



## Does patent harmonization impact the decision and volume of high technology trade?

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### ARTICLE INFO

#### Article history:

Received 3 October 2011  
Received in revised form 16 May 2012  
Accepted 16 May 2012  
Available online 23 May 2012

#### JEL classifications:

F10  
O34

#### Keywords:

Patent rights  
High technology goods  
Trade margins  
Intellectual property

### ABSTRACT

The World Intellectual Property Organization identified technology transfer as a key objective to their Development Agenda. Such transfer could be achieved if patent reform in developing countries aids these countries in attracting foreign high-technology exports. Encouragingly, the results of this paper suggest that patent reform in lower-middle income countries attracts new firms into the market, while reform in low income and upper middle income countries encourages existing trade partners to increase export volumes. These results suggest that policies to harmonize patent regimes are, in fact, useful in increasing high technology exports to developing countries.

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### 1. Introduction

This paper explores the impact of patent harmonization across countries on the extensive and intensive margins of high technology trade, paying particular attention to the effect on high technology exports to developing countries. Patent reform in a country can impact trade flows in two important ways: (1) these policies may provide incentives for firms to enter export markets (expansion of the extensive margin) and/or (2) the policies may cause current exporting firms to increase the export volume into a given market (expansion of the intensive margin). As Co (2010) points out, policy reform may influence each trade margin differently. This paper specifically examines how patent harmonization between trade partners influences the decision and volume of high technology exports to developing countries.

Many proponents of intellectual property rights in developing countries argue that the implementation of strong national policies to protect intellectual property can stimulate technology transfer and economic growth, as these policies will attract new firms (and countries) to export high technology goods to developing country markets (Arora, 2009). In fact, in 2007, the World Intellectual Property Organization (WIPO), a branch of the United Nations (UN), created a Development Agenda for which technology transfer and “access to knowledge” via intellectual property rights were key agenda items (WIPO, 2007). As WIPO’s Committee on Development and Intellectual Property in holds its ninth session in May 2012, it is increasingly critical to understand how policies that strengthen patent regimes in developing countries impact high technology exports to these countries.

The results in this paper indicate that the effectiveness of domestic patent reform in attracting high technology goods from abroad differs depending on the income level of the patent reforming country. Low income and upper middle income countries

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that reform their patent systems to become more similar to policies of their high technology trade partners do not see an increase in the number of firms exporting to their country, but do see an increase in the volume of high technology exports from existing trade partners (albeit at only the 10% significance level for low income countries). Patent reform in lower-middle income countries attracts new exporting firms into these countries, but does not impact the export volume of existing high technology trade partners. These results suggest that patent reform in developing countries can play a positive role in attracting high technology exports from abroad, suggesting that patent reform may be a good policy to encourage technology transfer via increased high technology trade.

Past literature has focused on the effect of patent reform on total bilateral trade flows, regardless of the firm-level behavior (extensive and/or intensive margin changes) leading to this outcome. Previous research has found that strengthening patent protection in a country leads to an increase in manufactured imports (Fink & Primo Braga, 2005; Maskus & Penubarti, 1995). The impact of patent reform on increasing *high technology* imports is less straightforward. Fink and Primo Braga (2005) find that the total volume of high technology imports is statistically unrelated to the strength of domestic patent protection, while Ivus (2010) contrastingly reports that developing countries with strong intellectual property protection have experienced relatively greater growth in high technology imports than did developing countries with weak intellectual property rights. When narrowly considering trade in certain high technology industries, the conclusions are also varied. Smith (2002) finds that stronger foreign patent protection encourages firms to increase pharmaceutical, medicinal, and biological manufacturing exports only if the patent reforming country has strong imitative capabilities; Yang and Woo (2006) find that patent reform has no significant impact on attracting foreign exports of planting seeds; while Liu and Lin (2005) find that such reforms have a positive impact on semiconductor and communication trade if the patent reforming country readily engages in R&D.

Most of the above papers utilize traditional gravity models to estimate bilateral trade flows. However, as pointed out by Helpman, Melitz, and Rubinstein (2008)—henceforth HMR—traditional gravity model methods of examining bilateral trade flows often ignore potential biases that result from firms' selection into export markets and from the exclusion of the impact of the extensive margin (the number of exporting firms) on estimates of the intensive margin (the quantity of exports). HMR provide a two-stage, non-linear least squares approach to correcting for these biases, thereby theoretically enabling researchers to discern a firm's binary decision to export into a given market from their continuous decision of how much to export. Another unique attribute of the bilateral trade methodology established by HMR is that it allows empiricists to determine firm-level decision making behavior while using aggregate country data. This is important as comprehensive firm-level data is often difficult to obtain, while country-level bilateral trade data is more easily attainable. For these reasons, this paper utilizes the HMR methodology to explore how harmonization of patent policies across countries influences bilateral, high technology trade. Future research may wish to utilize the HMR methodology of distinguishing between the firm-level decision to export and export volume so to consider the impact on patent reform on specific high technology industries.

## 2. Methodology and data

The empirical methodology presented by HMR is briefly discussed here to provide a clearer understanding of the methods used in this paper to obtain estimates of the extensive margin of trade (firms' binary decision to enter a given export market) and intensive margins of trade (firms' decision regarding the volume of exports). Appendix A provides a more detailed discussion of how patent rights enter into HMR's theoretical model. The primary purpose of this section, however, is to describe the empirical methodology derived from HMR's theoretical model. It is this empirical methodology that is utilized as the estimation technique in this paper.

The HMR model stems from the traditional gravity model of bilateral trade flows, which postulates that trade between two countries is greater the more similar these countries are in economic size and in the presence of smaller barriers to trade—such as physical, social, cultural, and economic distance. However, unlike traditional gravity models that predict bilateral trade flows at the country-level, HMR provide a theoretical basis from which firm-level export behavior can be discerned using country-level data. In doing so, HMR distinguish between the probability that a firm in country  $i$  exports to country  $j$  and the volume of exports that a firm in country  $i$  sends to country  $j$ . More specifically, estimates of the binary firm-level decision to export are included in the estimation of trade volume so to control for entry and exit of firms on export volume. HMR argue that failure to control for the fraction of exporting firms on export volume would mean that coefficients for the traditional gravity variables could no longer be interpreted as elasticities given that “the estimation of the standard gravity equation confounds the effects of trade barriers on firm-level trade with their effects on the proportion of exporting firms, which induces and upward biases in the estimated [gravity] coefficient(s)” (p. 454).

A two-stage estimation procedure is implemented that estimates the fraction of exporting firms in stage one and controls for the numbers of exporters when estimating the volume of trade in stage two. In the first stage, the probability that a firm exports is estimated using a probit model. The probability that a firm in country  $i$  exports to country  $j$  is characterized by (1)

$$y_{ijt} = \alpha_0 + \alpha_1 PAT_{ijt} + \alpha_2 Religion_{ij} + \beta_p X_{ij} + \varepsilon_i + \varepsilon_j + \varepsilon_t + \varepsilon_{ijt}$$

$$y_{ijt} = \begin{cases} 1 & \text{if } y_{ijt}^* > 0 \\ 0 & \text{if } y_{ijt}^* = 0 \end{cases} \quad (1)$$

where  $y_{ijt}^*$  is the latent variable representing the export value of high technology goods in country  $i$  to country  $j$  at time  $t$ ,  $PAT_{ijt}$  captures the difference in patent standards between country  $i$  and country  $j$  (using a formula that will be described momentarily);

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