USING PATENT DATA AS AN INDICATOR OF INTERNATIONAL TECHNOLOGY TRANSFER

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Patent activity is frequently used as a proxy for technological innovation, that is, the method by which new or enhanced technologies are made available and brought into widespread use. The transfer of technology between countries is investigated by looking at the relationship between the country where the application was first laid and any subsequent duplicate filings in other countries. This memo investigates the robustness of using duplicate patent applications to measure patterns and rates of international technology transfer.

Table 1. Technology transfer taxonomy

Market-mediated transfer	Non-market transfer
• Trade in goods and services • Foreign direct investment • Licensing • Joint ventures • Cross-border movement of personnel	• Imitation and reverse engineering • Employee turnover • Published information (journals, test data, patent applications)

Technology transfer between countries can take many forms; see Figure 1 for a market – non-market breakdown (see Maskus 2004 and World Bank 2006)[1]. Available empirical evidence strongly supports the finding that the bulk of technology transfer takes place via (i) trade, (ii) foreign direct investment (FDI) and (iii) licensing (Maskus 2004). Precisely which channel is most important depends in part upon the characteristics of the 'recipient country' (i.e. domestic research capacity, strength of intellectual property rights regimes, etc.) and the nature of the technology being transferred (i.e. the potential for imitation and reverse engineering).

The idea of using patent data to measure international technology transfer arises from the fact that there will be a partial 'trace' of the three main transfer channels in patent figures. Moreover, if there is any potential for reverse engineering, exporters, investors and licensors will each have an incentive to protect their intellectual property when it goes overseas. Technology transfer occurring via foreign direct investment and licensing of specific technologies involves the transfer of knowledge, expertise and equipment to another country. This may subsequently diffuse more widely in the economy by other channels – e.g. local employees of the subsidiary taking up employment in domestic firms and carrying knowledge about the technology with them. There is, however, little data to quantify transfer via FDI and licensing in the environmental area.

[1] Maskus, Keith E. (2004), Encouraging International Technology Transfer, UNCTAD-ICTSD.

Trade is a form of transfer where technological innovation embodied in a good improves the capital stock of another country. This transfer can be measured by trade flows. However, in the environmental area, sector or commodity classifications are not sufficiently defined to provide robust indicators for 'environmental' technologies, whereas patent data can provide such indicators due to their more detailed classification system. It is however, useful to look at the relationship between trade and patent transfer flows in order to substantiate that patent flows between countries are a valid indicator of international innovation transfer.

For this corroboration exercise, road vehicle data has been chosen as it is an area with large numbers of patents, large measurable trade flows, and comparable definitions. Road vehicle patent and trade data has been used to investigate the robustness of using duplicate patent applications to measure technology transfer.

Patent flows

Patents have been extracted from the PATSTAT database for road vehicles with an International Patent Classification of B62 "Land vehicles for travelling otherwise than on rail".
There are three ways to measure patent flow between countries:

1. Inventor country to priority office;
2. Inventor country to duplicate office;
3. Priority office to duplicate office.

Type three, priority office to duplicate office flow counts are used in the analysis shown below.

Trade flows

Data has been extracted from the UN COMTRADE database. Data was extracted for the period 1988 to 2005, using both the HS and SITC classification systems, SITC = 78 "Road Vehicles" and HS = 87 "Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof". Both exports (gross exports less re-exports) and imports (gross imports less re-imports) were investigated.

Trade and patent transfers between countries are collected for the period from 1988 to 2005. Correlations between patent flows and trade over time and country pairs are shown below. There was trade data and patent transfer counts available for approximately 50 exporting countries and 60 importing countries. Results are presented using all non missing pairs and also with outliers removed, namely flows from Canada to the United States and from Japan to Germany.

Patent transfer counts between priority office and duplicate office are extracted from the PATSTAT database[2] while trade data between countries comes from the UN COMTRADE database[3]. Trade and patent transfers are collected for the period from 1988 to 2005 where there is data available for approximately 50 countries.

[2] IPC code of B62 – Land vehicles for travelling otherwise than on rail.

[3] Using both the HS and SITC classification systems, SITC = 78 Road Vehicles and HS = 87 "Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof'

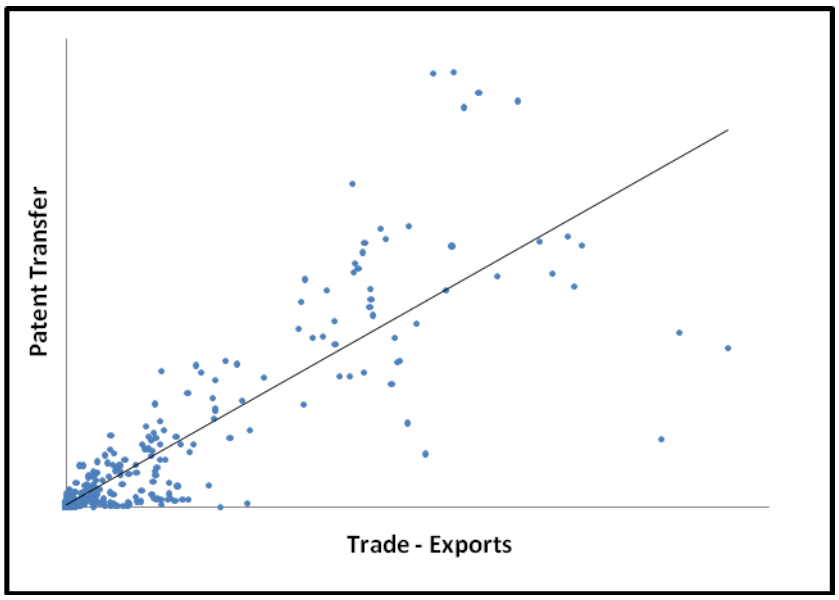
Table 2. Correlations between trade values and counts of duplicate patent applications

Correlation between trade flows and duplicate patenting	Full sample	Sub-sample excl. outliers (excl. CA-US and JP-DE flows)
Base dataset - all country pairs and all years (1988-2005), corr(exports, patents)	0.47 (4384)	0.69 (4348)
For each country pair, aggregate over time, corr(exports, patents)	0.52 (825)	0.74 (823)
For each exporter country, aggregate across partner countries, corr(exports, outgoing patents)	0.76 (446)	0.87 (446)
For each importer country, aggregate across partner countries, corr(imports, incoming patents)	0.71 (634)	0.76 (634)

Note: Pearson correlation coefficients; Number of observation in parentheses; When trade data was deflated by the US PPI all correlations improved marginally (by 0.01).

To substantiate the use of patent data as a measure of technological transfer, we would expect trade and patent flows to be strongly positively correlated as indeed they are found to be (Table 2). Firstly, each export-import pair (1988-2005) is correlated at 0.69. Aggregating over time for each export-import pair gives a correlation of 0.74. And finally, when aggregating trade and patent data for each exporter (regardless of who imports) gives a correlation of 0.88. Figure 2 below plots the last case with aggregate exports on the horizontal axis and total patents transfers from 'exporter' country on the vertical axis.[4]

Figure 1. Aggregate patent transfer counts and aggregate exports for road vehicles 1988-2005.



Technological transfer occurs via many channels, though arguably trade, foreign-direct investment and licensing are the most important. Given the lack of suitable data in these areas, in particular with respect to environmental fields, patent data which relates to these three channels of international technology transfer, offers a suitable indicator.

[4] Results are presented using all non missing pairs and also with outliers removed, namely flows from Canada to the United States and from Japan to Germany.