

International Patent Protection and Trade: Transaction-level Evidence

Gaétan de Rassenfosse ¹ Marco Grazzi ² Daniele Moschella ³ Gabriele Pellegrino ¹

¹College of Management of Technology, EPFL, Lausanne, (Switzerland)

²Department of Economics, Università Cattolica del Sacro Cuore, Milano (Italy)

³Institute of Economics &EMbeDS, Scuola Superiore Sant'Anna, Pisa (Italy)

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An overview

- ▶ Intellectual property rights (IPRs) play a central role in international trade. Existing contributions mostly on two perspectives:
 - ▶ Capability perspective: Patents as an inherent expression of superior capabilities, either of the firm or the country
 - ▶ Institutional perspective: studying the causal effect of IP rights in a country with respect to exports to that country.
- ▶ Our perspective: we provide direct causal evidence on the effect of patent protection on trade at the level of firm-product-country transactions.
 - ▶ Markets in which a firm manages to secure patent protection become more attractive to the firm (because it excludes other firms from selling the same technology) and it should export more to such markets.

Our contribution

- ▶ We provide direct causal evidence of the effect of patent protection on trade by leveraging unique data on the international patenting activity of French firms at the product-country level.
- ▶ The baseline specification, which exploits high dimensional fixed effects, shows that patent protection in a product-country destination increases total exports in that product-country destination by up to 6%, mostly due to a quantity effect.
- ▶ Our findings are robust to a range of alternative specifications including changes in sample composition, changes in the set of fixed effects, and controlling for variables of patent importance.
- ▶ We also provide a novel identification strategy to document the effect of patents on trade by leveraging information on rejected patent applications. We observe massive drops in exports, up to 70 percent in value, when such cases happen.

Data sources: export data

- ▶ Transaction-level exports from French customs (DGDDI) at the firm-product-country level
- ▶ Export value and quantity, period 2002-2011 (yearly)
- ▶ Product data originally at EU CN8, aggregated at HS6 (product category)
- ▶ Unit value can be computed as export value over quantity

Data sources: patent data and rejection events

- ▶ French patent office (INPI) and EPO
- ▶ Data on patent *applications*
- ▶ Assume average lifetime of patents of 10 years (Rassenfosse and Jaffe, 2018) and compute ten-years stock of patent applications
- ▶ We crawled the Google Patents website to obtain accurate data on the grant outcome of patent applications in our sample. We take only the most relevant destination countries: the United States, China, Korea, Japan, and Australia.
- ▶ To match patents to products, we have exploited the probabilistic crosswalk, developed by Lybbert and Zolas, 2014 and Goldschlag et al., 2019, between the 2002 HS classification at the 6-digit level and CPC codes at the 4-digit level.

The relative timing of patenting and export

Does patenting tend to anticipate exporting or viceversa?

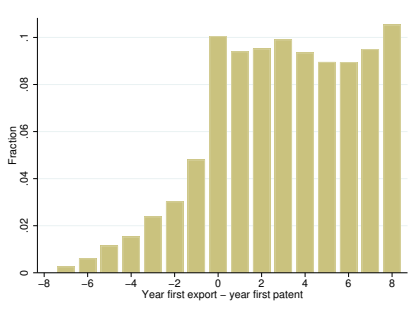


Figure 1: Distribution of the time interval between the first patent and the first export at the firm-product-country level.

Transactions covered by a patent at the firm-product-country level are 5.5% and account for 27% of export value. In around 90% of cases, the export activity is subsequent to the first patent application

Patents and export value: extensive and intensive margin

- ▶ Explore the effects of patenting activity on values, quantity and unit value in the observed firm-product-country flows
- ▶ Firm's total exports to a product-country destination are decomposed into extensive (quantity) and intensive margins (unit values)

$$\ln X_{fpct} = \ln Quantity_{fpct} + \ln UnitValue_{fpct}$$

- ▶ $\ln X_{fpc}$ is the log value (in euro) of exports by firm f in product p to country c , $Quantity_{fpc}$ is the physical quantity (in kilo) of good p exported to country c and $UnitValue_{fpc}$ is the unit value of the transaction.

Patents and export value: baseline equation

$$\ln Y_{fpct} = a + \beta DPat_{fpct} + \theta_{fpc} + \theta_{fpt} + \theta_{c(p)t} + \varepsilon_{fpct}$$

- ▶ $\ln Y_{fpct}$ denotes the logarithm of, alternatively, the total value, quantity and unit value of the firm's exports in the country-product pair
- ▶ $DPat_{fpct}$ is a binary variable taking value of 1 if the firm f has a positive ten-year stock of patents in country c and product p at time t
- ▶ θ_{ct} , account for destination specific time varying characteristics that are common to all firms.
- ▶ θ_{fpc} , are a set of firm-product-country fixed effects that capture all the observable and unobservable characteristics that are specific to the firm-product-country flow
- ▶ θ_{fpt} , capturing time-varying characteristics that are specific to the firm-product.
- ▶ The effects of patent protection on trade is identified by exploiting firm-product pairs that are exported in at least two countries, but that experience a change in patent protection only in a subset of them

Patents and export value: main results

	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln X_{fcpt}$	$\ln Quantity_{fcpt}$	$\ln UnitValue_{fcpt}$	$\ln X_{fcpt}$	$\ln Quantity_{fcpt}$	$\ln UnitValue_{fcpt}$
Only patenting firms						
$DPat_{fpct}$	0.063*** (0.008)	0.057*** (0.009)	0.006 (0.005)	0.064*** (0.011)	0.058*** (0.012)	0.006 (0.006)
N	3,122,592	3,122,592	3,122,592	2,540,788	2,540,788	2,540,788
adj. R^2	0.835	0.859	0.883	0.827	0.845	0.861
Only patenting firms - non-switchers + switchers from 0 to 1						
$DPat_{fpct}$	0.043*** (0.012)	0.047*** (0.013)	-0.005 (0.006)	0.053*** (0.014)	0.050*** (0.016)	0.003 (0.009)
N	2,959,032	2,959,032	2,959,032	2,376,768	2,376,768	2,376,768
adj. R^2	0.838	0.861	0.885	0.832	0.848	0.864
Only patenting firms - non-switchers + switchers from 1 to 0						
$DPat_{fpct}$	0.116*** (0.024)	0.090*** (0.024)	0.026*** (0.008)	0.106*** (0.030)	0.085*** (0.030)	0.021* (0.011)
N	2,809,944	2,809,944	2,809,944	2,230,901	2,230,901	2,230,901
adj. R^2	0.838	0.862	0.886	0.832	0.848	0.864
Country-Year FE	Yes	Yes	Yes	No	No	No
Product-Country-Year FE	No	No	No	Yes	Yes	Yes

Note. Table reports results of estimation from equation (18) at the firm-product-country level, using data on exports, quantity and unit value for years 2002-2011. Robust standard errors clustered at product-year level in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Accounting for patent importance

	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln X_{fcpt}$	$\ln Quantity_{fcpt}$	$\ln UnitValue_{fcpt}$	$\ln X_{fcpt}$	$\ln Quantity_{fcpt}$	$\ln UnitValue_{fcpt}$
Family size						
$DPat_{fcpt}$	0.041** (0.017)	0.042** (0.019)	-0.001 (0.010)	0.034 (0.023)	0.046* (0.026)	-0.012 (0.013)
<i>Family size</i>	0.003* (0.001)	0.002 (0.002)	0.001 (0.001)	0.004* (0.002)	0.002 (0.002)	0.002 (0.001)
<i>N</i>	2,867,657	2,867,657	2,867,657	2,285,921	2,285,921	2,285,921
adj. R^2	0.835	0.859	0.883	0.826	0.842	0.858
Count of citations received in a 3-year window						
$DPat_{fcpt}$	0.043*** (0.013)	0.039*** (0.014)	0.005 (0.007)	0.030* (0.017)	0.029 (0.019)	0.001 (0.010)
$(\log)\#citations$	0.020*** (0.007)	0.021*** (0.007)	-0.001 (0.004)	0.033*** (0.009)	0.033*** (0.010)	0.000 (0.005)
<i>N</i>	2,867,657	2,867,657	2,867,657	2,285,921	2,285,921	2,285,921
adj. R^2	0.835	0.859	0.883	0.826	0.842	0.858
Country-Year FE	Yes	Yes	Yes	No	No	No
Product-Country-Year FE	No	No	No	Yes	Yes	Yes

Note. Table reports results of estimation from equation (18) at the firm-product-country level, using data on exports, quantity and unit value for years 2002-2011, interacting with indicators of patent importance. Robust standard errors clustered at product-year level in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Accounting for endogeneity: using rejection events

- ▶ Still, the filing decision might be endogenous to exports, even accounting for all possible fixed effects
- ▶ We leverage information on rejected patent applications to address this concern. Evidence by Guellec and van Pottelsberghe (2000) suggests that international patent applications are more likely to be granted than single-country applications.
- ▶ The grant is not automatic, however. The literature has documented heterogeneity in the grant decision across patent offices for the same invention (Rassenfosse et al., forthcoming). In other words, although firms might very well expect that they will get a patent, the patent application may be rejected during the examination.
- ▶ Such rejection is plausibly an exogenous event that is, by and large, unforeseen by firms but at the same time relevant to the value of the export transaction

Accounting for endogeneity: rejection events

Exports and firm-product-country rejected patents: United States, China, Korea, Japan and Australia

	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln X_{fcpt}$	$\ln Quantity_{fcpt}$	$\ln UnitValue_{fcpt}$	$\ln X_{fcpt}$	$\ln Quantity_{fcpt}$	$\ln UnitValue_{fcpt}$
Rejected patents						
$DRejection_{fcpt}$	-0.137 (0.086)	-0.020 (0.097)	-0.116** (0.050)	-0.693** (0.285)	-0.318 (0.325)	-0.374** (0.173)
N	13,342	13,342	13,342	3,767	3,767	3,767
adj. R^2	0.764	0.855	0.901	0.677	0.791	0.841
Country-Year FE	Yes	Yes	Yes	No	No	No
Product-Country-Year FE	No	No	No	Yes	Yes	Yes

Note. Table reports results of estimation from equation on rejection at the firm-product-country level, using data on exports, quantity and unit value for years 2002-2011. Robust standard errors clustered at destination-year level in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Other robustness test

- ▶ Only product-related patents
- ▶ Placebo analysis
- ▶ Selection

Concluding remarks

- ▶ The results of the empirical analysis using a panel of French exporting firms in the period from 2002 to 2011 provide novel evidence on the extent to which international trade hinges on patents
- ▶ Controlling for a stringent set of fixed effects, we find that patenting is associated with an increase in the value of exports of around 6%. This result is primarily driven by greater quantities exported to the destination market rather than higher prices
- ▶ We interpret it as evidence that firms value foreign patent protection for the legal security that it brings rather than for the possibility of setting monopoly prices
- ▶ These findings are robust to a series of alternative specifications and to a placebo test
- ▶ Acknowledging that the patenting decision is endogenous to exports, we exploit information on rejected patent applications. We find evidence that exports collapse when patent applications are rejected by the local patent office, providing further evidence on the causal effect of patents on trade

Concluding remarks

- ▶ The very limited evidence of a positive premium on unit values, our proxy for price, poses some challenges to both future empirical and theoretical analysis.
- ▶ Large-scale empirical works matching together product-varieties, or even actual products, to patents are needed to confirm the findings of the present work. Currently, since we work at the product class level, we cannot exclude the possibility that the introduction of patented products with a higher price (e.g., a new mobile phone) is compensated by a decline in the price of the pre-existing phones in the same product category, with an average effect of zero. Thus, the finding of a lack of price effect needs to be taken with a pinch of salt.
- ▶ On a more theoretical viewpoint, our results suggest to explore models in which a substantial part of the value residing in foreign patent protection is in the legal security that it offers, rather than in the possibility to set monopoly prices.

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