Opposing firm-level responses to the China shock: Output competition versus input supply*

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Abstract

We decompose the "China shock" into two components that induce different adjustments for firms exposed to Chinese exports: an *output* shock affecting firms selling goods that compete with similar imported Chinese goods, and an *input supply* shock affecting firms using inputs similar to the imported Chinese goods. Combining French accounting, customs, and patent information at the firm-level, we show that the output shock is detrimental to firms' sales, employment, and innovation. Moreover, this negative impact is concentrated on low-productivity firms. By contrast, we find a positive effect - although often not significant - of the input supply shock on firms' sales, employment and innovation.

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1 Introduction

The spectacular growth of China's exports following its accession to the WTO – the eponymous "China shock" – has induced substantial adjustments in the manufacturing sectors of developed economies. Most of the literature analyzing those adjustments starts out with a measure of this shock (typically the growth rate of Chinese exports) at the sector level. According to this measure, one of the most affected sectors is apparel. Consider two subsets of French firms classified in this sector from our sample in 1999. One set of firms produced women's jackets using woven polyester as an intermediate input. The share of women's jackets imported from China (Chinese import penetration) increased by 30 percentage points (pp) between 2000 and 2007, whereas Chinese import penetration in woven polyester declined during the same period. Another set of firms produced embroidered clothing using women's trousers as intermediate input. Over that same 2000-07 period, Chinese penetration for embroidered clothes declined by 12pp, whereas Chinese penetration for women's trousers increased by 22pp. Both sets of firms were significantly impacted by the sharp rise in Chinese apparel, but in very different ways. The dominant component of the shock for the first set of firms was horizontal: a sharp increase in Chinese exports of products similar to those these firms were producing. On the other hand, the dominant component of the shock for the second set of firms was vertical: a sharp increase in Chinese exports of products used by this set of firms as intermediate inputs. Sales by firms in the first set decreased markedly between 2000 and 2007, whereas sales increased for the firms in the second set over the same period.

In this paper, we disentangle the output and input supply components of the Chinese import shock at the firm level and analyze its effects on employment, sales, and innovation. At the industry level, the output and input components of the Chinese import shock are highly correlated, which makes it difficult to interpret industry-level analyses of the China shock. Another issue with industry-level analyses is that relying only on industry-level variations makes it difficult to control for industry-level trajectories, regardless of a firm's exposure to either the output or the input supply component of the China shock. Moving from industry- to firm-level analysis allows us not only to separately identify the output and input components of the China shock but also to control for industry-level trends. We find that more than 80% of the variance of the input and output components of import competition is due to within-industry variation. This variation allows us to identify those output and input components separately from the industry-level trends.

We use French accounting records, customs, and patent information on a comprehensive firm-level panel dataset spanning the period 1994-2007 and show that those two components have opposite effects on French firms' outcomes in 2000-07. We find that exposure to output trade competition is detrimental to firms' sales, employment, and innovation. Moreover, this negative effect is concentrated among low-productivity firms. By contrast, we find a positive effect (although often insignificant) for the input component on firms' sales, employment, and innovation.

More specifically, we find that including a separate control for the input component markedly increases the negative impact of the output shock on employment. However, all of that increase stems from an industry aggregate trend. When we control for that industry-level variation, we find that the within-industry output competition component is vastly reduced. However, it remains negative and yields a much more precise measure for the downsizing of the impacted French firms. On the innovation side—contrary to what we find for employment—no significant industry-wide trend emerges in the response of patenting to the China shock. After controlling for the input component of the shock, we find a strong and significant negative impact of increased output competition on patenting by affected firms.

Our analysis contributes to the existing literature on the China trade shock. Much of that literature focuses on the consequences of import competition for local labor markets: how do labor markets adjust to the shock, which skill groups are more affected, how do governments respond. Following the seminal work of Autor et al. (2013), a vast literature leverages industry-level variations to analyze the effects of the China shock on those same employment, wage, and innovation outcomes. Acemoglu et al. (2016) show that import competition from China has increased after 2000 and has depressed US manufacturing employment and overall job dynamics through input-output linkages.

Further studies on the effects of the China shock on employment include Iacovone et al. (2011); Autor et al. (2016); Bombardini et al. (2017), Malgouyres (2017), and Mion and Zhu (2013) for the US and France, and Dauth et al. (2014) for Germany.[1] The effects of the shock on innovation are the focus of Bloom et al. (2016) and Autor et al. (2020a), where the former find a positive impact of the shock on innovation, whereas the latter find a negative impact.[2] None of these papers, however, distinguish between the output and input components of the shock, so that they cannot tell us whether a positive effect of import shocks on domestic performance is due to a positive escape competition effect from increased competition in output markets or to improved access to intermediate inputs.

Acemoglu et al. (2016) and Pierce and Schott (2016) distinguish between downstream and upstream competition shocks like we do in this paper. Yet, their analysis remains at the industry level, and firms' inputs are imputed from industry-level IO matrices. Instead, we identify the separate impact of horizontal competition in output markets from the vertical impact of imported intermediates for firms in the *same* industry using detailed firm-level output and input at a very disaggregated product level.[3] In a similar spirit, Taniguchi (2019) looks at imports of intermediates versus final goods at the local labor market level in Japan. In that setting, a given good is classified either as intermediate or final. Our product-firm level information allows us to be much more precise in the sense that we distinguish between a good that is used as an input by some firms but is also the final output good for some other firms. And it allows us to separately control for industry trends that are not necessarily related to either

[1] Dauth et al. (2014) report that German firms were not only hit by a China shock but also by an Eastern Europe import shock. France, however, is much less affected by this shock than Germany (even though the free circulation of workers, especially from Eastern Europe, has had an impact on the French labor market as shown in Muñoz, 2021). To show this, Figure B1 in Appendix B shows the annual import shares for France and Germany from 9 Eastern European countries that are currently part of the EU, and compares those with the annual Chinese import shares. The pattern for the increase in Chinese imports is very similar for both France and Germany. However, the patterns are vastly different when it comes to East-European imports: Only Germany experiences a marked increase in East European imports around the time of the "China shock".

[2] Our analysis can shed light on these contrasting findings: indeed, we find opposite effects of the output and input supply components of the China shock on firm-level outcomes, which suggests that differences in the input-output structures in the United States versus Europe may lie behind the opposite conclusions of these two papers, and that the findings in Autor et al. (2020a) are primarily driven by the output component of the shock.

[3] Beyond the intrinsic difficulties in estimating the impact of the China shock only using industry-level data, Acemoglu et al. (2016) and Pierce and Schott (2016) cannot disentangle the input supply shock from the input-output transmission of the China shock impacting the upstream industries. The industry fixed effects in our regressions control for these sectoral input-output linkages and thus deliver a coefficient measuring the pure input supply impact of the China shock.

input or output components. As we mentioned, that industry variation drastically inflates the impact of the China shock for employment.

An alternative to this econometric literature is to use quantitative trade models with input-output linkages to jointly evaluate the output and input components of the China shock. Caliendo et al. (2019) and Adao et al. (2021) are two recent examples. However, they come to very different conclusions regarding the overall impact of that shock for U.S. employment. Caliendo et al. (2019) find that the improved access to input components from China mitigates the negative impact of the shock for manufacturing employment (a smaller 0.3% decrease) and *reverse* the impact for overall employment (a 0.2% increase). Conversely, Adao et al. (2021) find that the negative impact of the output competition spillover to other sectors and *magnify* their consequences for overall U.S. employment (a 2% decrease). Those quantitative models are thus sensitive to the modeling assumptions used to incorporate the input-output structure, highlighting the importance of empirical work that evaluates those input-output linkages at the firm-level.

Also related to our analysis in this paper is a literature that identified a positive impact of increased access to imported intermediate inputs on firm performance. Amiti and Konings (2007) show that a 10 percentage points fall in input tariffs leads to a productivity gain of 12 percent for firms that import their inputs. In the same vein, Amiti and Khandelwal (2013) show that a reduction in import tariffs has a positive impact on product quality for varieties close to frontier and Gopinath and Neiman (2014) show that the devaluation of the Argentinian currency – which amounted to a negative shock for imported capital goods – had a negative impact on aggregate productivity.[4] We contribute to this literature by performing a firm-level analysis of the impact of the input supply component of the China shock in regressions where we also include the output component of the shock and where we control for industry-wide trends.

Other firm-level analyses of the relationship between trade and innovation include Lileeva and Trefler (2010); Bustos (2011); Aw et al. (2011); Aghion et al. (2022, 2021).

[4]See also Goldberg et al. (2010); Topalova and Khandelwal (2011); Bas and Strauss-Kahn (2014, 2015) and Bas (2012).

Using French firm-level data, Aghion et al. (2022) show how an exogenous increase in export market size induces innovation, in particular for the most productive firms. Aghion et al. (2021) further highlight the knowledge spillovers generated by French exporters to firms in their export destinations. Here, we analyze how the China import shock impacts employment and innovation, distinguishing between the output and input components of the shock.[5]

Finally, our paper relates to the existing theoretical literature on trade, innovation, and growth (see Grossman and Helpman, 1991a,b, Aghion and Howitt, 2009, chapter 13) which analyzes the role of innovation decision in explaining firm dynamics in global economies. Burstein and Melitz (2013) provides a updated survey of theoretical papers looking at how firms' innovation responds to trade liberalization and Akcigit et al. (2018) develops a dynamic general equilibrium growth model with endogenous innovation in an open economy.

The remaining part of the paper is organized as follows. Section 2 describes our data, displays some descriptive statistics, and specifies our estimation equations. Section 3 presents our results. Section 4 concludes.

2 Data, measurement, and empirical strategy

2.1 Data

We merge different sources of information at the firm level. First, the administrative and tax data set *FICUS* from Insee-DGFiP provides us with sales, employment, profit, and detailed sector information for the universe of French firms from 1994 to 2007. Second, the French Customs database provides us with firm-level information on exports and imports over a range of more than 5000 product categories (HS6 product-level).[6] This information is completed by *BACI*, from Cepii, which provides us with product level bilateral trade information for all country pairs. Finally, *PAT-*

[5]The literature has also explored the reverse channel of how domestic technology adoption can generate import shocks. Malgouyres et al. (2019) shows for example how access to broadband internet has led to an increase in firm-level import.

[6](*Statistiques du Commerce Extérieur de la Direction Générale des Douanes et Droits Indirects*)

STAT from the European Patent Office provides us with the patent information, which we match with firms' administrative identifiers using the matching algorithm developed by Lequien et al. (2019). This firm-level matching provides us with very precise information on total patent applications and the subset of triadic applications.[7]

Our various data sources run from 1994 to 2007. We use information over 1994-1999, our pre-sample period, to construct firms' exposure measures (the "share" part of our "shift-share" variables) as well as firm-level controls; and information over the 2000-2007 period to construct our shocks (the "shift" part of our shift-share shocks) and analyze their impacts on firm-level outcomes. We restrict our firm sample to privately managed manufacturing firms: (i) which record positive sales in 1999; (ii) which have 10 employees or more at least once over our whole sample period; (iii) which report export sales or imports to customs in 1999.

Table 1 shows the mean values of our main outcome variables in 1999. Going from left to right in the table, we increasingly restrict the set of French firms we consider. The first column covers all privately owned firms. The second column focuses on manufacturing firms. The third column restricts attention to the subset of manufacturing firms that report exports or imports to customs in 1999. And the fourth column further restricts our sample to firms with at least one patent between 1993 and 2007. Moving from the universe of privately owned firms to the subset of manufacturing firms that both trade and patent, we see that average firm size, whether measured by sales, employment, or value added, systematically increases. In addition to showing larger sales and employment, patenting firms also display above average levels of value-added per worker, patent flows, export-to-sales ratios, and of the number of exported and imported products, while showing a slightly lower than average labor share.

These findings are consistent with the export and innovation premia reported in Aghion et al. (2022). They are also consistent with existing studies emphasizing a negative correlation between firms' productivity and labor share (see, e.g. Autor et al., 2020b; Aghion et al., 2019), and a positive correlation between firm size and the

[7]Triadic patent families are sets of patent applications filled at the European Patent Office (EPO), the United States Patent and Trademark Office (USPTO) and the Japan Patent Office (JPO) that share a same priority application.

extensive margin of trade (number of exported products, e.g. Bernard et al., 2014, 2019b for the United States and Mayer et al., 2014 for France).

As of 2007, 27% of manufacturing firms present in our sample in 1999 have disappeared from our fiscal files. This amounts to an annual attrition rate of 3.8%. This rate most likely overestimates the true exit rate due to the death of the firm. If we restrict our exit count in year t to firms with a negative recorded value added in $t-1$ or with a drop of more than 30% in employment between $t-2$ and $t-1$, the annual average exit rate of manufacturing firms falls down to 1.8% (14% over the entire sample period). Finally, column (4) shows that, among manufacturing firms, those engaged in innovation and patenting exhibit lower exit rates (e.g. Bernard et al., 2006).

In the remaining part of the paper, we will focus our attention on firms that engage in international trade, that is, on the subset of firms described in the last two columns of Table 1. Those are the firms for which we can construct our firm-level trade shocks.

Table 1: Descriptive statistics

	All mean	Manufacturing mean	Customs mean	Patenting mean
Sales	8358.75	13592.21	17266.54	60233.90
Employees	40.44	60.22	81.25	259.28
Value added	2220.25	3236.57	4450.29	15881.26
Value added per worker	44.26	41.47	45.43	54.28
Labor share	0.58	0.60	0.59	0.52
Export intensity	0.05	0.13	0.13	0.21
Exported products	1.23	5.17	7.87	19.14
Imported products	1.99	8.38	12.75	27.90
Patent applications	0.00	0.25	0.37	2.96
Triadic patents	0.00	0.01	0.02	0.15
Exit	0.25	0.27	0.27	0.10
Death	0.14	0.14	0.14	0.06
Observations	243056	57764	37956	4710

Notes: Unweighted mean of descriptive variables by firm group in 1999. All columns exclude firms recorded with less than 10 employees over all our sample period. Going from left to right we step by step restrict the set of French firms. The first column covers privately owned firms, regardless of their industry. The second column only keeps privately owned manufacturing firms. The third column only keeps all privately owned manufacturing firms that can be matched to customs data in 1999. Finally the fourth column further restricts our sample to firms that are observed in patent data at least once between 1993 and 2007. Sales and value added are expressed in thousands of euros, value added per worker in thousands of euros per worker. We use a fractional count to define firms' total patent applications and triadic patent applications in 1999. Firm exit stands for missing fiscal identifiers as of 2007 while death stands for exit combined with negative recorded value added prior to exit and/or a 30% drop in firm employment in the 2 years preceding exit. Observations provide the number of firms.

2.2 Measuring trade shocks

For each firm, we construct both an output trade shock and an input supply trade shock. The output shock is constructed using the firm's export data at the detailed product level to measure its exposure to increased Chinese import penetration on its *outputs* markets. The input supply shock is constructed using the firm's import data at the same detailed product-level to measure its exposure to the same Chinese import penetration on its *inputs* markets.

Formally, let x_{f,i,t_0} and m_{f,i,t_0} denote firm f's exports and imports of product i in our base year $t_0 = 1999$. And let $S_{i,t}$ denote the share of total French imports of good i originating from China in year $t > t_0$. Our baseline empirical specification will regress firm f's outcome on long differences in the firm's output and input exposures to Chinese import penetration. These are defined, respectively, by:

$$O_{f,t} = \sum_i \frac{x_{f,i,t_0}}{\sum_j x_{f,j,t_0}} S_{i,t} \quad \text{and} \quad I_{f,t} = \sum_i \frac{m_{f,i,t_0}}{\sum_j m_{f,j,t_0}} S_{i,t}.$$

We then define the shift-share long-run differences corresponding to measured changes in output and input exposure to Chinese import competition as:

$$\Delta O_f = \sum_i \frac{x_{f,i,t_0}}{\sum_j x_{f,j,t_0}} \Delta S_i \quad \text{and} \quad \Delta I_f = \sum_i \frac{m_{f,i,t_0}}{\sum_j m_{f,j,t_0}} \Delta S_i$$

where ΔS_i is the 2007/2000 long run difference in the share of total imports of good i originating from China.[8] To match trade flows to customs data, we translate all product-level variables into the HS2002 classification at the 6-digit level.

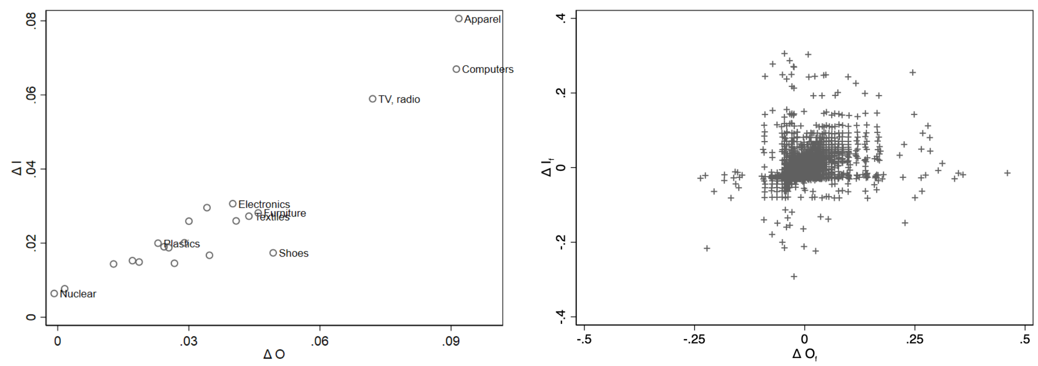
Figure 1 plots the long-run differences over the 2000-2007 period for the output and input exposure variables; at the industry level in Figure 1(a), and at the firm level controlling for industry fixed effects in Figure 1(b). The output and input exposures to Chinese import penetration are clearly correlated at the industry-level. This in turn implies that the firm-level variation displayed in Figure 1(b) is key for identifying the separate effects of output and input supply trade competition for firm-level outcomes

[8]The validity of this specification comes from an identification based on the exogenous assignment of the shocks. Borusyak et al. (2021) discuss at length the case of the China shock and argue that the associated specification can indeed reasonably be viewed as leveraging exogenous shock variations.

(controlling for industry trends). A simple variance decomposition of our firm-level output and input supply shocks shows that only 10% of the overall variance can be explained by the 2-digit industry variation. The remaining variation is exhibited between firms *within* in those industries.

Figure 1: Between and within industry exposure to trade competition

(a) industry-level exposure (b) firm-level exposure



Notes: Panel (a) displays a scatter plot of the average long difference of the output (ΔO) and input supply (ΔI) shocks by 2-digit manufacturing industries. Panel (b) displays a scatter plot of the residual long difference of firm-level output (ΔO_f) and input supply (ΔI_f) shocks once 2-digit industries fixed effects have been controlled for. For statistical secrecy reasons we discretize each shock's residuals into 100 bins and plot mean values of our residualized shocks for 2,997 groups each containing at least 5 firms. All long differences are taken over the 2000/2007 period.

Discussion of the output and input supply shocks By construction, the output shock ΔO_f captures a direct competition shock that directly impacts firm f at its position in the production chain. A positive ΔO_f means that there is more production from China of the same goods that firm f produces. This is true regardless of whether firm f produces intermediate, final goods, or both. The input supply shock ΔI_f can be seen as an input supply shock. A positive ΔI_f means that there is an increase in the China share in goods that firm f uses as inputs. We expect such a positive shock to improve firm f's access to upstream resources.

Even though firm-level measures of exposure to output and input supply trade competition improve upon industry-level measures, Figure 1(b) also displays a positive correlation between ΔO_f and ΔI_f.[9] In our data this correlation arises from the fact that firms tend to export and import within the same detailed product category. This

[9] The correlation between ΔO_f and ΔI_f when controlling for 2-digit industry fixed effects is 0.26 in our sample.

echoes Bernard et al. (2019a)'s finding that firms often export products that they did not themselves produce. To take into account this positive correlation between exports and imports at the firm level, a second empirical specification developed in the Appendix A splits our output and input supply shocks between: (i) a net export shock on exports that are not imported; (ii) a net import shock on imports that are not exported; (iii) a common export/import shock. Our results are robust to using this alternative specification.[10]

2.3 Empirical specification

Our baseline specification seeks to separately identify the causal impact of increased firm-level exposure to Chinese imports along the output (ΔO_f) and input supply (ΔI_f) dimensions. The regression equation is:

$$\tilde{\Delta} Y_f = \alpha + \beta_O \Delta O_f + \beta_I \Delta I_f + \gamma' X_{f,t_0} + \eta_{s(f)} + \varepsilon_f, \quad (1)$$

where (i) $\tilde{\Delta} Y_f$ is the growth rate of firm f's outcome of interest between 2000 and 2007; (ii) X_{f,t_0} is a collection of firm-level pre-t_0 controls, with $t_0 = 1999$; and (iii) $\eta_{s(f)}$ are 2-digits industry fixed effects. The 2000-2007 time window, which corresponds to the spectacular increase in China's influence in international trade, is very commonly used and allows our results to be comparable with previous studies of the effects of the China shock.

In all our specifications, X_{f,t_0} includes pre-1999 firm-specific levels and 5-year trends in employment and sales, as well as dummies for the firm's export/import status.[11] Our regressions with patenting as the outcome variable further control for pre-1999 initial stocks and average yearly patenting rates in the relevant patent category.

We treat our raw dependent variables Y_f in three different ways. First, when Y_f is

[10] Aghion et al. (2022) shows that export shocks induce an innovation response by French firms. In our main specification, we consider the impact of the input supply and output shock on firm patenting activities which could potentially be explained by the export channel if the export and import shocks are correlated. Our results are however unchanged when we control for the evolution of export over the time period considered.

[11] Controlling for export/import dummies amounts to controlling for the sum of "shares" in our shift-share shocks, which in turn is required when using an incomplete shift-share setting as explained in Borusyak et al. (2021).

a flow variable such as sales or employment we use its "Davis-Haltiwanger" (DH) growth rate between $t-k=2000$ and $t=2007$ defined as:

$$\tilde{\Delta} Y_f = 2\frac{Y_{f,t}-Y_{f,t-k}}{Y_{f,t}+Y_{f,t-k}}.$$

Second, when looking at patenting outcomes, we first compute firm's f 1993-1999 and 2000-2007 average yearly flows of patents. We then define our dependent variable of interest $\tilde{\Delta} Y_f$ as the DH growth rate of these two average yearly patent flows. Third, we treat binary outcomes such as industry switching or firm exit using a simple linear probability model.

We address potential biases on the estimated β_O and β_I coefficients arising from unobservable domestic shocks by instrumenting ΔO_f and ΔI_f by their counterparts constructed using product-level Chinese import penetration measures aggregated over six advanced countries excluding France (which is similar to Autor et al., 2013's identification strategy).[12]

3 Results

3.1 Comparing industry- and firm-level evidence

We first show in Table 2 how the measured responses to increased trade competition of employment and patenting vary when: (a) we move from industry-level shocks to firm-level shocks; (b) we move from the overall universe of manufacturing firms to the subset of trading firms with available customs data.

Our dependent variables are the 2007/2000 DH long difference of employment and the DH growth rate of yearly average triadic patent flows over the 2007-2000 period versus the 1993-1999 period. The first industry shock is defined as the increase in Chinese import penetration in each firm's initial 3-digit NACE industry. We report the OLS and shift-share IV estimates associated with this first industry shock in columns

[12]Our instrument are the counterparts of our output and input supply shocks computed with import penetration measures from Canada, Germany, Italy, Japan, the United Kingdom and the United States.

Table 2: Comparing industry- and firm-level shocks

	Employment							
	Industry					Firm		Placebo
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output	-0.728***	-0.467*	-1.012***	-2.310***	-2.703***	-0.872***	-0.367**	-0.0130
	(0.213)	(0.272)	(0.386)	(0.792)	(0.765)	(0.197)	(0.167)	(0.0311)
Input				1.868*	1.833*	-0.0214	0.136	-0.0208
				(1.075)	(1.003)	(0.189)	(0.179)	(0.0312)
F-Stat		131.6	119.6	17.66	14.00	160.1	142.2	142.2
Mean outcome	-0.0657	-0.0657	-0.0657	-0.0657	-0.108	-0.108	-0.108	0.0416
Observations	42,323	42,323	42,323	42,323	27,884	27,884	27,883	27,883
	Triadic patents							
	Industry					Firm		Placebo
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output	-0.195	-0.781	-1.074	-1.564	-1.589	-1.513***	-1.312***	0.210
	(0.560)	(0.735)	(0.775)	(1.572)	(1.565)	(0.494)	(0.487)	(0.374)
Input				0.748	0.844	0.114	-0.179	-0.335
				(2.209)	(2.161)	(0.490)	(0.482)	(0.359)
F-Stat		165.4	84.84	20.90	20.40	131.4	141.8	96.39
Mean outcome	0.101	0.101	0.101	0.101	0.100	0.100	0.100	0.0960
Observations	5,005	5,005	5,005	5,005	4,710	4,710	4,710	4,710
Firm controls	✓	✓	✓	✓	✓	✓	✓	✓
Industry FE							✓	✓
Sample	All Mfg	All Mfg	All Mfg	All Mfg	Trading Mfg	Trading Mfg	Trading Mfg	Trading Mfg
Shocks	3-dgt industry	3-dgt industry	4-dgt industry (from customs)	4-dgt industry (from customs)	4-dgt industry (from customs)	Firm (from customs)	Firm (from customs)	Firm (from customs)

Notes: This table compares different specifications and sources of identification when taking the 2000/2007 DH growth rate of employment and the 1993-1999 versus 2000-2007 DH growth rate of average yearly triadic patent flows as the outcome variables of interest. Columns (1) to (4) look at the universe of privately owned manufacturing firms with more than 10 employees while columns (5) to (8) restrict this sample to firms with available trade data. Columns (1) and (2) use trade shocks directly defined at the 3-digit industry. Columns (3) to (5) use product information aggregated from firm-level data to construct 4-digit industry shocks. Finally columns (6) to (8) use our preferred firm-level shocks. Column (8) is a placebo test which takes the pre-1999 DH growth rate of employment and triadic patents as our dependent variables. The detail of each specification is given in the main text. Standard errors clustered at the 4 digit industry-level are in parentheses. ***, ** and * indicate p-value of the Student test of null coefficient below 0.01, 0.05 and 0.1 respectively.

(1) and (2), respectively. As reported in several previous studies using comparable sources of identification (e.g. Autor et al., 2013; Malgouyres, 2017; Autor et al., 2020a), the employment effect of increased industry-level competition appears to be large and negative.

To assess the differences that may exist between direct industry-level measures of trade competition and our product-level approach, we build a second industry shock by aggregating our firm-level weights within each 4-digit industry. This aggregation procedure allows us to compute both an output and an input measure of industries' exposures to increased trade competition. We start in column (3) by reporting the shift-share IV estimate of the output component without controlling for its industry-level input supply counterpart. The difference between columns (2) and (3) shows that compared to product-based measures, direct industry-level measures of exposure to trade competition miss an important part of the negative output effect on employment growth. This can be attributed both to measurement error in the pure industry-level specification of column (2) and to the fact that industry-level measures tend to aggregate the input supply and output components of trade competition. The difference between columns (3) and (4) shows that not accounting for the positive effect of input-supply relationships indeed leads to an upward bias on the coefficient associated with output trade competition (omitted variable bias).

Before switching to our preferred firm-level specification, we check in column (5) that the employment effects from both input and output shocks measured in column (4) on the universe of manufacturing firms do not change significantly when we restrict our sample to the subset of trading manufacturing firms. Those are the firms for which we can compute our firm-level shocks.

From column (6) onward, Table 2 reports firms' responses to those firm-level shocks on that subset of trading manufacturing firms. The estimated negative effect of the output shock is divided by 3 when we switch from the industry trade measure (column (5)) to the more accurate firm-level trade measure (column (6)) on the same sample of firms. In addition, there are other potential industry-level characteristics that are correlated with a high Chinese export growth rate. We account for these industry trends in column (7) by adding 2-digit industry fixed effects to our baseline specification. Column (7), which is our preferred specification, shows the within-industry impact of the output and input China shocks. Controlling for industry trends is particularly important if we try to isolate the impact of output competition on employment: This impact is reduced by more than half when moving from column (6) to column (7), yet it remains economically and statistically significant. All regressions in the remaining part of the paper reproduce the setting of column (7) and include 2-digit industry fixed effects as well as the usual firm-level controls. Finally, the placebo test in column (8) shows no response from the pre-1999 employment growth rate to both shocks.

The bottom half of Table 2 shows that moving from the industry-level to our new firm-level measures of the China shocks also makes a big difference when assessing the impact of the China shock on innovation (new firm patents). The negative response of innovation to the output competition shock only becomes significant once we use our firm-level shock and separately control for the input supply shock. On the other hand, controlling for the industry-level trends does not have a major impact on the negative economic magnitude of the innovation response to the shock: This response is only slightly reduced when these controls are introduced. We view this result as a strong argument in favor of switching to firm-level evidence whenever possible and separating out the output and input supply components of the China shock.

3.2 Main firm-level outcomes

Table 3 extends our preferred column (7) specification from Table 2 to additional left-hand-side firm outcome variables. The first set of variables captures additional dimensions of the firms' "current" status beyond employment: sales, the labor share (in value added), exit from manufacturing (firm remains active), and firm death. We also add a broader measure of innovation captured by the average flow of all patent applications (not just triadic patent applications). Lastly, we add a set of variables that capture changes to the firms' exported product mix (we do not observe product-level details for domestic sales). We measure the fraction of new and discontinued products (entry/exit of an exported HS6 product between 1999 and 2007). And we quantify the extent to which French firms in our sample shift their production towards products where France had a comparative advantage relative to China in 1999.[13] This variable is only defined for firms with available export data for both 1999 and 2007.

Our main findings can be summarized as follows: Only the output shock negatively and significantly affects sales, employment, the firm's labor share, and patenting; the input supply shock has no significant effect on these variables; moreover, the input shock induces exit from manufacturing, conditional on the firm's survival. This last result suggests that access to cheaper inputs allows firms to move away from production tasks and instead concentrate on service activities outside of manufacturing.[14]

[13] We compute this firm-level measure of relative comparative advantage as an average across the set of exported products. For each HS6 product, we measure France's comparative advantage relative to China as the 1999 ratio of France's exports to the world over China's exports to the world. We then define firm-level comparative advantage as the average product-level comparative advantage over a firm's product mix, at all dates $t \geq 1999$.

[14] A firm is classified as a manufacturing firm if manufactured products account for a larger share of its total sales than the other 1-digit products. A switch away from manufacturing products towards services should therefore translate into both a decrease in the share of manufacturing firms and a decrease in the share of employment devoted to manufacturing products at manufacturing firms. Using the *EAE* data described in detail in section 3.3, which provides the share of employment used for manufacturing tasks, we find that a 1 pp increase in input supply competition decreases this employment share by 0.364 pp (standard error at 0.16); the corresponding coefficient for the output shock stands at 0.0562 (0.29). The share of employment used in manufacturing tasks in the

For those firms that maintain their manufacturing activities in France, the input shock induces them to stick to their current set of products: These firms are much less likely to introduce new products. On the other hand, the output shock induces a strong response in firms' product mix: affected firms switch to products where France's relative comparative advantage is stronger. Firms that benefit from increased access to Chinese imported inputs find it profitable to continue producing/exporting products where France's comparative advantage is weak.

Our findings are consistent with Autor et al. (2020a) and Pierce and Schott (2016) who both find that increased exposure to trade competition leads U.S. firms to reduce sales, employment and to shift their production away from labor intensive and high labor share production tasks into service activities. Our contribution is to show that the negative impact of the increased Chinese exposure on sales, employment, labor share, and domestic innovation is tightly linked to the output component of the trade shock. Finally, the direction of the effects of the shock on almost all firm-level outcomes is reversed when moving from the output component to the input supply component of the shock.

Table 3: MAIN FIRM-LEVEL OUTCOMES

	Main outcomes					Patents		Products		
	(1) Sales	(2) Employment	(3) Labor share	(4) Exit mfg	(5) Death	(6) Triadic	(7) Appln	(8) Discontinued	(9) New	(10) Comp Adv
Output	-0.417**	-0.367**	-0.255**	0.0104	0.0707	-1.312***	-1.488*	0.196*	0.191	0.637***
	(0.197)	(0.167)	(0.106)	(0.0751)	(0.0798)	(0.487)	(0.854)	(0.117)	(0.161)	(0.155)
Input	0.0653	0.136	0.136	0.301***	-0.0765	-0.179	0.412	-0.133*	-0.488***	-0.288*
	(0.186)	(0.179)	(0.114)	(0.0890)	(0.0931)	(0.482)	(0.945)	(0.0738)	(0.112)	(0.151)
F-stat	142.2	142.2	133.2	142.2	169.9	141.8	141.8	131.3	162.0	148.2
Mean outcome	0.0704	-0.108	-0.0236	0.0745	0.160	0.100	0.289	0.815	0.472	0.00161
Observations	27,883	27,883	24,999	27,883	33,203	4,710	4,710	24,232	17,307	16,090

Notes: This table reports our main results when regressing firm-level outcomes on our firm-level output and input supply shocks. Columns (1) to (5) gather results for variables taken from French fiscal and administrative files. Columns (6) and (7) present results for triadic patents and patent applications. Columns (8) to (10) use exported products to construct measures of changes in a firms' product scope. We use DH growth rate for continuous variables and a simple linear probability model for dummy variables in columns (4) and (5). The share of discontinued products (8) is defined for firms with export data in 2000. The share of new products (9) is defined for firms with export data in 2007 and the DH growth rate of the relative comparative advantage content of a firm's exports (10) is defined for firms with available exports both in 2000 and 2007. The baseline sample includes all manufacturing firms with positive sales in 1999, which can be matched to customs data in 1999 and are recorded with at least 10 employees once between 1994 and 2007. Columns (6) and (7) restrict this sample to firms observed with at least one patent in our time window while columns (8) to (10) are by construction restricted to exporting firms. All models control for initial 5-years trends and level of sales and employment, export/import dummies as well as 2-digit industry fixed effects (NAF rev. 1 classification). We add 1999 stock of patents and pre-1999 trend in patenting activity for models involving patenting outcomes. Standard errors clustered at the 4 digit industry-level are in parentheses. ***, ** and * indicate p-value of the Student test of null coefficient below 0.01, 0.05 and 0.1 respectively.

manufacturing sector decreases by 8.95pp in our sample.

3.3 Extending the sample to non-trading (domestic) firms

The construction of the shocks relies on international trade data at the firm level to precisely assess the set of products that are used as input and sold as output by French firms. This strategy has the advantage of relying on very detailed customs data which provides very granular details about the set of products exported and imported by each firm (a classification that contains more than 5,000 manufacturing products). However, this requires us to restrict the analysis to firms participating in international trade.

In Table 2, columns (4) and (5), we have already shown that there is no significant change when we go from the sample of all manufacturing firms (including firms that do not trade) to our main sample of trading firms when we use industry-level measures of exposure to Chinese competition in order to obtain a proxy of the exposure for the nontrading firms.

A related concern could be that the shocks affecting nontrading manufacturing firms differ systematically from the shocks that we observe for the set of trading manufacturing firms. To investigate this question, we take advantage of an additional data set, the "EAE Industry" (*Enquête Annuelle d'Entreprises dans l'industrie*). The EAE records detailed information on the activity of a large and representative sample of manufacturing firms, therefore shedding light on both trading and non-trading firms.[15] This EAE product-level data (4-digit French NAF nomenclature) is substantially less detailed than the product-level data that is available from customs data for the trading firms (700 product codes versus 5,000) and does not exhibit enough within-industry variation for our main analysis with industry fixed effects. Nonetheless, this new data set allows us to construct an alternate measure for the firm-level output shocks for both trading and non-trading firms, which we label "domestic".[16] The timeline for the average "domestic" shock is displayed in Figure 2(a) below, along with our preferred "customs" shock that we used so far. As French firms are more likely to export products for which France enjoys a comparative advantage, we can expect exported

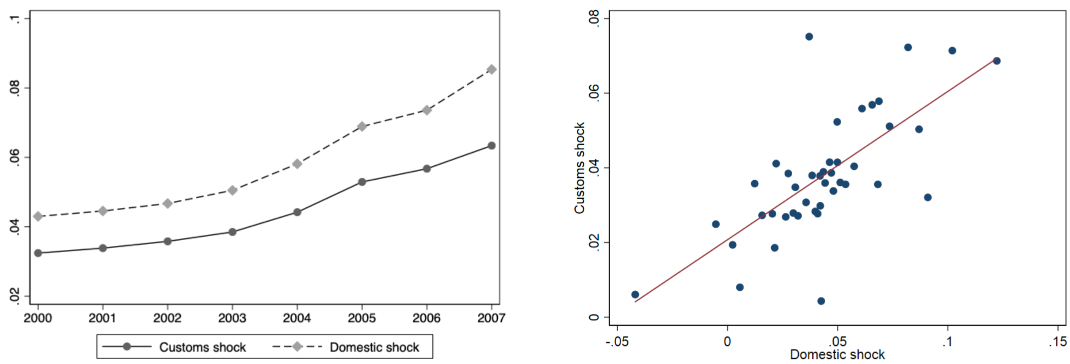
[15] The sample contains approximately 40,000 manufacturing firms per year between 1995 and 2007.

[16] We can only use the EAE data to compute a version of the output shock. We cannot use it to compute an input supply shock since it does not contain any information on inputs at the product level.

products to be less exposed to increased trade competition stemming from China. As shown in Figure 2(a) we indeed find that restricting our analysis to the exported products observed in the customs data leads to an under-measurement in the *level* of Chinese import penetration. However, there is no discernible difference in the *changes* in Chinese import penetration over time that we exploit in our analysis: the two lines in Figure 2(a) are parallel. Similarly, we plot in Figure 2(b) the cross-sectional correlation between the two shocks after removing a fixed sector effect.

Figure 2: Domestic vs Customs shocks

(a) Time series　　(b) Cross section



Notes: The left-hand side graph plots average firm level Chinese output import competition over the 2000/2007 period using (i) our main measure of output exposure to trade competition taken from firm level customs data and (ii) an alternative exposure measure constructed from the industry decomposition of firms' total sales (domestic and exported) as reported in the EAE survey dataset. The right-hand side graph plots the cross sectional relationship between these two different computations of the output shock after absorbing a sector fixed effect. Resulting data points have been binned into 50 categories.

Now we investigate further the differences between the customs shock and this alternate domestic shock for our regression results. For completeness, we also report differences due to changes in the underlying sample of firms – the trading firms in the customs data and the sample of firms (both trading and non-trading) in the EAE data. These regressions are reported in Table 4, and should be compared to our main results reported in columns (6) – without industry fixed effects – and column (7) – with industry fixed effects in Table 2. These regressions are reproduced in the first column (columns 1 and 5) of each panel (employment/patents and with/without fixed effects) of Table 4. As we have mentioned, we cannot construct an input shock using the EAE data, and therefore we drop this additional regressor throughout. However, switching to this alternative construction of the output shock barely impacts the coefficients as shown in columns (1) and (5) (which should be compared with columns (6) and (7) of Table 2).

Table 4: Domestic vs customs: employment and triadic patents

	Employment							
	Without industry FE (column 6 of Table 2)				With industry FE (column 7 of Table 2)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output	-0.879***	-1.017***	-0.897***	-0.894***	-0.328**	-0.434**	0.214	0.243
	(0.194)	(0.227)	(0.304)	(0.301)	(0.160)	(0.190)	(0.435)	(0.437)
Shocks	Customs	Customs	EAE	EAE	Customs	Customs	EAE	EAE
Sample	Customs	Customs and EAE	Customs and EAE	EAE	Customs	Customs and EAE	Customs and EAE	EAE
Firm controls	✓	✓	✓	✓	✓	✓	✓	✓
Industry FE					✓	✓	✓	✓
F-Stat	310.9	161.7	89.00	75.34	232.0	141.1	104.2	96.15
Mean outcome	-0.108	-0.182	-0.182	-0.183	-0.108	-0.182	-0.182	-0.183
Observations	27884	12864	12864	14438	27883	12863	12863	14437

	Triadic patents							
	Without industry FE (column 6 of Table 2)				With industry FE (column 7 of Table 2)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output	-1.465***	-1.789***	-1.740**	-1.740**	-1.382***	-1.470***	-1.913**	-1.913**
	(0.492)	(0.569)	(0.749)	(0.749)	(0.483)	(0.545)	(0.908)	(0.908)
Shocks	Customs	Customs	EAE	EAE	Customs	Customs	EAE	EAE
Sample	Customs	Customs and EAE	Customs and EAE	EAE	Customs	Customs and EAE	Customs and EAE	EAE
Firm controls	✓	✓	✓	✓	✓	✓	✓	✓
Sector FE					✓	✓	✓	✓
F-Stat	176.0	130.4	155.1	155.1	159.2	128.8	149.7	149.7
Mean outcome	0.100	0.110	0.110	0.110	0.100	0.110	0.110	0.110
Observations	4710	3510	3510	3510	4710	3509	3509	3509

Notes: This table tests the specifications described in columns (6) and (7) of Table 2, both for employment (top panel) and triadic patents (bottom panel). Columns (1) and (5) reproduce these specifications but omit to control for the input shock constructed from our customs data. Columns (2) and (6) narrow the sample of firms to the subset of trading firms present in the EAE data. Columns (3) and (7) keep this sample but switch the output shock from the customs to the EAE one. Finally columns (4) and (8) keep the EAE shock but extend the sample to include all firms of the EAE sample (not just the intersection of customs and EAE firms. All models control for pre-1999 5-years trends and level of sales and employment and export/import dummies. Standard errors clustered at the 4 digit industry-level are in parentheses. ***, ** and * indicate p-value of the Student test of null coefficient below 0.01, 0.05 and 0.1 respectively.

Focusing on the panels on the left side (without fixed effects), we see that switching either the shock measure (domestic versus customs) or the firm sample (customs versus EAE) does not affect our main results (columns 1-4). The only noticeable difference is that the point estimate of the patent response using the EAE sample is larger, although substantially less precisely estimated. Focusing on the right-hand side panels, there are some more substantial differences between the results using the EAE and customs shocks. Most notably, the employment response becomes insignificant with the EAE shock. This is driven by the much coarser measure of product aggregation that is available in the EAE data relative to customs: There is no longer enough within-industry variation to be able to measure the employment response while controlling for industry fixed effects. Only 36% of the variation in the EAE shock is within industry. The comparable variation for the customs shock within-industry is substantially higher at 88%. In terms of the patenting response, we notice the same pattern as the one we had described without industry fixed effects: the patenting response with the

EAE shock is larger, although again much less precisely estimated.

Taken together, these additional results confirm that our main reported results for the impact of the output China shock (columns 6-7 in Table 2) are not specific to our sample restriction to trading firms. This allows us to use the much more detailed product classification available in the customs data while controlling for industry fixed effects; and crucially also allows us to measure the impact of the intermediate inputs supply China shock.

3.4 Introducing firm heterogeneity

The average firm behavior as described in Table 3 may hide heterogeneous responses between different groups of firms. Therefore, we group the firms according to their *initial labor productivity* measured as sales per worker in 1999. More specifically, we introduce below-median ($q = 1$) and above-median initial productivity ($q = 2$) dummies, which we interact with the input and output shocks. Table 5 reproduces the results from Table 3 but separates the response of each of these two groups of firms to the output and input China trade shocks.

Table 5: Evidence of heterogeneous response

	Main outcomes					Patents		Products		
	(1) Sales	(2) Employment	(3) Labor share	(4) Exit mfg	(5) Death	(6) Triadic	(7) Appln	(8) Discontinued	(9) New	(10) Comp Adv
Output*(q=1)	-0.409*	-0.489**	-0.244*	-0.0326	0.0349	-1.259**	-1.888*	0.0189	-0.0368	0.578***
	(0.247)	(0.206)	(0.127)	(0.0648)	(0.116)	(0.516)	(1.058)	(0.0926)	(0.192)	(0.208)
Output*(q=2)	-0.403	-0.0778	-0.263	0.117	0.0442	-1.159	-0.904	0.411**	0.377**	0.694***
	(0.264)	(0.204)	(0.168)	(0.127)	(0.0888)	(0.838)	(1.372)	(0.184)	(0.178)	(0.178)
Input*(q=1)	0.0185	-0.207	-0.0181	0.220***	0.126	-0.0668	0.255	-0.0925	-0.415**	-0.327
	(0.204)	(0.200)	(0.128)	(0.0740)	(0.110)	(0.481)	(1.139)	(0.0853)	(0.172)	(0.213)
Input*(q=2)	0.117	0.488*	0.348*	0.371**	-0.322**	-0.341	0.428	-0.224*	-0.577***	-0.264
	(0.328)	(0.282)	(0.188)	(0.162)	(0.143)	(0.901)	(1.622)	(0.120)	(0.156)	(0.194)
F-Stat	70.32	70.32	66.66	70.32	83.93	32.23	32.30	65.32	51.80	49.59
Mean outcome	0.0704	-0.108	-0.0236	0.0745	0.160	0.100	0.289	0.815	0.472	0.00161
Observations	27,883	27,883	24,999	27,883	33,203	4,710	4,710	24,232	17,307	16,090

Notes: This table reproduces the exact specifications described in Table 3 but interacts our output and input supply shocks with below ($q = 1$) and above ($q = 2$) median dummies of sales per worker as measured in 1999. In addition to the controls described in Table 3 all models also control for the direct effects of the above/below median dummies. All models control for pre-1999 5-years trends and level of sales and employment, export/import dummies as well as 2-digit industry fixed effects (NAF rev. 1 classification). On the patent side we further add the initial stock of patents, the pre-1999 average patenting rate in the relevant patent category. Standard errors clustered at the 4 digit industry-level are in parentheses. ***, ** and * indicate p-value of the Student test of null coefficient below 0.01, 0.05 and 0.1 respectively.

The negative effects of the output shock highlighted in Table 3 on sales, employment, labor share, triadic patents, and patent applications turn out to be concentrated on "laggard" firms with below median initial productivity. Consistent with this finding, the existing literature on competition and innovation points to a more negative effect of competition on innovation in firms far behind the technological frontier (Aghion et al., 2005).[17]

Columns (2) and (3) also show that the effects of the input supply shock on employment and labor share are positive and significant for the initially most productive firms: These firms appear more able to enhance their competitive advantage following an increase in Chinese penetration in their input markets. Consistent with this observation, these more productive firms have a lower probability of exit (column (5)).

Columns (8), (9), and (10) document how firms also respond to the China shock through product turnover and shifts in their product mix. When faced with higher competition on their output markets, frontier firms adjust their product mix: they stop exporting some of their products and start exporting new ones (columns 8 and 9). In contrast, when facing more intense competition in their input markets, both frontier and laggard firms introduce fewer new products. This suggests that improved access to cheaper inputs offsets the need to switch to new products. Finally, column (10) shows that both frontier and laggard firms respond to increased output competition by strongly shifting their product mix towards products where France has a comparative advantage relative to China.[18]

The heterogeneous response highlighted in Table 5 shows that both the output and input shocks were first-order factors in the evolution of employment and innovation over the 2000-2007 period. Indeed, using the two coefficients in column (2) significant at the 10% level, we can compute the counterfactual employment growth $\tilde{\Delta} Y_f^c$ that we would have witnessed absent the output shock to low-productivity firms and the

[17]In a selection of industries, Holmes and Stevens (2014) report that the largest firms, which produce standardized mass-market products, are the most affected by the competition from China imports. Our data are also consistent with these results. Table B1 reports a differentiated impact for the output and input shocks according to the initial size of the firm, measured by its total sales in 1999. As the output shock coefficient is not significant for the smallest firms, it suggests that overall, it is the large / low productivity firms that were hit more strongly by direct Chinese competition on their output markets.

[18]This echoes the findings of Bernard et al. (2006) for the U.S.

input shock to high-productivity firms using only within-industry variations:

$$\frac{E^c_{f,2007} - E_{f,2000}}{\frac{E^c_{f,2007}+E_{f,2000}}{2}} = \tilde{\Delta}Y^c_f = \tilde{\Delta}Y_f - \beta_{O,q=1}\Delta O^{instr}_{f,q=1} - \beta_{I,q=2}\Delta I^{instr}_{f,q=2}$$

Summing over (a subset of) firms f in our regression sample, we can contrast the observed employment with this counterfactual employment. While French manufacturing employment in low-productivity firms decreases by 10.3% between 2000 and 2007, we predict that it would have decreased by 9.4% absent the output China shock. This implies that 8.6% of the decline in manufacturing employment in low-productivity firms can be attributed to this output China shock.[19]

While the negative impact of the China shock on employment runs through the output shock on the subset of low-productivity firms, its positive impact is passed on to high-productivity firms through their input supply shock. Given that high-productivity firms are larger on average, this positive supply shock can potentially reverse the impact of the negative output shock. Indeed, even though the coefficients are similar, the supply shock creates over three times more jobs than the output shock destroys.This estimate should be interpreted with caution, as it is derived from a coefficient that is only marginally significant (at the 10% level). However, it still clearly illustrates the quantitative importance and relevance of the vertical input supply channel for evaluating the overall impact of Chinese imports on French employment: its positive impact can potentially swamp the negative impact of horizontal product competition, which has been highlighted much more prominently in the literature.

On the other hand, the China shock is unambiguously detrimental to innovation, as the only significant coefficients correspond to the negative impact of the output shock on low-productivity firms (columns (6) and (7)). The China shock substantially reduces innovation at the impacted firms; yet the aggregate impact turns out to be very small because those low-productivity firms are small inventors. The observed DH growth in the yearly number of applications in low-productivity firms between 1993-1999 and 2000-2007 is 21%. Absent the (instrumented) output shock on these

[19]Close to our paper but using industry variations to study the impact of the China shock on French local labor markets, Malgouyres (2017) finds that direct trade competition accounted for 13% of the decline in French manufacturing employment.

low-productivity firms, this growth rate would have been 27% (the corresponding figures for triadic patenting are 3.9% and 8.4%).

We now restrict our analysis to firms with at least one application in the 1993-1999 period, for which we can compute a counterfactual number of applications in 2000-2007. Among them, low-productivity firms have filed on average 1,800 patent applications each year in the 2000-2007 period. They would have filed 540 (or 30%) more applications without the output shock. However, taking into account patenting at high-productivity firms, these 540 additional patents only represent 4% of the total number of yearly patents. Since triadic patents are even more concentrated amongst the most productive firms, the China shock's impact on that higher-quality innovation is minimal. Indeed, among firms with at least one triadic patent over 1993-1999, low-productivity firms have filed for 47 triadic patents in an average year of 2000-2007, versus 640 for all firms. Low-productivity firms would have filed 14% more triadic patents absent the (instrumented) output China shock, which represents a mere 1% of these 640 patents.

4 Conclusion

In this paper, we use comprehensive firm-level panel data to analyze the effect of Chinese import shocks on sales, employment, and innovation. We separately identify firms' responses to the horizontal output and vertical input supply components of the China shock. We find that the output shock is detrimental to firm sales, employment, and innovation. In addition, this negative effect is concentrated in low-productivity firms. The output shock also strongly induces firms to switch their product mix towards products where France's comparative advantage relative to China is stronger. However, these effects are reversed when it comes to the input supply shock.

At the industry level, the output and input shocks are highly correlated, which makes it difficult to interpret industry-level analyses of the China shock. Instead, our results suggest that in order to correctly identify the effects of increased import competition, these two components of the China shock must be disentangled at the firm level and industry-wide trends must be controlled for. In particular, the contrasting findings in Bloom et al. (2016) versus Autor et al. (2020a) regarding the effects of the China shock on domestic innovation might be explained once we consider more detailed firm-level information and look more closely at firms' input-output structures: indeed, given that we found opposite effects of the output and input supply components of the China shock on firm-level outcomes, a natural conjecture is that the differences in the input-output structures in the United States versus Europe may lie behind the opposite conclusions that come out of these two papers. Our finding of a negative overall effect of the China shock on French domestic innovation is broadly in line with Autor et al. (2020a). However, that effect is quantitatively small and concentrated on French firms with low productivity.

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Appendix

A Controlling for the common component of firms' export/import flows

In this Appendix we split our output and input shocks between: (i) a net export shock on exports which are not imported; (ii) a net import shock on imports which are not exported; (iii) a common export/import shock. More formally:

- let $\widetilde{x}_{f,i,t_0}$ denote firm f's **net exports** of product i in base year t_0 :

$$\widetilde{x}_{f,i,t_0} = \max(x_{f,i,t_0} - m_{f,i,t_0}, 0)$$

- let $\widetilde{m}_{f,i,t_0}$ denote firm f's **net imports** of product i in base year t_0 :

$$\widetilde{m}_{f,i,t_0} = \max(m_{f,i,t_0} - x_{f,i,t_0}, 0)$$

- let $\widetilde{c}_{f,i,t_0}$ denote firm f's **import/export intersection** of product i in base year t_0 :

$$\widetilde{c}_{f,i,t_0} = \min(m_{f,i,t_0}, x_{f,i,t_0}).$$

We shall then define firm f's output, input, and common Chinese shift-share shocks, respectively, by:

$$\Delta\widetilde{H}_f = \sum_i \frac{\widetilde{x}_{f,i,t_0}}{\sum_j \widetilde{x}_{f,j,t_0}} \Delta S_i, \quad \Delta\widetilde{V}_f = \sum_i \frac{\widetilde{m}_{f,i,t_0}}{\sum_j \widetilde{m}_{f,j,t_0}} \Delta S_i \text{ and } \Delta\widetilde{C}_f = \sum_i \frac{\widetilde{c}_{f,i,t_0}}{\sum_j \widetilde{c}_{f,j,t_0}} \Delta S_i.$$

Our extended specification which splits our output and input shocks between a net export shock on exports which are not imported, a net import shock on imports which are not exported, and a common export/import shock, is summarized by the regression equation:

$$\Delta^t_{t-k} Y_f = \alpha + \beta_O \Delta^t_{t-k} \widetilde{H}_f + \beta_I \Delta^t_{t-k} \widetilde{V}_f + \beta_C \Delta^t_{t-k} \widetilde{C}_f + \gamma' X_{f,t_0} + \eta_{s(f)} + \varepsilon_f. \qquad \text{(A)}$$

Table A1 reports the results of this exercise and confirms the main messages conveyed in Table 3.

B Additional Tables and Figures

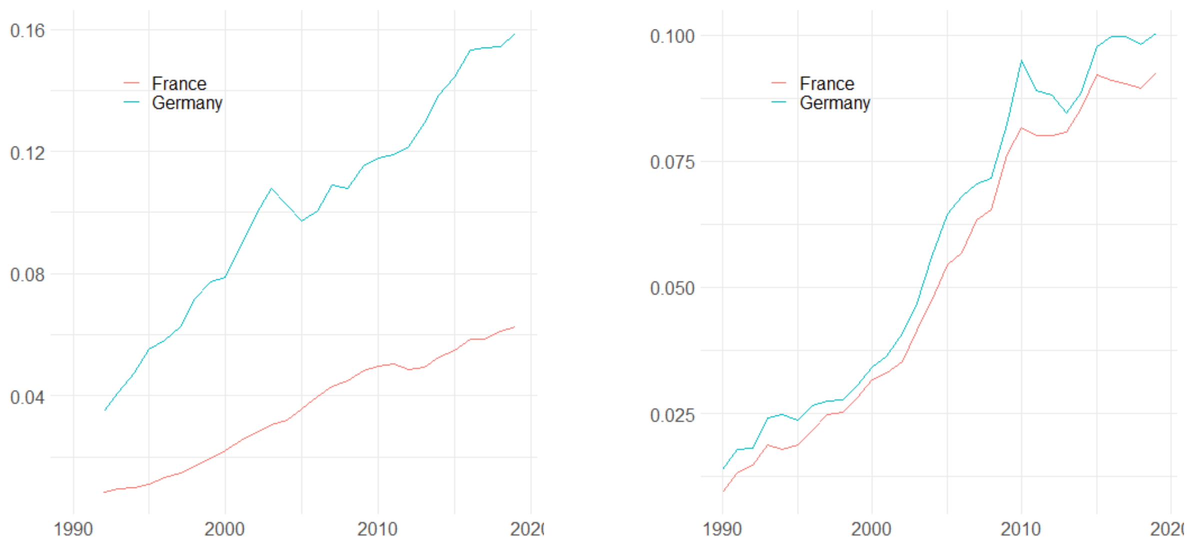
Table A1: MAIN OUTCOMES CONTROLLING FOR THE COMMON EXPORT/IMPORT COMPONENT

	Main outcomes					Patents		Products		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Sales	Employment	Labor share	Exit mfg	Death	Triadic	Appln	Discontinued	New	Comp Adv
Output	-0.403**	-0.374**	-0.336***	0.0385	0.0512	-1.240**	-1.967*	0.279***	0.243	0.462***
	(0.195)	(0.175)	(0.108)	(0.0710)	(0.0890)	(0.553)	(1.029)	(0.102)	(0.164)	(0.167)
Input	0.205	0.322*	0.0808	0.269***	0.0159	-0.560	-1.040	0.0297	-0.225*	-0.00775
	(0.202)	(0.191)	(0.119)	(0.0828)	(0.0929)	(0.457)	(0.799)	(0.0736)	(0.129)	(0.141)
Common	-0.215	-0.215	0.140	0.0113	-0.0563	-0.0744	1.104	-0.278***	-0.288**	-0.0332
	(0.222)	(0.186)	(0.134)	(0.0968)	(0.112)	(0.420)	(0.935)	(0.0714)	(0.131)	(0.168)
F	88.05	88.05	79.67	88.05	118.6	71.79	71.79	105.4	123.2	125.9
Mean outcome	0.0704	-0.108	-0.0236	0.0745	0.160	0.100	0.289	0.815	0.472	0.00161
N	27883	27883	24999	27883	33203	4710	4710	24232	17307	16090

Notes: This table reproduces the results of Table 3 but adds the common shock to the original specification. Because we add the common component of the output and input shocks, all results contained in this table control for a dummy indicating whether the firm both exported and imported in at least one HS6 product category. The definition of dependent variables and the exact specifications are otherwise unchanged. All models control for 2-digits industry fixed effects. Standard errors are clustered at the 2-digit industry-level. Standard errors clustered at the 4 digit industry-level are in parentheses. ***, ** and * indicate p-value of the Student test of null coefficient below 0.01, 0.05 and 0.1 respectively.

Figure B1: IMPORTS FROM CHINA AND FROM EASTERN EUROPE

(a) Eastern Europe (b) China



Notes: This figure provides the share in total imports in France and Germany coming from Eastern European countries (left-hand side) and China (right-hand side). Eastern European countries include BGR, CZE, EST, HUN, LTU, LVA, POL, ROU and SVK. Source: OECD, STAN database.

Table B1: Evidence of heterogeneous response by total sales

	(1) Sales	(2) Employment	(3) Labor share	(4) Exit mfg	(5) Death	(6) Triadic	(7) Appln	(8) Discontinued	(9) New	(10) HHI	(11) Comp Adv
Horizontal*(q=1)	-0.148	-0.262	-0.334**	-0.00144	0.110	-0.742	-0.917	0.170	0.197	-0.335***	0.666***
	(0.237)	(0.225)	(0.137)	(0.0717)	(0.111)	(0.520)	(1.031)	(0.113)	(0.226)	(0.126)	(0.231)
Horizontal*(q=2)	-0.804***	-0.542**	-0.142	0.0193	0.0357	-2.183**	-1.369	0.236	0.191	-0.283***	0.617***
	(0.270)	(0.227)	(0.158)	(0.117)	(0.113)	(0.884)	(1.415)	(0.153)	(0.175)	(0.109)	(0.190)
Vertical*(q=1)	-0.0712	-0.0269	0.195	0.282***	-0.0197	-0.428	1.342	-0.00853	-0.310*	0.201	-0.255
	(0.219)	(0.224)	(0.136)	(0.104)	(0.110)	(0.438)	(1.047)	(0.0977)	(0.185)	(0.151)	(0.236)
Vertical*(q=2)	0.328	0.368	0.0245	0.338***	-0.163	0.580	-1.384	-0.288***	-0.649***	0.0568	-0.307
	(0.299)	(0.255)	(0.179)	(0.129)	(0.163)	(1.258)	(2.007)	(0.109)	(0.125)	(0.129)	(0.186)
F	68.15	68.15	65.26	68.15	81.05	33.77	33.77	65.66	84.60	75.06	75.06
Mean outcome	0.0704	-0.108	-0.0236	0.0745	0.160	0.100	0.289	0.815	0.472	0.0236	0.00161
N	27883	27883	24999	27883	33203	4710	4710	24232	17307	16090	16090

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reproduces the exact specifications described in Table 3 but interacts the output and input shocks with below ($q = 1$) and above ($q = 2$) median dummies of total sales as measured in 1999. In addition to the controls described in Table 3 all models also control for the direct effects of the above/below median dummies. All models control for pre-1999 5-years trends and level of sales and employment, export/import dummies as well as 2-digit industry fixed effects (NAF rev. 1 classification). On the patent side we further add the initial stock of patents, the pre-1999 average patenting rate in the relevant patent category. Standard errors clustered at the 4 digit industry-level are in parentheses. ***, ** and * indicate p-value of the Student test of null coefficient below 0.01, 0.05 and 0.1 respectively.