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# Patent Commercialization

George Abi Younes

PhD Candidate

Chair of Innovation and IP Policy

Ecole Polytechnique Federale de Lausanne

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# Why is market entry timing an important decision for companies?

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<sup>1</sup>Shlomo Kalish and Gary L Lilien. "A market entry timing model for new technologies". In: *Management Science* 32.2 (1986), pp. 194–205.

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# Why is market entry timing an important decision for companies?

- Companies need to strike a good compromise between commercializing too early and too late.<sup>1</sup>
- An early commercialization may risk pushing an underdeveloped product into the market.
- A late commercialization risks losing market share to other competitors who commercialize earlier.<sup>2</sup>

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- This decision is even more complicated for patented inventions and technologies because of the extra factors and constraints that come into play.

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- One factor that we believe potentially affects market entry timing of patented inventions is the **timing of patent grants**.

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⇒ **Research Question:** Are grant delays by patent offices slowing down product commercialization, and if so, to what extent?

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# Several important milestones exist during patent commercialization

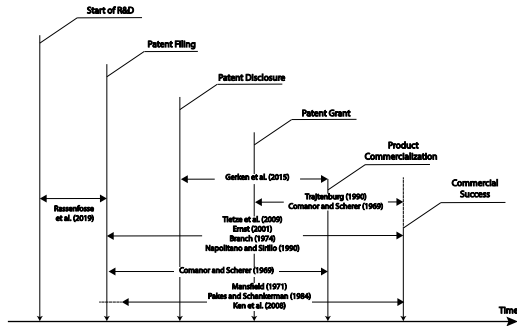


Figure: Important milestones in the process of patent commercialization

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- **Product commercialization lag:** duration between patent filing and product market release.

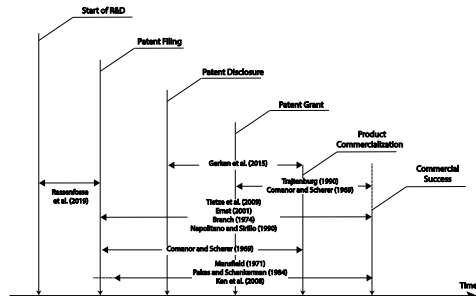


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Isn't it straightforward that companies have to wait for patents to be granted before commercializing?

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- **Not true.** It is not always the case that companies commercialize after patent grants.

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- **Not true.** It is not always the case that companies commercialize after patent grants.
- Even though it's rare, U.S. companies are allowed to commercialize their products up to 1 year prior to **filing** for the patent, which is also known as a grace period.<sup>4</sup>

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- Even though it's rare, U.S. companies are allowed to commercialize their products up to 1 year prior to **filing** for the patent, which is also known as a grace period.<sup>4</sup>
- In our data sample, we find that around 17% of the products have been commercialized prior to the grant date of its patent.

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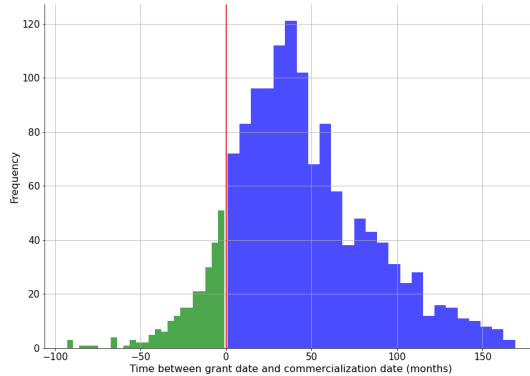


Figure: Duration between grant date and commercialization date

# In building the dataset, we collect and supplement our data from various sources

- The building block of our data set is a product-patent pair, which we sample from **IPProduct**<sup>5</sup>, which links patents to their associated products using VPM<sup>6</sup> pages.

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- We collect product-based measures (e.g. release date, ratings ...) by web-scraping **Amazon marketplace**.

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- Patent-product pairs are manually tagged and stored from VPM pages.
- The database contains around 30000 patents from more than 700 companies and is continuously growing.

Fiat Bottom Pouch (BOX POUCH®) making machine

Product Name	Patent Number
BH-60DG-F	US7331917, US7775957, US8579779, US8579780, US8777826, US9205597, US9346249, US9370899
BH-80DG-F	US7331917, US7775957, US8579779, US8579780, US8777826, US9205597, US9346249, US9370899

Three-side-seal automatic pouch making machine

Product Name	Patent Number
BH-60D	US8535040, US9205597
BH-60DLS	US8535040, US9205597
BH-60DLLC	US8535040, US9205597, US9370899
BH-60DLLSC	US8535040, US9205597, US9370899
BH-80D	US8535040, US9205597
BH-120V	US8535040

Figure: An example of a VPM page

Table: Summary Statistics

Variable	Definition	Mean	Std. dev.	Min	Max
<b>Dependent Variable</b>					
<i>Commercialization Lag</i>	Duration between commercialization date and patent application date (in months)	69.22	43.88	2	215
<i>Patent Application Date</i>	Date of patent application	-	-	-	-
<i>Patent Grant Date</i>	Date of patent grant by the USPTO	-	-	-	-
<i>Product Commercialization Date</i>	Extracted release date of product	-	-	-	-
<b>Independent Variables</b>					
<i>Patent grant lag</i>	Duration between grant date and patent application date (in months)	39.63	21.65	3	143
<b>Control Variables</b>					
<i>Backward Citations</i>	No. of backward citations referenced in the patent	45.62	39.08	1	179
<i>Forward citations</i>	Number of forward citations	5.86	6.9	0.00	50
<i>Family size</i>	Docdb family size of patent	102.44	378.47	1.00	5876.00
<i>Geographic family size</i>	Geographic family size of patent	5.81	5.14	1.00	24
<i>No. applicants</i>	Number of applicants for the patent	1.1	0.13	1.00	5
<i>No. inventors</i>	Number of inventors of the patent	2.90	2.4	1.00	29
<i>No. claims</i>	No. of claims made in the patent document	20.89	14.85	1.00	219
<i>No. ind. claims</i>	Number of independent claims	2.93	1.92	1.00	19
<i>No. NPL citations</i>	Number of non-patent literature citations	13.01	22.47	0	29
<i>Patent originality</i>	Patent originality index	0.59	0.23	0	0.95
<i>No. Rejections</i>	Number of rejections before patent grant	1.96	1.68	0	14
<i>Process</i>	Dummy variable indicating process patent	0.34	0.47	0	1
<i>Company size</i>	Categorical variable of company size	-	-	-	-
<i>Company sector</i>	Dummy variable indicating the sector of the company	-	-	-	-
<i>Product Age</i>	Number of days since the product release date	2103.91	1050.23	351.00	5667.00
<i>Product score</i>	Product ratings score on Amazon	3.38	1.59	0	5
<i>No. Product ratings</i>	Number of product ratings on Amazon	1041.66	3384.5	0	35394
<i>Examiner Speed</i>	Calculated speed of examiner	114.69	39.79	18.56	308.76

# Empirical Setup

The two main variables of interest in our study are:

- *GrantLag* ( $GL$ ) = *PatentGrant* – *PatentFiling*
- *CommercializationLag* ( $CL$ ) = *ProductCommercialization* – *PatentFiling*

and our baseline model is:

$$CL_i = GL_i + x_i \cdot \beta + s_i \cdot \theta$$

where  $x_i$  is the set of patent-based control variables and  $s_i$  the set of product-based control variables.

# Unfortunately, the baseline model suffers from a potential endogeneity issue

- A patent applicant can purposefully delay the examination process by taking more time to respond to the patent office.
- By delaying the examination process, the applicant gets more time to add more features to the patent, thus making it stronger upon granting.
- **Solution:** We instrument our model using an IV<sup>7</sup>.

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<sup>7</sup>Instrumental variable

The instrumental variable we resort to is examiner speed, which we calculate as follows:

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- For each patent examiner in our data set, we calculate the average grant lag divided by number of claims for patents he or she examined within a four-year window from the granting of the focal patent.

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- For each patent examiner in our data set, we calculate the average grant lag divided by number of claims for patents he or she examined within a four-year window from the granting of the focal patent.
- This gives us a notion of how fast, on average, the examiner goes through the examination process while taking into account the size of the patent document.



## More explicitly...

$$examiner\_speed = \sum_{i=1}^N \frac{GL_{p_i}}{nb\_claims_{p_i}}$$

where  $p_i \dots p_N$  are the set of patents that have been examined by the focal examiner in a four-year window, taking the grant date of the focal patent as reference.

# Empirical Results: Baseline Model

Table: Baseline model results

	(1)	(2)	(3)	(4)	(5)
log_grant_lag_m	0.506*** (19.61)	0.490*** (15.60)	0.490*** (15.60)	0.495*** (12.29)	0.341*** (6.62)
nb_bcites		-0.000687 (-1.28)	-0.000687 (-1.28)	-0.00193** (-2.85)	-0.00301*** (-3.79)
nb_fcites		0.0147*** (6.68)	0.0147*** (6.68)	0.0172*** (6.77)	0.0115*** (3.40)
nb_npl		-0.00468*** (-5.22)	-0.00468*** (-5.22)	-0.00296* (-2.00)	0.00233 (1.34)
nb_ipc		0.00428 (0.89)	0.00428 (0.89)	-0.00277 (-0.48)	0.00233 (0.35)
nb_assignee		0.0142 (0.13)	0.0142 (0.13)	0.00275 (0.02)	0.0377 (0.22)
nb_inventor		-0.0108 (-1.61)	-0.0108 (-1.61)	-0.0114 (-1.54)	-0.0273** (-2.91)
nb_claims		-0.000924 (-0.69)	-0.000924 (-0.69)	-0.00108 (-0.58)	-0.00444* (-2.00)
nb_independent_claims		0.0165 (1.94)	0.0165 (1.94)	0.0378*** (3.32)	0.0511*** (3.40)
family_size		0.000167** (2.79)	0.000167** (2.79)	0.000200** (3.10)	0.000192* (2.34)
geog_family_size		0.0186*** (3.89)	0.0186*** (3.89)	0.0284*** (4.59)	0.0211*** (3.61)
nb_rejections		-0.00935 (-0.87)	-0.00935 (-0.87)	-0.00485 (-0.38)	0.00996 (0.59)
process		-0.0651 (-1.78)	-0.0651 (-1.78)	0.0187 (0.40)	0.0151 (0.25)
originality_flex		0.0387 (0.48)	0.0387 (0.48)	0.0187 (0.20)	-0.101 (-0.97)
young			0 (.)	0 (.)	0.0147 (0.12)
large			0 (.)	0 (.)	0.129 (1.84)
ratings				0 (.)	0.0000137* (2.46)
score_1				0 (.)	0.0616 (1.43)
nb_tms				0 (.)	7.41e-09 (1.48)
Constant	2.405*** (26.24)	2.326*** (14.50)	2.326*** (14.50)	2.153*** (11.68)	2.479*** (7.55)
Observations	1374	1370	1370	992	1076

t statistics in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

# Empirical Results: 2SLS

Table: Baseline model

	(1)	(2)	(3)	(4)	(5)
log_grant_lag_m	0.806*** (17.55)	0.999*** (12.90)	0.999*** (12.90)	1.129*** (10.88)	0.935*** (7.70)
nb_bcites		-0.0000479 (-0.08)	-0.0000479 (-0.08)	-0.000816 (-1.04)	-0.00222** (-2.60)
nb_fcites		0.00851*** (3.30)	0.00851*** (3.30)	0.0115*** (3.80)	0.00696 (1.90)
nb_npl		-0.00375*** (-3.76)	-0.00375*** (-3.76)	-0.00440** (-2.59)	0.00108 (0.58)
nb_ipc		0.00333 (0.63)	0.00333 (0.63)	-0.00179 (-0.27)	0.00286 (0.40)
nb_assignee		-0.0449 (-0.36)	-0.0449 (-0.36)	-0.0477 (-0.37)	-0.00384 (-0.02)
nb_inventor		-0.0140 (-1.88)	-0.0140 (-1.88)	-0.0138 (-1.64)	-0.0270** (-2.70)
nb_claims		-0.00171 (-1.15)	-0.00171 (-1.15)	-0.00228 (-1.07)	-0.00451 (-1.90)
nb_independent_claims		0.0171 (1.81)	0.0171 (1.81)	0.0382** (2.94)	0.0539*** (3.37)
family_size		0.0000939 (1.41)	0.0000939 (1.41)	0.000154* (2.10)	0.000190* (2.19)
geog_family_size		0.0242*** (4.55)	0.0242*** (4.55)	0.0300*** (4.27)	0.0205*** (3.31)
nb_rejections		-0.111*** (-6.08)	-0.111*** (-6.08)	-0.122*** (-5.38)	-0.106*** (-3.79)
process		-0.0685 (-1.70)	-0.0685 (-1.70)	0.00344 (0.07)	0.0238 (0.37)
originality_flex		-0.0202 (-0.23)	-0.0202 (-0.23)	-0.0177 (-0.17)	-0.0716 (-0.65)
young			0 (.)	0 (.)	0.00566 (0.04)
large			0 (.)	0 (.)	0.0932 (1.25)
ratings				0 (.)	0.0000171** (2.89)
score_1				0 (.)	0.132** (2.77)
nb_tms				0 (.)	1.73e-08** (3.10)
Observations	1370	1367	1367	989	1073

t statistics in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

# Comments to discuss with Gaétan

- two options for displaying results: either including fixed effects for products and firms, and thus excluding all the company and product specific variables or removing fixed effects like in column and only keeping sector fixed effects. The second option will allow us to observe the coefficients for the omitted variables.

# Conclusion

# References

Table: Histogram: grant delay (months)

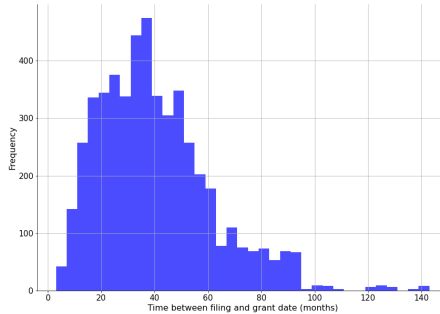


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