. The concordance table between the COM 6-digit commodity data and HS 9-digit trade data are constructed in Baek et al. (2019)[10]. In our matched data set, 1125 products are included, while in the original data set in the COM, there are 2378 products as of the year 2014. However, not all products in the COM are tradable goods (e.g., revenue from modification and repair fee or piecework) or can be matched with trade statistics (e.g., miscellaneous office paper products). Lastly, we use BACI database, which is maintained by CEPII research center, to measure the China competition and quantify bilateral product proximity. The database provides information on bilateral trade flows among countries at HS 6-digit level.

To define the spatial structure of the plant's organization, as well as to

[8]The survey in year 2011 was conducted as "Economic Census for Business Activities" (Ministry of Internal Affairs and Communications) in place of the COM. We complement the data of the year 2011 from Economic Census.

[9]The information on the international trade activities at plant-level is quite limited. It provides the share of export revenue in total shipment from 2001. However, there is no information on the import side.

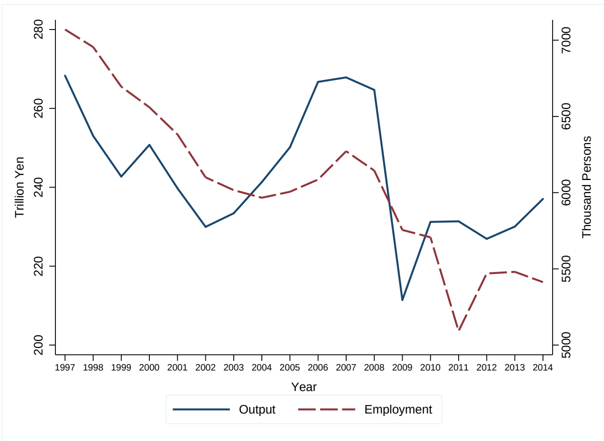
[10]The concordance table is provided by Dr. Youngming Baek.

compute our product space variables we work at the level of the commuting zone. Commuting zones represent an intermediate spatial scale between prefectures and municipalities. The choice for commuting zones against prefectures is driven by the the fact that there are 47 prefectures in Japan, each comprises more than one local market, and thus they are too large to represent local markets as a geographical unit. Whereas, the choice against municipalities (*Shi Ku Cho Son*) is motivated by the fact that they are too small to cover local markets given that as of year 2005 there are 2500 municipalities in Japan. In contrast, the commuting zones represent local markets and they are constructed by merging several municipalities based on commuting patterns. We obtain the information on the 110 commuting zones from Minrokyu 2015 compiled by Asahi Shimbunsha [11]

3.2 Key figures

Our period of investigation is a period of contraction in Manufacturing sector as illustrated by Figure 1. Overall, employment declined by about 23% between 1997 and 2014. Output has been more cyclical but the general trend is also downwards over the period. In terms of the number of manufacturing plants, Table 1 (first column) shows also a decline (38.5 %) from 195,168 to 120,945.

Figure 1: Manufacturing employment and output in Japan (1997-2014)



Source: Census of Manufacturer (Ministry of Economy, Trade and Industry).
Notes: The census covers plants with four or more employees. Output is computed as the sum of plant shipments and employment is computed as the sum of plant employees.

The remaining columns of Table 1 present the breakdown of plants with respect to corporate affiliation and plant product scope for 4 reference years

[11] While there is no official definition for the commuting zones in Japan, several researchers propose slightly different definitions. For example, Kanemoto and Ishioka (2002) define the urban employment area, which does not cover all the municipalities in rural areas unlike the definition in Minryoku. The commuting zones in Minryoku are used in earlier papers such as Yano et al. (2003).

during 1997-2014. This breakdown reveals that the shares of plants affiliated to single-unit and multi-unit firms have remained stable over time, and the former accounts for more than 85% of all plants. The shares of specialized and diversified plans, defined respectively as single-product and multi-product plants, have also been stable over our period of investigation, with the share of specialized plants accounting for about 75% of all plants. Interestingly, this stability contrasts with the finding by (Bernard and Okubo, 2016) according to which the share of Japanese manufacturing multi-product firms (not plants) increases over the period 1992-2006. However, both findings can be reconciled in so far as the expansion of multi-product firms partly occurs through the expansion of specialized plants within multi-unit firms. Below, we show some evidence supporting this view [12].

Table 1: Breakdown of plants by corporate organization structure and product scope

		Breakdown of plants (as %)					
		owned by Single-unit Firms			owned by Multi-unit Firms		
Year	**Count**	Specialized	Diversified	Total	Specialized	Diversified	Total
1997	195 168	64	22	86	9	4	14
2002	168 521	65	22	88	8	4	12
2007	151 462	65	22	87	9	4	13
2014	120 945	63	23	86	9	4	14

Source: A matched database of Census of Manufacturers with International Trade data.

In Table 2, we distinguish plants owned by multi-unit firms further by considering the spatial organization of the parent firm. We label parent multi-unit firms that have all their units in the same commuting zone as compact multi-unit firms referring to their compact spatial organization. Then, multi-unit firms that have their units in different commuting zones are labeled as dispersed multi-unit firms owing to dispersion in their spatial organization. [13] The table shows that the share of plants belonging to multi-unit firms has increased over time, and the increase is driven by specialized plants, which represent the majority of affiliated plants. This implies that in a context of global decline in the number of Japanese manufacturing plants, there is a survival bias in favor of specialized plants belonging to dispersed multi-unit firms.

In order to highlight plant heterogeneity among different types of firm structure, we present some descriptive statistics on the average plant size for plants owned by single-unit firms, compact multi-unit firms, and dispersed multi-unit firms in Table 3. For specialized plants, we report the average number of employees, while we report both the average number of employees

[12] Overall, these contrasting features of micro-data at firm versus plant levels show the importance of going deep into micro-data to reveal all the dimensions of the structural change that takes place within Manufacturing in high wage countries (see Fort et al. (2018) for a similar argument)

[13] To identify the spatial organization of the parent firm, we use the list of headquarter names and addresses of COM, which is also provided by METI.

Table 2: Breakdown of plants by parent firm spatial scope

		Breakdown of plants (as %)					
		owned by Compact Multi-unit Firms			owned by Dispersed Multi-unit Firms		
Year	**Count**	Specialized	Diversified	Total	Specialized	Diversified	Total
1997	10 994	29	12	41	39	20	59
2002	7 537	26	10	37	42	22	63
2007	6 912	26	10	36	43	21	64
2014	5 611	24	9	34	45	22	66

Source: A matched database of Census of Manufacturers with International Trade data.

and the average number or products for diversified plants.

Table 3: Plant heterogeneity according to product scope and corporate organization structure

	Average # of employees	**Average # of products**
Specialized plants (*owned by*)		
Single-unit firms	21	-
Compact Multi-unit firms	56	-
Dispersed Multi-unit firms	105	-
Diversified plants (*owned by*)		
Single-unit firms	33	2.47
Compact Multi-unit firms	115	2.65
Dispersed Multi-unit firms	289	3.01

Source: A matched database of Census of Manufacturers with International Trade data.

This breakdown highlights large size gaps between our different plant categories. To illustrate, the average size of specialized standalone plants is less than one-tenth of the average size of diversified plants owned by dispersed multi-unit firms. A clear size hierarchy also appears between plants owned by compact multi-unit firms and plants owned by dispersed multi-unit firms, the latter being at least twice as large as the former whatever their product scope. Finally, within diversified plants, the product scope of plants owned by dispersed multi-unit firms is systematically larger than the product scope of plants owned by compact multi-unit firms, or by standalone plants.

4 Econometric Model and Estimation Issues

4.1 Model Specification and Variables

Let i be the plant, k be the product, and $r(i)$ be the locality where plant i operates. Our baseline econometric specification is expressed as:

$$\begin{aligned} y_{i,k,t} &= \beta_1 IMP_{k,t-s} + \beta_2 X_{i,t-s} + \beta_3 Share_{i,k,t-s} + \beta_4 IMP_{k,t-s} * Share_{i,k,t-s} \\ &\quad + \beta_5 LPA_{k,r(i),t-s} + \beta_6 LPR_{k,r(i),t-s} + \mu_{i,k} + \lambda_t + \epsilon_{i,k,t} \qquad (1) \end{aligned}$$

In this equation, the dependent variable indicates either product exit or sales. When $y_{i,k,t}$ indicates product exit, following Iacovone et al. (2013), it is defined as a dummy variable that takes the value 1 when plant i produces product k in year $t-s$ but not in t [14]. When $y_{i,k,t}$ indicates sales, it is defined as the logarithm of sales revenues of plant i in product k in year t, given that k was present in its product portfolio in year $t-s$.

In our baseline specification, explanatory variables are time lagged by an amount of s. We study the case $s = 1$ as the immediate response of the plant, and $s = 3$ as its later response. We expect product level responses to vary over time since product differentiation, plant or firm level adjustments can take some time to be effective on outcome variables we study.

Among explanatory variables, $IMP_{k,t-s}$ accounts for the China import competition pressure, and it is defined as the Chinese import share in year $t-s$ in Japan's total imports of product k. $X_{i,t-s}$ is a vector of plant characteristics. It includes the labor productivity[15], the number of employees in logarithm, and the logarithm of the number of products at the plant-level. $Share_{i,k,t-s}$ is defined as the share of product k in sales of plant i in year $t-s$. It allows to identify whether or not product k is a core product for plant i. In the literature on trade of multi-product firms (e.g., Mayer et al. (2014)), a product with the largest sales within a firm is regarded as the most profitable product or *core product*. To control for within-plant heterogeneity across products, we include the interaction term of $Share_{i,k,t-s}$ with import competition measure, $IMP_{k,t-s}$.

Next, $LPA_{k,r(i),t-s}$ and $LPR_{k,r(i),t-s}$ account for the effect of external agglomeration economies, and they are defined at the level of our 110 commuting zones. Thus, the locality $r(i)$ of firm i is the commuting zone containing i. Among them, local product alignment (LPA) is a dummy variable which controls for whether product k has a revealed comparative advantage (RCA) at the locality level. If this is the case, we would consider that plant-product k is aligned with the competitive advantage of locality $r(i)$. On the other hand, local product relatedness (LPR) accounts for the proximity of product k to all the core products of locality $r(i)$. To quantify bilateral proximity between any pair of products, we make use of the methodology

[14] For a few plants, we observed re-entry of a product after the plant has dropped it for a few years. Thus, the dummy variable indicating product exit is constructed by taking the final reporting year of the plant-product as a reference.

[15] We do not compute total factor productivity (TFP) because information on the amount of tangible assets is restricted to plants with 30 or more employees.

of Hidalgo et al. (2007). This methodology relies on the likelihood of the co-occurrence of products in the export baskets of countries to infer the similarities or complementarities among products based on underlying capabilities, which can be production factors, skills, knowledge base, institutions, business networks, etc. The details of the definitions of LPA and LPR and main construction steps are explained in Appendix A. Lastly, $\mu_{i,k}$, λ_t, and $\epsilon_{i,k,t}$ stand for plant-product fixed effects, year fixed effects, and the error term, respectively.

4.2 Estimation Issues

Ordinary Least Squares (OLS) estimation of the specification given in Equation 1 can suffer from endogeneity bias, if the demand shock in Japan affects both import from China to Japan and the domestic product sales. To account for that, we follow the identification strategy proposed by Autor et al. (2013), and use the shares of Chinese import to the U.S. and to Europe to instrument the import competition variable. These variables can be expected to be correlated with Japan's imports from China, because they would all get affected by a supply shock in China, such as an improvement of market access from China to developed countries, or productivity enhancement of Chinese firms. However, they are likely to be exogenous as the demand shock in Japan may not have any effect on the European and the U.S. imports from China. Therefore, these variables can be expected to work as valid instruments.

We first estimate the baseline specification by distinguishing specialized and diversified plants. We then further discriminate plants with respect to the organization structure of the parent firm, and estimate the baseline model separately for the three sub-samples of standalone plants, plants owned by compact multi-unit firms and plants owned by dispersed multi-unit firms. This allows us to examine potential heterogeneity within specialized and diversified plants that can be induced by firm structure and spatial organization.

5 Results

5.1 Baseline Results

Table 4 presents estimation results for the baseline specification, which is given in Equation 1, for specialized and diversified plants and for two different time lags and plant outcomes[16]. We compare plant responses in 1-year and 3-years labeling them as immediate response and later response, respectively. We also compare two plant outcomes, which are product exit and product sales conditional on the survival of the product line.

[16] We present only the results of the second stage of the instrumental variables estimation. The first stage regression results can be provided upon readers' request

Table 4: A global view of immediate and late responses of specialized and diversified plants: product exit and product sales

	Immediate Response ($s = 1$)				Later Response ($s = 3$)			
	Exit		Sales in Survivors		Exit		Sales in Survivors	
	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified
IMP	0.377***	0.514***	-0.785***	-1.301***	0.607***	0.816***	-0.876***	-1.381***
	(0.0797)	(0.0600)	(0.210)	(0.226)	(0.136)	(0.114)	(0.232)	(0.276)
IMP * Share		-0.266***		0.449***		-0.379***		0.161
		(0.0268)		(0.125)		(0.0447)		(0.116)
Share		0.0127*		1.389***		0.0376***		0.488***
		(0.00742)		(0.0433)		(0.0117)		(0.0328)
log # of products		-0.00773***		0.0581***		-0.0112***		0.00973
		(0.00177)		(0.00891)		(0.00292)		(0.00862)
log employees	-0.0950***	-0.0942***	0.711***	0.633***	-0.129***	-0.118***	0.419***	0.354***
	(0.00304)	(0.00283)	(0.00733)	(0.0123)	(0.00415)	(0.00550)	(0.0102)	(0.0149)
labor productivity	-0.0374***	-0.0326***	0.451***	0.362***	-0.0518***	-0.0452***	0.198***	0.165***
	(0.00163)	(0.00174)	(0.00676)	(0.00785)	(0.00259)	(0.00318)	(0.00657)	(0.00707)
LPA	-0.00320**	-0.00277*	0.0129***	0.0566***	-0.00607*	-0.00208	0.00878**	0.0272***
	(0.00146)	(0.00142)	(0.00332)	(0.00491)	(0.00310)	(0.00253)	(0.00432)	(0.00453)
LPR	-0.0231	-0.0714***	0.0548	0.0691	-0.134***	-0.194***	0.111*	0.0994*
	(0.0215)	(0.0161)	(0.0565)	(0.0479)	(0.0324)	(0.0244)	(0.0600)	(0.0563)
Observations	2,071,042	1,926,526	1,732,625	1,577,469	1,885,123	1,740,105	1,282,943	1,135,855
R-squared	0.257	0.267	0.960	0.946	0.592	0.610	0.955	0.944
Hansen J	0.489	5.079	1.974	1.314	1.175	5.940	2.465	1.371
Hansen J_p	0.484	0.0789	0.160	0.519	0.278	0.0513	0.116	0.504
Widstat	3508	2012	3042	1668	3212	1827	2484	1258

Notes: IV estimation, Plant-Product and Year FE included, errors clustered at the Product level. ***, ** and * indicate the statistical significance at 1%, 5% and 10% respectively.

According to Table 4, China import competition fostered product exit in both specialized and diversified plants in Japan and in both 1-year and 3-year time windows. The negative effect of import competition on product survival in stronger on the 3-year horizon, which is consistent with the idea that exit decisions entail costs and take time. The impact of China import competition can further be observed in product sales given that the product line is maintained.

Regarding the magnitudes of the effects of IMP, a 1% increase in IMP increases product exit probability by 0.6% for specialized plants and by 0.8% for diversified plants. Conditional on the survival of the product, it also decreases product sales by 0.9% in specialized plants and by 1.4% in diversified plants. Since average IMP increases from 16% to 33% during our sample period, a three-year average change in IMP is 3% and it increases product exit probability by 1.8% for specialized plants and by 2.4% for diversified plants; and decreases product sales by 2.6% for specialized plants and by 4.2% for diversified plants.

When we take a closer look at immediate response of diversified plants, we observe that the coefficient estimates for the interaction term $IMP * Share$ are statistically significant and have the opposite sign of the import competition coefficient. This implies higher resilience of core products and it is a result in line with our theoretical priors (Bernard et al. (2011), Mayer et al. (2014)) and with the previous empirical findings by Iacovone et al. (2013). When we consider plant responses at a longer period of 3-years, we observe higher tendency of core products to survive. However, conditional on survival, no further evidence on the resilience of core products is found in terms of sales.

A second group of coefficient estimates in Table 4 supports the hypothesis that plant heterogeneity can mitigate the negative impact of import competition. Given China import competition pressure and regardless of the length of the time-window, we observe, for both specialized and diversified plants, that the higher the plant productivity and size, the higher the probability that the product line is maintained and the more the product sales. In the case of diversified plants, the plant product range also deters exit in any given product line and fosters subsequent sales, possibly due to common or complementary resources among their products.

The last group of coefficient estimates in Table 4 shed some light on whether external agglomeration can help plants to mitigate negative effects of import competition. When we compare immediate and later responses of plants in terms of product exit, we observe different roles played by alignment with local specialization (LPA) and relatedness to local specialization (LPR). In the short run, plants are likely to maintain product lines, in which the locality has a RCA. However, the effect of this alignment is small in magnitude. Also, the statistical evidence for diversified firms is weaker, which may be explained by within plant complementarity in diversified plants since it can substitute for external agglomeration economies. In the longer run, we find stronger statistical evidence both for specialized and diversified firms that they are likely to maintain products related to core capabilities of the region. This change over time might be due to the fact that relatedness can work through quality upgrade or innovation, which would require some time to become effective on plant behavior. It is observed that for diversified plants that the coefficient of the LPR variable is statistically significant even in the 1-year window. It may again be within plant variety in capabilities, or former diversification experience that makes diversified plants more agile in exploiting relatedness to local specialization. When we look at further effects of external agglomeration on maintained product lines, we find statistical evidence that both specialized and diversified plants operating in the same product line as the local specialization obtain higher sales. Although weak, we also find some evidence that relatedness to local specialization fosters sales conditional on survival of the product line.

The analysis we present above confirms that manufacturing plants in Japan adjusted to China import competition either by dropping or by downsizing their most exposed product lines. Moreover, it comforts the view that product survival and sales are also impacted by the individual characteristics of the plant, and by different types of external agglomeration economies. In the next regression step, we integrate the structure and spatial organization of the parent firm to the analysis. The main issue at stake is to assess whether the negative impact of import competition varies according to the type of the parent firm. We indeed expect the sensitivity to China competition to differ between standalone plants, and plants owned by multi-unit firms, as adjustment costs are likely to differ across these two categories of plants. Additionally, we expect the structure and spatial organization of the parent firm to alter the role of certain individual plant characteristics, as the impact of the latter might be alleviated by the presence or strength of agglomeration economies internal to firms. Finally, the effects of external agglomeration economies discussed above might also conceal substantial heterogeneity in particular if internal agglomeration economies partly substitute for external ones (Behrens and Sharunova, 2015).

5.2 Extension with the structure and spatial organization of the parent firm

Table 5 distinguishes exit response of plants according to the structure and spatial organization of the parent firm. As baseline, we present the results for later exit (s=3) as we have seen that a wider time window permits different channels of adjustment, and especially the exit one, to become fully effective[17]. The estimation results for sub-samples confirm the negative impact of import competition on the survival of product lines for each category of plants. Although the coefficients are systematically higher for plants owned by multi-unit firms, those differences are not statistically significant[18]. So plants owned by large multi-units firms do not show higher tendency to drop exposed products, despite the fact they could in theory more easily reallocate their resources across different uses. Interestingly, they don't show

[17] Our sub-sample results for immediate response (s=1) on both the extensive (exit) and the intensive (sales) margins are presented in Appendix B

[18] We tested the null hypotheses on the equality of IMP coefficients by computing the z-score with unstandardized coefficient estimates.

either higher resilience to import competition than standalone plants, despite the fact they could in theory benefit from large corporations' specific assets to resist foreign competition[19].

Considering the group of coefficients related to plant level characteristics, we do not see much heterogeneity across our different sub-samples of plants. Still, it appears that plant labor productivity matters more for standalone plants as compared to plants owned by multi-unit corporations. This result could be explained by the fact that standalone plants are more sensitive to their own efficiency than plants that can rely on assets external to them but internal to the firm they belong to. Also, for plants belonging to compact multi-unit firms, for which internal agglomeration economies can be assumed to prevail, we find that the plant product range does not hinder product exit. This is consistent with the idea that within-plant complementarities are less key for plants which are part of a larger corporation and these plants rather rely on cross-plant complementarities within that corporation.

Table 5: Determinants of product exit for specialized and diversified plants (s=3): breakdown by firm organization

	Single-unit Firms		Compact Multi-unit Firms		Dispersed Multi-unit Firms	
	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified
IMP	0.572***	0.772***	0.793**	0.684***	0.793**	0.876***
	(0.128)	(0.125)	(0.375)	(0.148)	(0.375)	(0.109)
IMP * Share		-0.389***		-0.366***		-0.562***
		(0.0442)		(0.117)		(0.0862)
Share		0.0468***		0.0330		0.0233
		(0.0123)		(0.0287)		(0.0199)
log # of products		-0.0133***		-0.00632		-0.0323***
		(0.00300)		(0.0119)		(0.00824)
log employees	-0.133***	-0.116***	-0.115***	-0.0950***	-0.115***	-0.131***
	(0.00435)	(0.00635)	(0.00982)	(0.00757)	(0.00982)	(0.00631)
labor productivity	-0.0544***	-0.0472***	-0.0326***	-0.0249***	-0.0326***	-0.0286***
	(0.00286)	(0.00345)	(0.00432)	(0.00515)	(0.00432)	(0.00354)
LPA	-0.00734**	2.58e-05	-0.000443	-0.0156**	-0.000443	-0.0151***
	(0.00333)	(0.00273)	(0.00526)	(0.00736)	(0.00526)	(0.00442)
LPR	0.00436	-0.100***	0.268*	0.0755	0.268*	0.169***
	(0.0379)	(0.0369)	(0.143)	(0.117)	(0.143)	(0.0640)
Observations	1,659,743	1,431,356	129,507	90,743	129,507	205,177
R-squared	0.596	0.618	0.589	0.645	0.589	0.590
Hansen J	0.989	6.888	2.515	3.741	2.515	2.496
Hansen J_p	0.320	0.0319	0.113	0.154	0.113	0.287
Widstat	3089	1429	112.3	77.60	112.3	271.8

Notes: IV estimation, Plant-Product and Year FE included, errors clustered at the Product level. ***, ** and * indicate the statistical significance at 1%, 5% and 10% respectively.

The heterogeneity regarding the effect of external agglomeration on product exit is more substantial across our different categories of plants. First, the global result for specialized firms that LPA deters exit is indeed driven by standalone plants. This results suggests that specialized plants, which do not benefit from a large corporate affiliation, tend to rely on external economies as a possible substitute for the lack of internal economies. Another plausible explanation is that specialized plants belonging to multi-unit

[19] It could be that the two effects are counterbalancing each other. However, our empirical framework does not allow to disentangle these two potential opposing forces.

firms are likely to represent the case where the firm maximizes economies of scale in a mature product, for which the returns of agglomeration can be constant or even negative due to saturation on the local market, fierce competition, etc. (Potter and Watts, 2010). Second, the global result for specialized firms that LPR hinders exit is indeed driven by cross-group differences. Standalone plants do not benefit from local product relatedness, possibly because they lack resources or cross-fertilization opportunities arising from within plant/firm variety. Finally, although it is weak, we find some evidence that specialized plants belonging to multi-unit firms tend to exit from products related to the specialization of the locality. This is a puzzling result that echoes the complex relationship between agglomeration economies and resilience to competitive shocks found in Behrens et al. (2019)[20].

Table 6: Determinants of product sales for specialized and diversified plants (s=3): breakdown by firm organization

	Single-unit Firms		Compact Multi-unit Firms		Dispersed Multi-unit Firms	
	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified
IMP	-0.742***	-1.249***	-0.671**	-1.795***	-1.995***	-1.744***
	(0.208)	(0.310)	(0.327)	(0.486)	(0.676)	(0.279)
IMP * Share		0.154		0.392		0.557**
		(0.121)		(0.263)		(0.249)
Share		0.430***		0.505***		0.671***
		(0.0339)		(0.0896)		(0.0638)
log # of products		0.00966		0.0418		0.0338
		(0.00946)		(0.0359)		(0.0241)
log employees	0.424***	0.378***	0.340***	0.212***	0.353***	0.255***
	(0.00999)	(0.0169)	(0.0189)	(0.0260)	(0.0266)	(0.0197)
labor productivity	0.198***	0.168***	0.140***	0.128***	0.190***	0.118***
	(0.00685)	(0.00749)	(0.0164)	(0.0201)	(0.0159)	(0.0122)
LPA	0.00913**	0.0179***	0.000286	0.0127	0.0109	0.0785***
	(0.00412)	(0.00481)	(0.0135)	(0.0212)	(0.0137)	(0.0144)
LPR	-0.0996	0.0685	-0.0991	-0.0607	-0.223	-0.294
	(0.0674)	(0.0786)	(0.189)	(0.324)	(0.298)	(0.188)
Observations	1,115,217	912,301	60,981	61,591	99,511	153,003
R-squared	0.949	0.934	0.946	0.934	0.944	0.929
Hansen J	2.275	1.551	1.596	0.912	1.698	4.825
Hansen J_p	0.131	0.461	0.206	0.634	0.193	0.0896
Widstat	2372	968	77.22	50.40	97.43	208.4

Notes: IV estimation, Plant-Product and Year FE included, errors clustered at the Product level. ***, ** and * indicate the statistical significance at 1%, 5% and 10% respectively.

In Table 6, we study plant responses in terms of product sales by distinguishing them according to the structure and spatial organization of the parent firm. Our results reveal that, conditional on survival, specialized plants belonging to dispersed multi-unit firms are more sensitive to China competition than other specialized plants [21] Specifically, following the same

[20]Understanding those relationships better would require to investigate the exit cases accompanied with new product entry, because exit for these plants implies corporate restructuring and corporate resources can make product switching less costly for them as compared to single-unit firms.

[21]The null hypotheses suggesting equality of the coefficient of IMP for plants belonging to dispersed multi-unit firms to that of standalone plants and plants belonging to compact multi-unit firms are rejected at 90% confidence level.

reasoning as above, the magnitude of the impact of IMP on product sales for specialized plants owned by Multi-unit firms is a 2% decrease in product sales in a three-year horizon.

Considering the impact of the regional variables, we find that the positive impact of local product alignement(LPA) on product sales is mainly driven by standalone plants. For plants belonging to compact multi-unit firms, finding no evidence on such an effect can be explained by internal agglomeration economies (Behrens and Sharunova, 2015; Alccer and Delgado, 2016). Indeed, internal economies are likely to be less strong for plants belonging to spatially dispersed multi-unit firms as interacting at a distance is costly. This may explain why we find some evidence on LPA variable for this group of plants. Lastly, we find no statistical evidence on the effect of LPR on sales regardless of the sub-sample. This reveals that the mitigating effect of the LPR variable we observed for all plants (Table 4) was indeed driven by cross-group differences. This means that it is safer to conclude that, once the product survives, there is no further impact of LPR on product sales.

5.3 Robustness Checks

We studied the sensitivity of the above-presented results by extending our model with further international trade measures. First, we controlled for the share of import from 10 ASEAN member countries in the focal product market (ASEAN IMP), because Japan's imports from low-wage countries are not only from China. This additional control is considered as an endogenous variable, and instrumented in the same way as the share of Chinese imports.

As can be observed from estimation results presented in Table 7 and Table 8, the coefficient estimates of the additional variable turned out to be statistically insignificant, and the main findings that are discussed in the previous section remained unchanged. First, both standalone plants and plants owned by large corporations are negatively impacted by China competition. Second, product resilience is not higher for plants owned by large corporations than for standalone plants, yet for diversified plants core product line is more resistant to import competition. Third, conditional on survival, product sales of plants owned by large corporations are nonetheless more sensitive to China competition than standalone plants[22]. Fourth, individual plant efficiency, which we proxy with labor productivity, plays a stronger alleviating role for standalone plants than for plants owned by large corporations. Fifth, the product range of diversified plant is not a factor hindering product exit in plants owned by compact multi-unit firms, while it plays such a supportive role in standalone plants and in plants owned by dispersed multi-unit firms. Lastly, external agglomeration economies (LPA and LPR), play in a very similar way as compared our baseline regressions. Evidence is weak, if at all, that they affect product competitiveness in plants belonging to compact multi-unit firms. Product alignment to local specialization helps product survival mainly in standalone plants and the plants owned by dispersed multi-unit firms. Whereas, product relatedness to local

[22]Note that in this robustness check, this fact holds for both diversified and specialized plants, while it was holding for specialized plants only in our baseline regressions.

specialization usually favor product survival, although a noticeable exception prevails for plants owned by dispersed multi-unit firms, for which LPR favors product exit instead of hindering it.

Second, we controlled for the share of exports from Japan to China in the focal product market to control for the export opportunities. According to Dauth et al. (2014), who investigate the impact of Chinese imports on German local labor markets, export demand from China mitigates negative impacts of import competition and contributes to retaining manufacturing sectors in Germany. Since Japans exports to China is as large as its imports from China, increased export opportunities may mitigate the negative impact of import competition pressures as in Germany. In the case of product exit, as can be observed from Table 9, we don't find evidence on such a mitigation effect. The coefficients of the export opportunity variables are either statistically insignificant or they have the opposite sign. The unexpected positive coefficient estimate might be pointing out to relocation rather than closure of a product line for plants belonging to dispersed multi-unit firms, yet it is baffling for specialized plants belonging to standalone and compact firms. Controlling for export opportunities leaves the results on product exit unchanged. In the case of product sales, we find some statistical evidence on a mitigation effect as shown in Table 10. Export opportunities can help mitigating the impacts of import competition for standalone plants and specialized plants belonging to compact multi-unit firms. Controlling for export opportunities leaves again the results on product sales almost the same. Here, the only noticeable difference is that specialized plants owned by compact multi-unit firms become insensitive to China competition. This change can be explained by the fact that specialized plants operated by compact multi-unit firms are likely to be upstream plants providing highly specific or high quality input to other units of the compact firm[23]. Thus, once we account for alleviation of the negative impact of import competition by export opportunities, we can expect to observe no further negative impact of import competition on these plants benefiting from within firm vertical linkages.

Third, we considered a measure of imported inputs from China. Increases in cheaper and a larger variety of imported input from China may be beneficial for product survival, and product sales. To take account of this effect, we follow the previous literature (Acemoglu et al. (2016) and Iacovone et al. (2013) in particular) by using Japanese Input-Output tables and calculating Chinese import shares weighted with input-output coefficients[24]. Again, as presented in Table 11 and Table 12 , coefficient estimates of the new variable turned out to be insignificant and our key results remained

[23]Behrens and Sharunova (2015) emphasize indeed that multi-unit compact firms are characterized by strong vertical linkages across their units.

[24]We used the input coefficients in the year of 1995 which is included in Linked Input-Output (IO) Table for 1995-2000-2005. To link the sector classification of Linked IO Table with the COM commodity classification, we use the concordance table between 2005 Basic IO Table and the COM commodity classification, which is provided in the Appendix of 2005 Basic IO Table. Following Acemoglu et al. (2016), we choose 1995 IO table because the input-output linkages in 1995 might be less likely to be affected by the import from China.

unchanged.

Table 7: Product Exit (s=3): Controlling for the share of ASEAN countries in imports of Japan

	All Firms		Single-unit Firms		Compact Multi-unit Firms		Dispersed Multi-unit Firms	
	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified
IMP	0.562***	0.800***	0.541***	0.768***	0.520*	0.701***	0.752**	0.855***
	(0.156)	(0.130)	(0.149)	(0.145)	(0.306)	(0.158)	(0.383)	(0.110)
IMP * Share		-0.377***		-0.389***		-0.366***		-0.559***
		(0.0460)		(0.0470)		(0.118)		(0.0860)
Share		0.0372***		0.0467***		0.0330		0.0226
		(0.0118)		(0.0127)		(0.0289)		(0.0198)
ASEAN IMP	-0.189	-0.144	-0.0995	-0.0519	-0.0277	0.0305	-0.801	-0.257
	(0.471)	(0.517)	(0.475)	(0.595)	(0.516)	(0.352)	(0.750)	(0.336)
log # of products		-0.0114***		-0.0133***		-0.00617		-0.0328***
		(0.00293)		(0.00302)		(0.0119)		(0.00823)
log employees	-0.130***	-0.118***	-0.133***	-0.116***	-0.0920***	-0.0951***	-0.114***	-0.131***
	(0.00464)	(0.00542)	(0.00491)	(0.00634)	(0.00851)	(0.00762)	(0.0102)	(0.00621)
labor productivity	-0.0519***	-0.0451***	-0.0545***	-0.0471***	-0.0189***	-0.0250***	-0.0327***	-0.0282***
	(0.00281)	(0.00319)	(0.00310)	(0.00346)	(0.00445)	(0.00521)	(0.00434)	(0.00361)
LPA	-0.00586**	-0.00185	-0.00722**	0.000113	0.00275	-0.0157**	0.000496	-0.0148***
	(0.00296)	(0.00261)	(0.00318)	(0.00280)	(0.00881)	(0.00741)	(0.00513)	(0.00444)
LPR	-0.138***	-0.198***	0.00313	-0.102**	-0.0285	0.0787	0.280*	0.155**
	(0.0327)	(0.0303)	(0.0380)	(0.0412)	(0.136)	(0.119)	(0.150)	(0.0681)
Observations	1,885,103	1,740,002	1,659,724	1,431,293	85,497	90,734	129,506	205,145
R-squared	0.592	0.609	0.596	0.618	0.629	0.644	0.569	0.587
Hansen J	1.576	6.586	1.898	7.397	0.213	6.020	1.454	2.185
Hansen J_p	0.455	0.0863	0.387	0.0603	0.899	0.111	0.483	0.535
Widstat	481.8	291.1	448.4	220.1	29.73	20.09	25.38	44.36

Notes: IV estimation, Plant-Product and Year FE included, errors clustered at the Product level. ***, ** and * indicate the statistical significance at 1%, 5% and 10% respectively.

Table 8: Product Sales (s=3): Controlling for the share of ASEAN countries in imports of Japan

	All Firms		Single-unit Firms		Compact Multi-unit Firms		Dispersed Multi-unit Firms	
	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified
IMP	-0.678***	-1.291***	-0.546***	-1.163***	-0.720**	-1.985***	-1.945**	-1.650***
	(0.226)	(0.293)	(0.200)	(0.325)	(0.336)	(0.659)	(0.820)	(0.294)
IMP * Share		0.159		0.149		0.365		0.564**
		(0.115)		(0.122)		(0.256)		(0.245)
Share		0.487***		0.430***		0.513***		0.672***
		(0.0320)		(0.0332)		(0.0881)		(0.0633)
ASEAN IMP	0.999	0.820	0.884	0.761	-0.223	-0.873	2.643	1.292
	(0.728)	(0.941)	(0.692)	(1.041)	(0.582)	(1.355)	(1.849)	(0.977)
log # of products		0.0106		0.00999		0.0387		0.0346
		(0.00889)		(0.00965)		(0.0368)		(0.0247)
log employees	0.423***	0.353***	0.428***	0.377***	0.341***	0.213***	0.349***	0.255***
	(0.0133)	(0.0147)	(0.0131)	(0.0170)	(0.0190)	(0.0263)	(0.0294)	(0.0202)
labor productivity	0.199***	0.164***	0.199***	0.168***	0.140***	0.131***	0.189***	0.117***
	(0.00724)	(0.00708)	(0.00743)	(0.00745)	(0.0164)	(0.0203)	(0.0168)	(0.0123)
LPA	0.00755*	0.0258***	0.00771*	0.0165***	0.000143	0.0151	0.0120	0.0770***
	(0.00399)	(0.00487)	(0.00398)	(0.00498)	(0.0136)	(0.0217)	(0.0149)	(0.0154)
LPR	0.129**	0.121*	-0.0937	0.0883	-0.111	-0.100	-0.317	-0.207
	(0.0654)	(0.0636)	(0.0665)	(0.0860)	(0.186)	(0.333)	(0.355)	(0.206)
Observations	1,282,935	1,135,776	1,115,210	912,260	60,981	61,585	99,510	152,970
R-squared	0.954	0.944	0.948	0.934	0.946	0.933	0.934	0.927
Hansen J	1.890	0.613	2.282	0.580	1.643	1.173	0.498	3.372
Hansen J_p	0.389	0.894	0.319	0.901	0.440	0.760	0.780	0.338
Widstat	342.5	216.5	314.5	165	19.11	17.06	15.01	32.87

Notes: IV estimation, Plant-Product and Year FE included, errors clustered at the Product level. ***, ** and * indicate the statistical significance at 1%, 5% and 10% respectively.

Table 9: Product Exit (s=3): Controlling for export opportunities

	All Firms		Single-unit Firms		Compact Multi-unit Firms		Dispersed Multi-unit Firms	
	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified
IMP	0.661***	0.852***	0.635***	0.812***	0.527*	0.689***	0.768**	0.892***
	(0.147)	(0.116)	(0.137)	(0.126)	(0.290)	(0.145)	(0.361)	(0.109)
IMP * Share		-0.383***		-0.392***		-0.372***		-0.567***
		(0.0474)		(0.0467)		(0.118)		(0.0855)
Share		0.0380***		0.0471***		0.0336		0.0228
		(0.0121)		(0.0128)		(0.0288)		(0.0199)
Exp opportunity	0.227*	0.166	0.224*	0.127	0.466**	0.127	0.307	0.397***
	(0.129)	(0.105)	(0.133)	(0.107)	(0.195)	(0.167)	(0.214)	(0.115)
log # of products		-0.0110***		-0.0132***		-0.00622		-0.0290***
		(0.00292)		(0.00301)		(0.0119)		(0.00837)
log employees	-0.127***	-0.117***	-0.130***	-0.116***	-0.0906***	-0.0951***	-0.116***	-0.129***
	(0.00471)	(0.00554)	(0.00480)	(0.00646)	(0.00814)	(0.00758)	(0.00928)	(0.00606)
labor productivity	-0.0512***	-0.0451***	-0.0539***	-0.0471***	-0.0180***	-0.0250***	-0.0326***	-0.0283***
	(0.00250)	(0.00316)	(0.00278)	(0.00345)	(0.00454)	(0.00517)	(0.00426)	(0.00357)
LPA	-0.00590*	-0.00182	-0.00718*	0.000265	0.00229	-0.0159**	-0.000576	-0.0155***
	(0.00348)	(0.00252)	(0.00369)	(0.00272)	(0.00914)	(0.00738)	(0.00533)	(0.00442)
LPR	-0.131***	-0.186***	0.00389	-0.0933**	-0.0359	0.0739	0.280**	0.183***
	(0.0321)	(0.0242)	(0.0372)	(0.0362)	(0.134)	(0.118)	(0.137)	(0.0647)
Observations	1,885,123	1,740,105	1,659,743	1,431,356	85,497	90,743	129,507	205,177
R-squared	0.589	0.608	0.594	0.617	0.625	0.644	0.589	0.587
Hansen J	1.813	5.987	1.630	6.623	1.747	7.431	3.250	2.551
Hansen J_p	0.404	0.112	0.443	0.0850	0.417	0.0594	0.197	0.466
Widstat	2853	2618	2799	2188	44.07	69.15	57.26	311.8

Notes: IV estimation, Plant-Product and Year FE included, errors clustered at the Product level. ***, ** and * indicate the statistical significance at 1%, 5% and 10% respectively.

Table 10: Product Sales (s=3): Controlling for export opportunities

	All Firms		Single-unit Firms		Compact Multi-unit Firms		Dispersed Multi-unit Firms	
	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified
IMP	-0.685***	-1.171***	-0.545***	-0.974***	-0.481	-1.608***	-1.841***	-1.703***
	(0.225)	(0.260)	(0.205)	(0.277)	(0.358)	(0.466)	(0.638)	(0.276)
IMP * Share		0.151		0.137		0.416		0.558**
		(0.110)		(0.111)		(0.259)		(0.250)
Share		0.487***		0.430***		0.498***		0.670***
		(0.0305)		(0.0306)		(0.0891)		(0.0636)
Exp opportunity	0.759***	0.644**	0.758***	0.726**	0.775***	0.446	0.0967	0.312
	(0.221)	(0.274)	(0.220)	(0.298)	(0.275)	(0.366)	(0.414)	(0.318)
log # of products		0.0111		0.0105		0.0416		0.0369
		(0.00877)		(0.00958)		(0.0358)		(0.0241)
log employees	0.428***	0.356***	0.433***	0.380***	0.344***	0.211***	0.354***	0.257***
	(0.0154)	(0.0149)	(0.0156)	(0.0169)	(0.0196)	(0.0258)	(0.0251)	(0.0196)
labor productivity	0.200***	0.165***	0.200***	0.169***	0.141***	0.127***	0.190***	0.119***
	(0.00743)	(0.00703)	(0.00758)	(0.00744)	(0.0166)	(0.0201)	(0.0156)	(0.0122)
LPA	0.00926**	0.0282***	0.00958**	0.0191***	0.000247	0.0133	0.0106	0.0781***
	(0.00391)	(0.00478)	(0.00380)	(0.00515)	(0.0134)	(0.0211)	(0.0132)	(0.0144)
LPR	0.127*	0.132**	-0.0974	0.111	-0.0805	-0.0478	-0.194	-0.279
	(0.0658)	(0.0553)	(0.0709)	(0.0780)	(0.193)	(0.323)	(0.296)	(0.187)
Observations	1,282,943	1,135,855	1,115,217	912,301	60,981	61,591	99,511	153,003
R-squared	0.955	0.944	0.948	0.935	0.946	0.934	0.945	0.929
Hansen J	12.60	4.892	11.72	4.876	12.69	7.282	8.787	9.492
Hansen J_p	0.00184	0.180	0.00286	0.181	0.00175	0.0634	0.0124	0.0234
Widstat	2530	1887	2233	1545	38.54	42.06	49.47	238.5

Notes: IV estimation, Plant-Product and Year FE included, errors clustered at the Product level. ***, ** and * indicate the statistical significance at 1%, 5% and 10% respectively.

Table 11: Product Exit (s=3): Controlling for imported inputs from China

	All Firms		Single-unit Firms		Compact Multi-unit Firms		Dispersed Multi-unit Firms	
	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified
IMP	0.681***	0.823***	0.631***	0.747***	0.672**	0.661***	0.958**	0.903***
	(0.189)	(0.162)	(0.182)	(0.173)	(0.327)	(0.192)	(0.423)	(0.173)
IMP * Share		-0.383***		-0.391***		-0.370***		-0.596***
		(0.0468)		(0.0450)		(0.119)		(0.0982)
Share		0.0388***		0.0475***		0.0337		0.0306
		(0.0122)		(0.0126)		(0.0291)		(0.0221)
log # of products		-0.0109***		-0.0129***		-0.00524		-0.0321***
		(0.00291)		(0.00299)		(0.0119)		(0.00827)
log employees	-0.129***	-0.119***	-0.133***	-0.117***	-0.0912***	-0.0960***	-0.114***	-0.132***
	(0.00435)	(0.00549)	(0.00444)	(0.00631)	(0.00893)	(0.00759)	(0.00995)	(0.00652)
labor productivity	-0.0519***	-0.0456***	-0.0545***	-0.0474***	-0.0187***	-0.0258***	-0.0326***	-0.0290***
	(0.00271)	(0.00317)	(0.00296)	(0.00345)	(0.00454)	(0.00520)	(0.00444)	(0.00359)
imported inputs	0.407	0.323	0.462	0.412	0.189	0.484	0.374	0.586
	(0.692)	(0.469)	(0.739)	(0.492)	(0.582)	(0.492)	(0.645)	(0.493)
LPA	-0.00556*	-0.00185	-0.00684**	0.000205	0.00322	-0.0153**	6.30e-05	-0.0143***
	(0.00315)	(0.00253)	(0.00332)	(0.00272)	(0.00891)	(0.00737)	(0.00576)	(0.00445)
LPR	-0.128***	-0.189***	0.0149	-0.0944***	-0.00774	0.0916	0.295**	0.173***
	(0.0332)	(0.0241)	(0.0390)	(0.0362)	(0.135)	(0.118)	(0.141)	(0.0644)
Observations	1,885,123	1,740,105	1,659,743	1,431,356	85,497	90,743	129,507	205,177
R-squared	0.590	0.609	0.595	0.618	0.625	0.645	0.580	0.589
Hansen J	4.649	7.710	4.726	9.230	5.548	4.560	2.969	6.053
Hansen J_p	0.0978	0.0524	0.0941	0.0264	0.0624	0.207	0.227	0.109
Widstat	1506	743.9	1404	545.5	50.64	44.17	72.36	153.6

Notes: IV estimation, Plant-Product and Year FE included, errors clustered at the Product level. ***, ** and * indicate the statistical significance at 1%, 5% and 10% respectively.

Table 12: Product Sales (s=3): Controlling for imported inputs from China

	All Firms		Single-unit Firms		Compact Multi-unit Firms		Dispersed Multi-unit Firms	
	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified
IMP	-1.122***	-1.603***	-0.974***	-1.515***	-0.795**	-2.129***	-2.640***	-1.613***
	(0.279)	(0.348)	(0.256)	(0.400)	(0.358)	(0.569)	(0.778)	(0.422)
IMP * Share		0.170		0.163		0.390		0.656**
		(0.117)		(0.125)		(0.265)		(0.275)
Share		0.485***		0.427***		0.502***		0.656***
		(0.0333)		(0.0348)		(0.0894)		(0.0693)
log # of products		0.00992		0.0102		0.0461		0.0357
		(0.00874)		(0.00963)		(0.0364)		(0.0240)
log employees	0.417***	0.353***	0.422***	0.377***	0.338***	0.205***	0.342***	0.261***
	(0.0105)	(0.0146)	(0.0101)	(0.0167)	(0.0190)	(0.0258)	(0.0300)	(0.0200)
labor productivity	0.198***	0.164***	0.197***	0.168***	0.139***	0.123***	0.188***	0.120***
	(0.00663)	(0.00691)	(0.00689)	(0.00738)	(0.0164)	(0.0203)	(0.0167)	(0.0121)
imported inputs	0.980	0.737	0.950	1.130	0.663	2.366*	1.403	-1.865
	(0.757)	(1.017)	(0.778)	(1.177)	(0.546)	(1.415)	(0.903)	(1.167)
LPA	0.00931**	0.0275***	0.00957**	0.0181***	0.000626	0.0136	0.0133	0.0756***
	(0.00461)	(0.00461)	(0.00437)	(0.00491)	(0.0135)	(0.0215)	(0.0152)	(0.0147)
LPR	0.116*	0.0999*	-0.0984	0.0672	-0.103	0.00766	-0.307	-0.300
	(0.0620)	(0.0561)	(0.0694)	(0.0783)	(0.191)	(0.335)	(0.316)	(0.188)
Observations	1,282,943	1,135,855	1,115,217	912,301	60,981	61,591	99,511	153,003
R-squared	0.954	0.944	0.948	0.934	0.946	0.933	0.941	0.929
Hansen J	8.020	5.590	9.158	6.960	2.346	1.833	2.078	5.662
Hansen J_p	0.0181	0.133	0.0103	0.0732	0.309	0.608	0.354	0.129
Widstat	1170	546	1081	385.8	45.62	30.47	61.07	130.1

Notes: IV estimation, Plant-Product and Year FE included, errors clustered at the Product level. ***, ** and * indicate the statistical significance at 1%, 5% and 10% respectively.

6 Concluding Remarks

This study examines how Japanese plants change their product portfolio in response to the surge of import from China. Using the comprehensive Japanese plant-product level panel data set, we examine the impact of import competition on plant's product downsizing and exit. On the broad picture, we found that China import competition pressure did affect product exit and product sales, and that depending on plant characteristics and external agglomeration economies, Japanese plants could mitigate this effect at different extents.

We also found that the structure and spatial organization of the parent firm alter plants' product churning behavior, and also alleviate the role played by plant heterogeneity and external agglomeration economies. In particular, specialized plants owned by large dispersed firms are more sensitive to China competition than the standalone plants, in the sense that conditional on survival, they are more likely to downsize the sales of their exposed products. On the other hand, for diversified plants belonging to dispersed firms, core products play a much stronger role in alleviating the effect of import competition. Considering the individual plant characteristics, we found that productive efficiency plays a stronger alleviating role for standalone plants as compared to plants owned by larger corporations. Also, for plants belonging to geographically compact firms, where strong internal agglomeration economies can be expected, complementarities arising from the product range of the local plant do not play a role in hindering exit as it is the case for other plants. Lastly, external economies arising from alignment with and relatedness to the local specialization play a mitigating role mostly for standalone firms.

One extension of this study would be to investigate plant-product entry and especially to focus on switching decisions. Compact and dispersed multi-unit plants are likely to have higher opportunities to replace a product instead of droping it merely. Thus switching per se as an outcome is complementary to understanding the adjustment process. Also, the direction of switching is an interesting open question that can contribute to better understanding the spatial dimension of the adjustment process, and evolution of regional comparative advantages as a result of external shocks.

From policy point of view, another promising extension would be to shift the focus from product level churning to plant survival and employment to study the effect of import competition on regional economies. Our findings point out to differences among standalone local plants and affiliated plants in terms of their reliance on local capabilities in restructuring their product portfolios in the presence of import competition. Thus, spatial dimension of plant level adjustment and contingencies with respect the firm structure appear as future research directions.

Appendix A

In this appendix, we explain how we construct the local product alignment (LPA) and local prodcut relatedness measures (LPR).

The LPA measure we use is an output-based approach of the Balassa (1965) index of revealed comparative advantage (RCA). Specifically we use output data at both national and regional levels in Japan and we first define the RCA index of product k in locality r. Specifically,

$$LPA_{kr} = \begin{cases} 1 & if RCA_{kr} = \frac{S_{kr}}{\sum_k S_{kr}} / \frac{\sum_j S_{kr}}{\sum_j \sum_n S_{kr}} > 1 \\ 0 & otherwise \end{cases} \tag{2}$$

where S is the sales of product k produced in locality r. We then define our local product alignment variable (LPA) as a dummy variable which takes the value 1 if $RCA_{kr} > 1$ and 0 otherwise.

The LPR measure we use is also based on RCA computations both at the local level in Japan and at the international level.

First, we utilize international trade data at product-level to compute Balassa (1965) RCA index for product j in country n as follows;

$$RCA_{jn} = \begin{cases} 1 & if \frac{a_{jn}}{\sum_k a_{jn}} / \frac{\sum_j a_{jn}}{\sum_j \sum_n a_{jn}} > 1 \\ 0 & otherwise \end{cases} \tag{3}$$

where a is the value of product j exported by country n. Then, we calculate the conditional probability P that country has RCA in product j given that it has RCA in product m:

$$P(j|m) = \frac{\text{\# of countries with RCA in both j and m}}{\text{\# of countries with RCA in m}} \tag{4}$$

Based on this conditional probability, Hidalgo et al. (2007) define the relatedness indicators as follows:

$$\phi_{jm} = min\left\{P(j|m),\ P(m|j)\right\} \tag{5}$$

Our relatedness indicator for selected products are presented in Table A1. The pair of Computer and TV&Radio is 0.264, while the one for the pair of Bread and TV&Radio is only 0.05 .

Next, to link the regional data set, we use the RCA_{kr} indexes we computed using product-level data by region. Specifically, using the conditional probability calculated with international trade data, local product relatedness is defined as follows:

$$LPR_k^r = \sum_{m=1, m\neq k}^{M} \left(\frac{\phi_{km}}{\sum\limits_{m=1, n\neq k}^{M} \phi_{km}} LPA_{mr} \right) \tag{6}$$

For the calculation of international trade based RCA index, we use the BACI data set prepared by CEPII. And region-product-level RCA index is calculated with the COM product-level data aggregated at commuting zone-level.

Appendix B

In this Appendix, we present the immediate responses of plants (s=1) to China competition pressure, for our sub-samples discriminating plants according to the structure and spatial organization of their parent firm. As emphasized in the main text, we expect those immediate responses to be uncomplete as compared to the later responses (s=3) that we use as our baseline.

The results are displayed in Table 13 for the response in terms of product exit and in Table 14 for the response in terms of product sales. On both margins, the immediate responses are smaller than the later responses, confirming our view that full adjustment takes time regardless of the plant type. Moreover, contrary to what we observe for the later responses, the immediate responses do not differ across our different categories of plants. This means that the corporate affiliation of the plant does not make much difference in the way plant-product are impacted in the short run, although on a longer run, plants owned by large corporations adjust somehow differently than standalone plants.

Concerning the role of the regional variables, we find weaker evidence that standalone plants benefit more from external agglomeration economies as compared to the plants owned by compact multi-unit firms. Indeed, on the short time horizon (s=1), all types of plants seem to benefit from their product alignment to local specialization (LPA). We also have a puzzling result on our LPR variable as the positive coefficient for this variable in Table 5 tells us that, on this short run horizon, relatedness of the product to the local specialization favors (instead of hindering) product exit not only for plants owned by dispersed multi-unit firms but also for specialized standalone plant. Once again, this calls for further investigation of product entry along with product exit, but this is left for further research.

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Table 13: Determinants of product exit for specialized and diversified plants (s=1): breakdown by firm organization

	Single-unit Firms		Compact Multi-unit Firms		Dispersed Multi-unit Firms	
	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified
IMP	0.364***	0.516***	0.274**	0.338***	0.420**	0.417***
	(0.0764)	(0.0698)	(0.139)	(0.0770)	(0.176)	(0.0488)
IMP * Share		-0.285***		-0.261***		-0.289***
		(0.0281)		(0.0604)		(0.0411)
Share		0.0220***		0.00248		-0.0170
		(0.00817)		(0.0177)		(0.0106)
log # of products		-0.00902***		-0.0128		-0.0221***
		(0.00191)		(0.00840)		(0.00459)
log employees	-0.0967***	-0.0909***	-0.0774***	-0.0936***	-0.0900***	-0.114***
	(0.00330)	(0.00334)	(0.00507)	(0.00516)	(0.00612)	(0.00424)
labor productivity	-0.0400***	-0.0336***	-0.00973***	-0.0149***	-0.0193***	-0.0235***
	(0.00179)	(0.00192)	(0.00323)	(0.00367)	(0.00248)	(0.00228)
LPA	-0.00421***	-0.00125	-0.00106	-0.0110**	0.00412	-0.0119***
	(0.00155)	(0.00153)	(0.00509)	(0.00487)	(0.00369)	(0.00279)
LPR	0.0454*	-0.0277	-0.109	-0.00508	0.0204	0.208***
	(0.0238)	(0.0240)	(0.0933)	(0.0831)	(0.0803)	(0.0495)
Observations	1,821,558	1,585,620	94,122	99,771	144,110	227,311
R-squared	0.261	0.273	0.276	0.288	0.249	0.251
Hansen J	0.394	6.207	0.0190	1.742	1.748	2.935
Hansen J_p	0.530	0.0449	0.890	0.419	0.186	0.230
Widstat	3385	1580	98.64	86.80	120	299

Notes: IV estimation, Plant-Product and Year FE included, errors clustered at the Product level. ***, ** and * indicate the statistical significance at 1%, 5% and 10% respectively.

Table 14: Determinants of product sales for specialized and diversified plants (s=1): breakdown by firm organization

	Single-unit Firms		Compact Multi-unit Firms		Dispersed Multi-unit Firms	
	Specialized	Diversified	Specialized	Diversified	Specialized	Diversified
IMP	-0.685***	-1.197***	-0.826***	-1.358***	-1.406***	-1.671***
	(0.193)	(0.258)	(0.255)	(0.357)	(0.493)	(0.236)
IMP * Share		0.418***		1.207***		0.989***
		(0.127)		(0.270)		(0.206)
Share		1.300***		1.362***		1.855***
		(0.0429)		(0.0855)		(0.0662)
log # of products		0.0533***		0.102***		0.101***
		(0.00981)		(0.0290)		(0.0206)
log employees	0.710***	0.645***	0.646***	0.528***	0.711***	0.574***
	(0.00697)	(0.0143)	(0.0149)	(0.0200)	(0.0189)	(0.0164)
labor productivity	0.444***	0.364***	0.425***	0.311***	0.481***	0.328***
	(0.00696)	(0.00863)	(0.0139)	(0.0164)	(0.0159)	(0.0121)
LPA	0.0106***	0.0354***	0.0229**	0.0508***	0.0265**	0.178***
	(0.00330)	(0.00452)	(0.00932)	(0.0182)	(0.0109)	(0.0156)
LPR	-0.110**	-0.0552	-0.162	0.194	0.0369	-0.0639
	(0.0551)	(0.0697)	(0.193)	(0.247)	(0.236)	(0.156)
Observations	1,512,282	1,280,503	81,568	84,304	129,908	201,825
R-squared	0.954	0.936	0.953	0.937	0.955	0.933
Hansen J	1.858	1.591	2.287	1.383	1.700	3.343
Hansen J_p	0.173	0.451	0.130	0.501	0.192	0.188
Widstat	2912	1288	92.80	71.12	114.1	272.2

Notes: IV estimation, Plant-Product and Year FE included, errors clustered at the Product level. ***, ** and * indicate the statistical significance at 1%, 5% and 10% respectively.

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