

International Patenting Models and Forecasts of Filings at the EPO

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Motivation:

1. International Technology Diffusion & Trends in Innovation
2. Sources of Growth in Patenting (over time & across regions):
Innovation Potential and/or Filing Propensity
3. Implications for EPO: Internal Workload, Budget (Revenues, Resources).
4. Implications of various routes (i.e. Euro-Direct vs. Euro via PCT, First vs. Subsequent Filings) for Interaction between EPO and WIPO, EPO and National Offices.

Overview:

1. Brief Literature Review
2. Conceptual Framework (Sketch)
3. Sample Statistics
4. Forecasts of:
 - (A) Aggregate Filings (by Modes of Filing)
 - (B) Sectoral (Joint Cluster) Filings
 - (C) Patent Family Formation

Definitions:

Modes of Filings refer to Euro direct filings and indirect filings (via the PCT route), and to first or subsequent filings.

Joint Clusters refer to 14 particular technological groupings (e.g. JC 1 is Electrical Machines and Electricity, JC 2 Handling and Processing,, and JC 14 Vehicles and General Technology).

A patent family is a group of patent filings that claim the priority of a single filing (e.g. original priority filing plus subsequent filings around the world). In other words, international patent applications relating to the *same invention*.

1. Previous Empirical Work:

-- Literature studying “Demand for Patents” or “Determinants of Patenting”:

A. Primary Surveys

(e.g. Levin et. al. (1987), Mansfield (1994), Cohen et. al. (1997))

B. Statistical Data Analyses

i. Ad-Hoc Models

(e.g. Schiffel and Kitti (1978), Bosworth (1980, 1984), and Slama (1981)).

ii. Optimizing Models

(e.g. Eaton and Kortum (1996), Kortum and Lerner (1998), Park (2001), McCalman (2001), Hall and Ziedonis (2001), and Gallini (2004)).

-- Influences on Patenting:

- Exports
- Patent Laws & Reforms (TRIPS)
- Patenting Costs
- Market Size
- Gravity Factors (e.g. Geographic distance, Regional Trade Relations)
- Research and Development (R&D)
- Human Capital
- Strategic Incentives (e.g. Blocking, Bargaining Chips, etc.)

-- Overall Issues:

- Is the Growth in Worldwide Patenting due primarily to Technological Growth & Opportunities (including more efficient management of R&D resources) OR Legal regime changes (e.g. more pro-patent authorities)?
- Does a strengthening of patent rights have relatively a greater “Inventive Effect” OR “Filing Effect”?

-- Several Gaps in Literature, among which are:

- Role of EPO (or PCT system); i.e. Institutional Perspectives
- Distinction among different modes or methods of filing patents. Not only why firms patent, but what route(s) they choose (and why).

2. Conceptual Framework:

Static View:

$$P_{ij} = \alpha_i \varepsilon_{ij} f_{ij}$$

where P_{ij} denotes patent applications from source country i in destination country j .

α_i denotes patentable innovations (in source country i)
(Should depend on R&D, Knowledge Base)

ε_{ij} the fraction of α_i that has “applicability” in destination j
(Should depend on bilateral factors, fixed/random effects (country pair specific))

f_{ij} the fraction of $\alpha_i \varepsilon_{ij}$ that is applied for patents in destination j
(Should/could depend on attractiveness of destination)

Note: Regarding f_{ij} , inventor generally files for a patent if:
Value of Patenting – Value of Not Patenting \geq Cost of Patenting

Forecasting:

Suppose

$$P_{it} = \beta_0 + \beta_1 x_{it} + \varepsilon_{it},$$

where x is an independent variable

$t = 1, \dots, T$ denotes time (sample period)

$i = 1, \dots, N$ denotes source countries

$j = \text{EPO}$ (hence subscript j is omitted)

$$\varepsilon_{it} = v_i + \mu_{it}$$

Panel Data Set, where v is used to capture the bilateral specific effect.

Fitted equation is then: $\hat{P}_{it} = \hat{\beta}_0 + \hat{\beta}_1 x_{it}$

Given $x_{iT+1}, x_{iT+2}, \dots, x_{iT+k}$, we use estimates $\hat{\beta}_0, \hat{\beta}_1$ to generate predictions for $\hat{P}_{iT+1}, \hat{P}_{iT+2}, \dots, \hat{P}_{iT+k}$ for each $i = 1, \dots, N$.

[Note: P's will be logs of actual patent applications per worker. Thus, need to take the exponent of P and multiply by number of workers to obtain the predicted number of patent applications (in natural units).]

Forecast Accuracy:

Root Mean Square Percentage Errors, RMSPE

For date $T+k$, compare actual patent applications P_{iT+k} and predicted \hat{P}_{iT+k} :

$$\text{RMSPE}_{iT+k} = \sqrt{\left(\frac{P_{iT+k} - \hat{P}_{iT+k}}{P_{iT+k}} \right)^2}$$

- Provide mean RMSPE across source countries $i = 1, \dots, N$.
- Provide sample forecasts by individual source countries.

Dynamics:

$$P_{it} = \beta_0 + \beta_{11}P_{it-1} + \dots + \beta_{1j}P_{it-j} + \beta_2 x_{it} + u_i + \mu_{it},$$

*[Through the lagged variables, we have the entire history of the independent variables in the equation. Thus the effect of “x” is conditioned on this history. The impact of x on P reflects the effect of *new* info.]*

We examine AR1 and AR3 versions (i.e. models without x's)

We also examine the contribution of the x's (especially R&D). Estimation by FE, RE, and GMM.

3. Sample Statistics (see Tables 1, 2, 9, 22, 25 & Charts 1-4)

4. Estimates & Forecasts (see Tables 10, 11, 12, 15-21, 28, 29, 30)