How resilient was trade to COVID-19? The effects of China, technology and labour intensity

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Motivation

- COVID-19 shock in early 2020 resulted in substantial disruptions to economic activities;
- Between January and June 2020, the volume of global trade retraced by 13 percent (World Bank, 2020);
- Negative demand shock account for some of trade decrease (Evenett, 2020; Stelliner et al., 2020);
- Negative supply shock resulted from the role of China in the GVC;
- Additional challenges: restrictions on local labor mobility and international travelling.

Contributions

- We identify causal evidence on:
- (1) The production characteristics that were most vulnerable to the unexpected first wave of the COVID-19 shock;
- (2) The effects of the stay-at-home policy on exports depending on product vulnerabilities.

What We Do

- **Identification strategy:** difference-in-differences type of specification to study the causal relationship between the COVID-19 shock and policies on exports depending on product vulnerabilities
- **High-frequency monthly data for product (HS6) export flows** from January 2016 to July 2020 for all countries around the world to the four largest markets: France, Germany, Japan and the United States;
- Rely on a within HS6-product-exporting country estimation ;
- We identify **causal effects** by exploiting exogenous COVID-19 shock prior to adjustments made by firms and governments;
- Control for unobservable shocks across exporting countries over time and across HS6-products over time to account for global demand or technological shocks;

How We Do

- We regress bilateral monthly product exports to the four large markets on interaction terms between:
- (1) measures of **COVID-19 incidence** (death over population) and proxies for the various production vulnerability measures;
- (2) **containment policies** (lockdown) and production vulnerability measures
- Production vulnerability measures: **labor intensity, concentration of input trade in China and complexity or innovation-intensity measured by input contractability.**

What We Find

- The reliance on inputs for which China is a dominant supplier is the main production vulnerability.
- The effects of other production characteristics depend on the market:
  - For exports to Japan and Germany, exports relying on production processes using more customized inputs, higher input contractibility, decreased relatively more in countries with a higher incidence.
- The main source of vulnerability in face of lockdown policies is also the nature of the inputs used in the production process:
  - **Reliance on inputs for which China is a dominant supplier or on customized inputs** that are difficult to substitute in face of disruptions are the main drivers of a negative effect of stay-at-home policies on exports to all four markets.

Related literature

Impact of the crisis and shocks on trade

- This literature focus on the 2008-2009 global financial crisis (Amiti and Weinstein, 2011; Bricongne et al., 2012; Chor and Manova, 2012; Levchenko et al., 2010)

International transmission of foreign shocks

- Hummels et al., 2001; Yi, 2003; Johnson and Noguera, 2012, 2017; Johnson, 2014; Eaton et al., 2016a, 2016b.

- **Contribution** $\rightarrow$ Our work differs from these studies in two ways:

  - Emphasizes the drivers of resilience of trade to an unprecedented crisis;
  - Focuses on the short-run impacts of an unprecedented crisis which combines negative supply and demand shocks with a substantial increase in uncertainty.

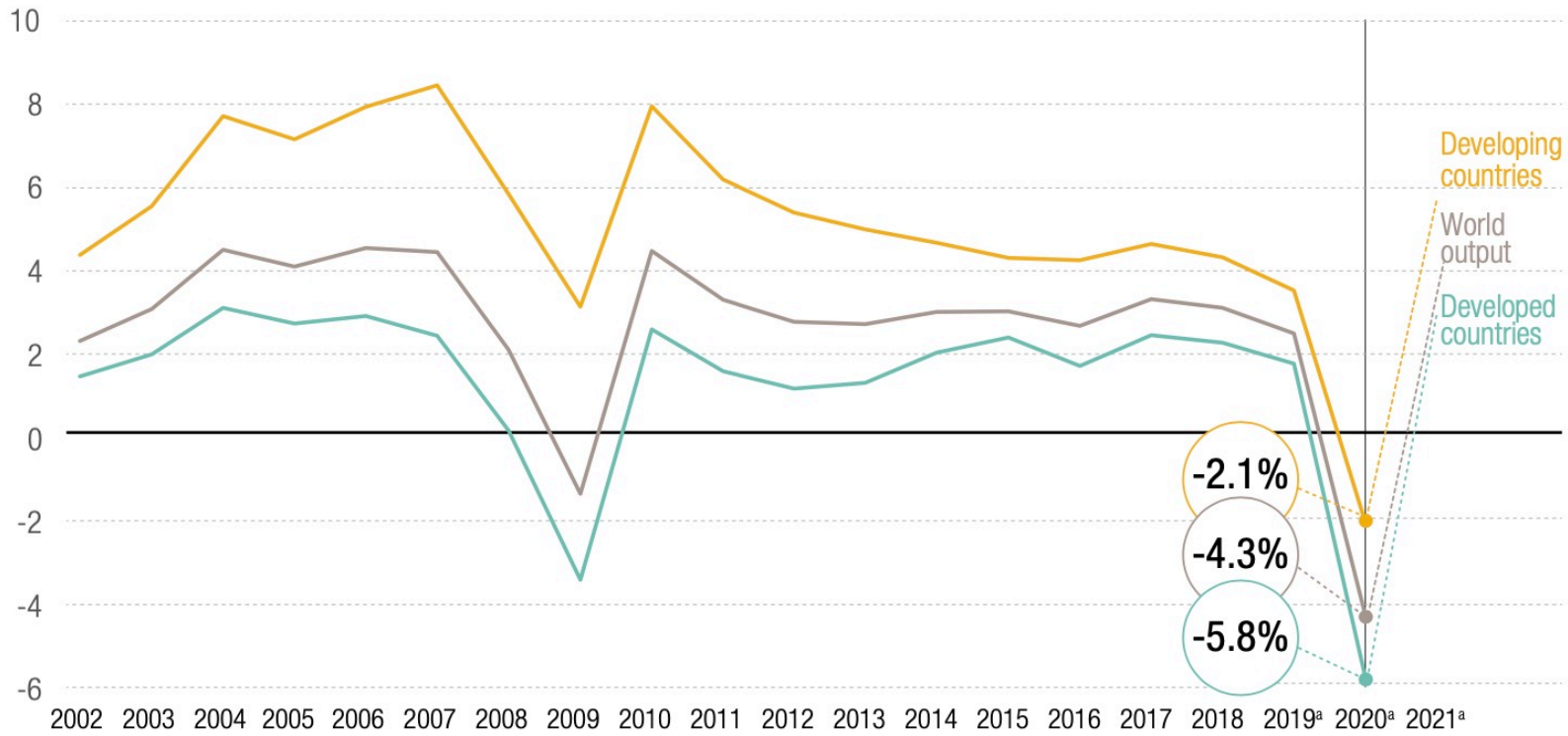
Outline

1. Empirical Motivation
2. Theoretical Motivation
3. Data
4. Identification strategy
5. Empirical tests

Empirical Motivation

Trends in global economic growth

(Annual percentage change)

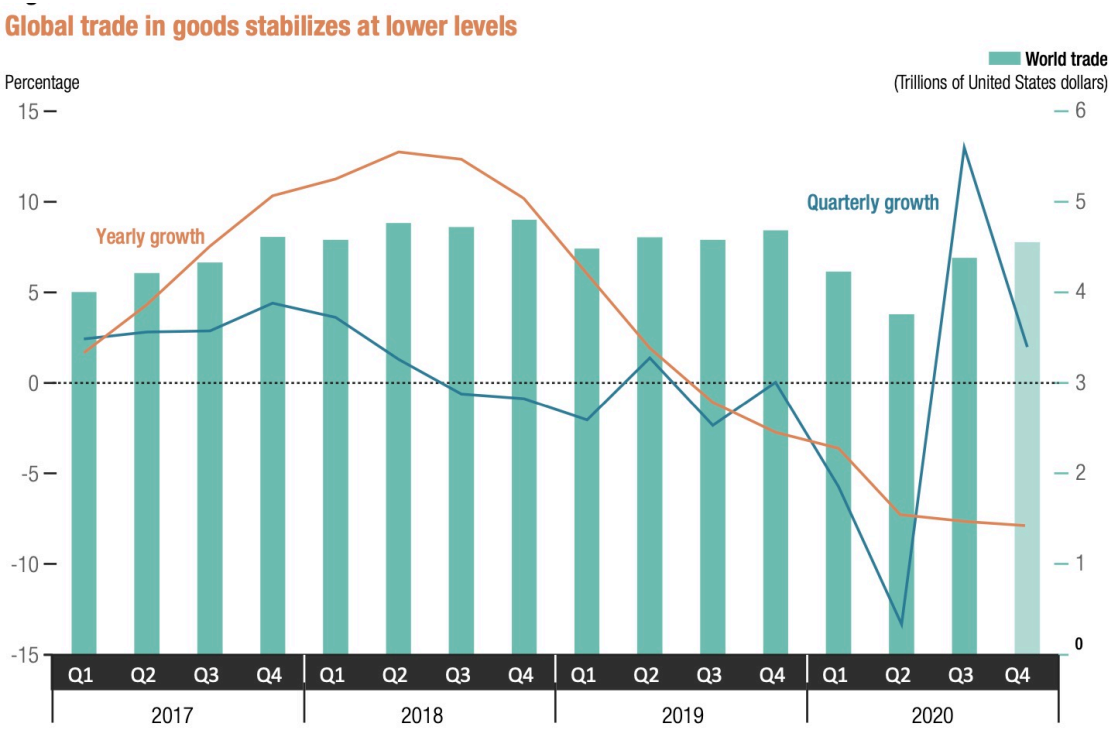


Source: UNCTAD (2020).

Note: Calculations for country aggregates are based on GDP at constant 2015 dollars

[a] Forecasts.

Empirical Motivation



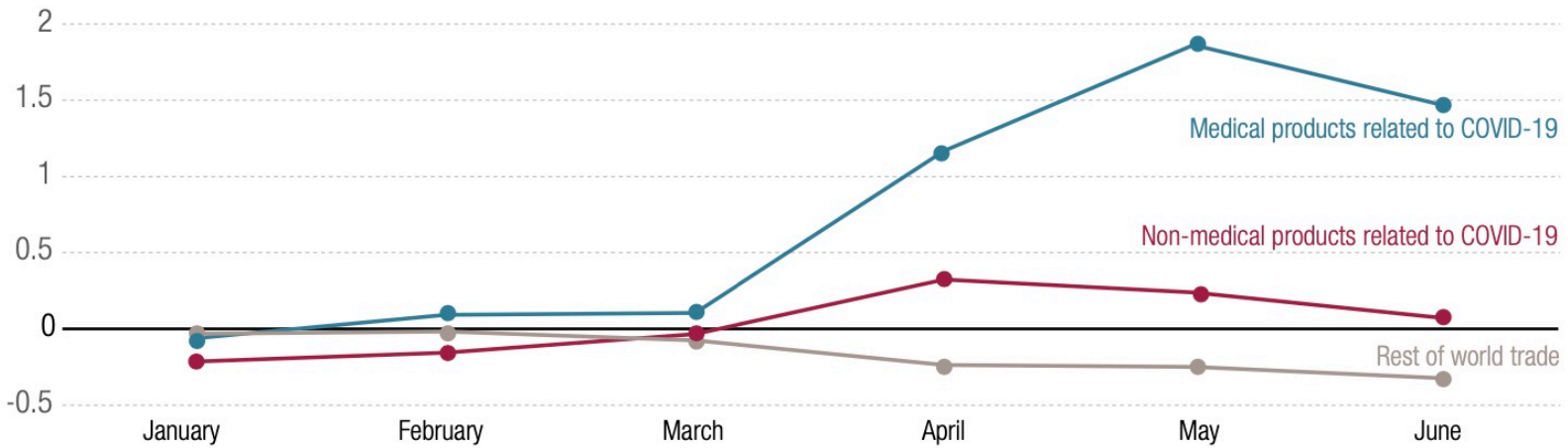
Source: UNCTAD. (2020). Global Trade Update, October, and UNCTAD calculations, based on national statistics.
Abbreviations: Q1, first quarter; Q2, second quarter; Q3, third quarter; Q4, fourth quarter.
Notes: Quarterly growth is the quarter over quarter growth rate of seasonally adjusted values. Yearly growth is the average growth rate of last 4 quarters. For 2020, third quarter figures are preliminary, and fourth quarter figures are forecast.

- Growth in international trade hit the lowest level in the second quarter of 2020, with a reduction of 13 percent from the previous quarter

Empirical Motivation

Global merchandise trade of medical products, 2020

(Percentage)



Source: UNCTAD secretariat calculations, based on the national statistics of China (GACC, 2020), United States (United States Census Bureau, 2020) and European Union (Eurostat, 2020).

Note: Year-on-year percentage changes.

Theoretical Motivation

- Testable hypotheses regarding the vulnerability of exports to the shock relying on a production function framework.

- Consider exports of product Y produced relying on three core inputs labor (L), intermediate inputs (I), capital (K) as well as on ideas/technology/productivity (A):

$$Y = f(A, L, I, K)$$

- The COVID-19 shock affected export production through effects on all components of supply (L, I, K, A).

Testable implications 1

- The shock is expected to reduce labor supply (L) due to social distancing as well as lockdown and business closures;
- This supply shock is more relevant for all economic activities that are not possible to execute from home, in particular manufacturing production chains and especially those less susceptible to automation;
- **H1: The labor intensity of production was a source of vulnerabilities in the COVID-19 pandemic.**
- $\rightarrow$ proxy by sectoral labor intensity of production.

Testable implications 2

- The shock is expected to affect intermediates and capital (I, K) due to GVC;
- The disruption of production in China is expected to have greatly affected the production processes of manufacturing GVC that were highly dependent on those imports from China ;
- **H2: The COVID-19 pandemic constrained exports of intermediates by China and the production of goods-for-export relying on those intermediates was vulnerable.**
- $\rightarrow$ proxy by sectoral reliance on intermediates from China (using IO tables).

Testable implications 3

- The shock is expected to affect productivity (A) due to reduced mobility and production disruptions.;
- For sophisticated products relying on highly customized inputs, the nature of inputs implies an inability to substitute towards other input suppliers during the shock resulting in productivity decline.
- **H3: Complex production processes were more vulnerable to the COVID-19 pandemic as any disruption to customized inputs is fatal (e.g., substitution is very costly).**
- $\rightarrow$ proxy by the input specificity of production (or contract intensity) for a sector.

Testable implications 4

- For innovation-intensive products, productivity depends to a large extent on trusted collaborations.
- **H4: Innovation-intensive production processes were more vulnerable to the COVID-19 pandemic as in-person interactions were severely curtailed .**
- $\rightarrow$ proxy by a measure of production innovation-intensity the degree of product sophistication proposed by Hausmann and Hidalgo (2009, 2011).

Data

- Monthly data on import flows at product level by four major markets over the period ranging **from January 2016 to July 2020: France, Germany, Japan, and the US.**

- **Eurostat** monthly trade flows for France and Germany, **Ministry of Finance** for Japan and United States **International Trade Commission** for the US.

- All datasets include the country's import flows from all partner countries for each product at a 6-digit level of disaggregation of the HS classification and providing information on import value (in USD) and import quantity.

Data

- **COVID-19 incidence measure:** total number of reported COVID-19 deaths per capita per month in each country from WHO for the period from December 2019 onward;

- **Stay-at-home measures:** lockdown measures, imposed by each country in each month to contain the virus from the Oxford COVID-19 Government Response Tracker.

Production vulnerability

- **Labor intensity**: the ratio of employment to capital for each 6-digit 1997 NAICS industry in 2011 from U.S. NBER-CES Manufacturing Industry Database.

- **China export share in inputs**: identify the importance of China as a supplier of inputs for production of each good- exporting country combining export data from COMTRADE at HS 6-digit-year level and OECD input-output tables in 2011.

- **Product contract intensity**: the share of intermediate inputs used by a sector that require customized or relationship-specific investments following Nunn (2007).

- **Product innovation intensity**: the weighted average of the GDP per capita of the countries that export the HS 6-digit product, where weights are given by countries' revealed comparative advantage index in that product following Hausmann and Hidalgo (2009, 2011).

Control variables

- (1) **Medical supplies goods**:
- a dummy variable that identifies the set of COVID-19 products, i.e., essential medical equipment, supplies and goods to combat COVID-19 according to the WTO classification;
- (2)**Herfindahl of exports in inputs**:
- the sectoral average Herfindahl index of concentration of exports of inputs combining data from COMTRADE export data-HS 6-digit-year level and OECD input-output tables in 2011.

Empirical strategy

- Estimate the short-term **within effect of the COVID-19 shock** on exports depending on proxies for production vulnerability:

$$Y_{ept} = \beta_1 covid\ incidence_{et} \times vulnerability_p + \beta_2 policy_{et} \times vulnerability_p + \gamma X_{ept} + k_{ep} + \theta_{et} + \pi_{pt} + \varepsilon_{ept}$$

  - where Y_{ept} is the logarithm of the value of exports to one of the four markets by country e of HS 6-digit product p in month-year t
  - $Vulnerability_p$ is one of the four measures of product vulnerability.
  - X_{ept} is a vector of the control variables.
  - k_{ep} exporting country-HS6 product fixed effects;
  - θ_{et} **unobservable shocks varying across countries and over time** and over time (month-year) such as exchange rate shocks or any other demand shifters;
  - π_{pt} **unobservable shocks varying across products and over time** such as global demand or technological shocks.

Results

Table: Panel A: United States

	log(export value to US) at country-HS 6-digit-product-month level				
	(1)	(2)	(3)	(4)	(5)
Death over pop x labor over capital	-2.683***			-0.664	-0.670
	(0.771)			(0.830)	(0.843)
Death over pop x China export share in inputs		-0.679***		-0.631***	-0.631***
		(0.087)		(0.104)	(0.110)
Death over pop x product complexity			0.009	-0.004	-0.004
			(0.006)	(0.006)	(0.006)
Death over pop x product contractibility			-0.080***	-0.017	-0.015
			(0.017)	(0.019)	(0.021)
Death over pop x Herfindahl of exports in inputs					0.004
					(0.086)
Death over pop x medical supplies goods					-0.033
					(0.025)
Observations	3,000,392	2,904,177	2,947,839	2,854,014	2,854,014
R-squared	0.873	0.873	0.873	0.873	0.873
Exporting country-HS6 product fixed effects	yes	yes	yes	yes	yes
Exporting country-time (month-year) fixed effects	yes	yes	yes	yes	yes
HS6 product-time (month-year) fixed effects	yes	yes	yes	yes	yes

Results

Table: Panel B: Japan

	log(export value to Japan) at country-HS 6-digit-product-month level				
	(1)	(2)	(3)	(4)	(5)
Death over pop x labor over capital	-2.437***			0.619	0.661
	(0.764)			(0.854)	(0.872)
Death over pop x China export share in inputs		-0.545***		-0.306***	-0.313***
		(0.091)		(0.109)	(0.113)
Death over pop x product complexity			0.029***	0.022***	0.022***
			(0.006)	(0.007)	(0.007)
Death over pop x product contractibility			-0.126***	-0.094***	-0.091***
			(0.015)	(0.018)	(0.020)
Death over pop x Herfindahl of exports in inputs					0.021
					(0.083)
Death over pop x medical supplies goods					-0.008
					(0.023)
Observations	3,010,932	2,742,836	2,970,688	2,708,215	2,708,215
R-squared	0.875	0.869	0.875	0.869	0.869
Exporting country-HS6 product fixed effects	yes	yes	yes	yes	yes
Exporting country-time (month-year) fixed effects	yes	yes	yes	yes	yes
HS6 product-time (month-year) fixed effects	yes	yes	yes	yes	yes

Results

Table: Panel C: Germany

	log(export value to Germany) at country-HS 6-digit-product-month level				
	(1)	(2)	(3)	(4)	(5)
Death over pop x labor over capital	-0.019			0.920	1.003
	(0.829)			(0.920)	(0.948)
Death over pop x China export share in inputs		-0.320***		-0.272**	-0.291**
		(0.105)		(0.133)	(0.143)
Death over pop x product complexity			-0.008	-0.005	-0.005
			(0.006)	(0.007)	(0.007)
Death over pop x product contractibility			-0.062***	-0.049**	-0.043*
			(0.019)	(0.022)	(0.024)
Death over pop x Herfindahl of exports in inputs					0.039
					(0.081)
Death over pop x medical supplies goods					-0.028
					(0.029)
Observations	3,701,308	3,469,671	3,631,115	3,405,649	3,405,649
R-squared	0.842	0.843	0.843	0.844	0.844
Exporting country-HS6 product fixed effects	yes	yes	yes	yes	yes
Exporting country-time (month-year) fixed effects	yes	yes	yes	yes	yes
HS6 product-time (month-year) fixed effects	yes	yes	yes	yes	yes

Results

Table: Panel D: France

	log(export value to France) at country-HS 6-digit-product-month level				
	(1)	(2)	(3)	(4)	(5)
Death over pop x labor over capital	-1.678**			-0.702	-0.837
	(0.828)			(0.953)	(0.958)
Death over pop x China export share in inputs		-0.439***		-0.441***	-0.405***
		(0.104)		(0.121)	(0.127)
Death over pop x product complexity			0.002	-0.003	-0.003
			(0.007)	(0.007)	(0.007)
Death over pop x product contractibility			-0.017	0.027	0.015
			(0.020)	(0.023)	(0.027)
Death over pop x Herfindahl of exports in inputs					0.060**
					(0.030)
Death over pop x medical supplies goods					-0.078
					(0.097)
Observations	3,347,257	3,153,833	3,285,600	3,096,544	3,096,544
R-squared	0.840	0.843	0.841	0.844	0.844
Exporting country-HS6 product fixed effects	yes	yes	yes	yes	yes
Exporting country-time (month-year) fixed effects	yes	yes	yes	yes	yes
HS6 product-time (month-year) fixed effects	yes	yes	yes	yes	yes

Results

Table: The effect of stay-at-home policy

	log(export value to market) at country-HS 6-digit-product-month level			
	United States		**Japan**	
	(1)	(2)	(3)	(4)
Death over pop x labor over capital	-1.021	-1.053	0.768	0.845
	(0.876)	(0.891)	(0.882)	(0.902)
Stay at home dummy x labor over capital	2.057	2.178	-2.064	-2.109
	(1.477)	(1.485)	(1.362)	(1.378)
Death over pop x China export share in inputs	-0.559***	-0.552***	-0.251**	-0.265**
	(0.115)	(0.122)	(0.115)	(0.119)
Stay at home dummy x China export share in inputs	-0.282*	-0.307*	-0.252*	-0.247*
	(0.162)	(0.167)	(0.139)	(0.142)
Death over pop x product complexity	-0.009	-0.009	0.020***	0.020***
	(0.007)	(0.007)	(0.007)	(0.007)
Stay at home dummy x product complexity	0.033***	0.034***	0.019**	0.019**
	(0.011)	(0.011)	(0.009)	(0.009)
Death over pop x product contractibility	-0.021	-0.020	-0.086***	-0.081***
	(0.020)	(0.023)	(0.019)	(0.021)
Stay at home dummy x product contractibility	0.014	0.016	-0.071**	-0.077**
	(0.034)	(0.039)	(0.029)	(0.034)
Controls	yes	yes	yes	yes
Observations	2,852,557	2,852,557	2,706,548	2,706,548
R-squared	0.873	0.873	0.869	0.869
Exporting country-HS6 product fixed effects	yes	yes	yes	yes
Exporting country-time (month-year) fixed effects	yes	yes	yes	yes
HS6 product-time (month-year) fixed effects	yes	yes	yes	yes

Results

Table: The effect of stay-at-home policy II

	log(export value to market) at country-HS 6-digit-product-month level			
	Germany		**France**	
	(1)	(2)	(3)	(4)
Death over pop x labor over capital	0.873	0.966	-0.986	-1.088
	(0.955)	(0.988)	(0.986)	(0.994)
Stay at home dummy x labor over capital	0.101	0.278	1.444	1.279
	(2.090)	(2.109)	(1.705)	(1.729)
Death over pop x China export share in inputs	-0.138	-0.158	-0.288**	-0.259*
	(0.139)	(0.150)	(0.127)	(0.134)
Stay at home dummy x China export share in inputs	-0.631***	-0.680***	-0.710***	-0.672***
	(0.242)	(0.247)	(0.187)	(0.193)
Death over pop x product complexity	-0.008	-0.008	-0.006	-0.006
	(0.007)	(0.007)	(0.007)	(0.007)
Stay at home dummy x product complexity	0.039**	0.041**	0.034***	0.032**
	(0.017)	(0.017)	(0.013)	(0.013)
Death over pop x product contractibility	-0.039*	-0.035	0.032	0.025
	(0.023)	(0.026)	(0.024)	(0.028)
Stay at home dummy x product contractibility	-0.130**	-0.113**	-0.075*	-0.096**
	(0.052)	(0.056)	(0.043)	(0.048)
Controls	yes	yes	yes	yes
Observations	3,402,696	3,402,696	3,095,498	3,095,498
R-squared	0.844	0.844	0.844	0.844
Exporting country-HS6 product fixed effects	yes	yes	yes	yes
Exporting country-time (month-year) fixed effects	yes	yes	yes	yes
HS6 product-time (month-year) fixed effects	yes	yes	yes	yes

Conclusion

- Our findings show that a **higher reliance on inputs for which China is a dominant supplier is the main production vulnerability** which negatively impacted exports to all markets during the COVID-19 shock.

- Production complexity captured by sectoral **input contractibility also matters** to understand the pandemic impact on exports to Germany and Japan.

- The main driver of the negative effect of **COVID-19 containment policies on exports to all four markets is also the nature of inputs** used: their reliance on China as a supplier and their degree of customization

Conclusion

- These results are preliminary and in future work we plan to tackle:
- the effect on prices (unit values) and quantities,
- Alternative measures of product innovation;
- Difference depending on exporting countries (DC vs. LDC);
- Alternative measures of COVID-19 incidence, namely cases per capita, and alternative measures of containment policies, namely those that account for school closures and travel restrictions.

Conclusion

Thanks for your attention....