Chapter VI: Annex

A. Measuring the share of surplus profits in total profits[1]

Section B.6.2 of the *Trade and Development Report* (pp. 124-125) defines surplus profits as the difference between actually observed total profits and typical profits. Therefore:

Total profits = surplus profits + typical profits (1).

This section details the mathematical formula used to calculate the share of surplus profits in total profits.

Let sectors[2] be denoted by $j = 1, \dots, Q$; firms by $i = 1, \dots, N_j$, with N_j the number of firms in sector j. Years are denoted by *t*=1995, … ,2015; and time periods by *p*=1995-2000, 2001-2008, 2009-2015.
π_{ijt} are the observed operating profits of firm *i* in sector *j* in year *t*, as recorded in the firm's financial statements.
$\widehat{\pi_{ijt}}$ stands for the typical profit of firm *i* in sector *j* in year *t* and is calculated as follows:

$$\widehat{\pi_{ijt}} = K_{ijt} \times R_{jp} \qquad (2)$$

where :

- K_{ijt} are the total assets of firm *i* in sector *j* in year *t,* as recorded in the firm's financial statements
- R_{jp} is the benchmark for typical profitability in the period *p* such that $t \in p$. R_{jp} is then calculated as the annual average over the period *p* of the median value of the rate of return on assets (ROA) for firms in sector *j*. The ROA is defined as the ratio of firms' operating profits to their total assets.

Equation (1) can be rewritten *at the firm level* as follows:

$$\pi_{ijt} = (\pi_{ijt} - \widehat{\pi_{ijt}}) + (\widehat{\pi_{ijt}}) \ ,$$

where the difference $\pi_{ijt} - \widehat{\pi_{ijt}}$ equals the surplus profits of firm *i* in sector *j* in year *t*.

It follows that, for period *p*, the share S_p of surplus profits in total profits can be written as:

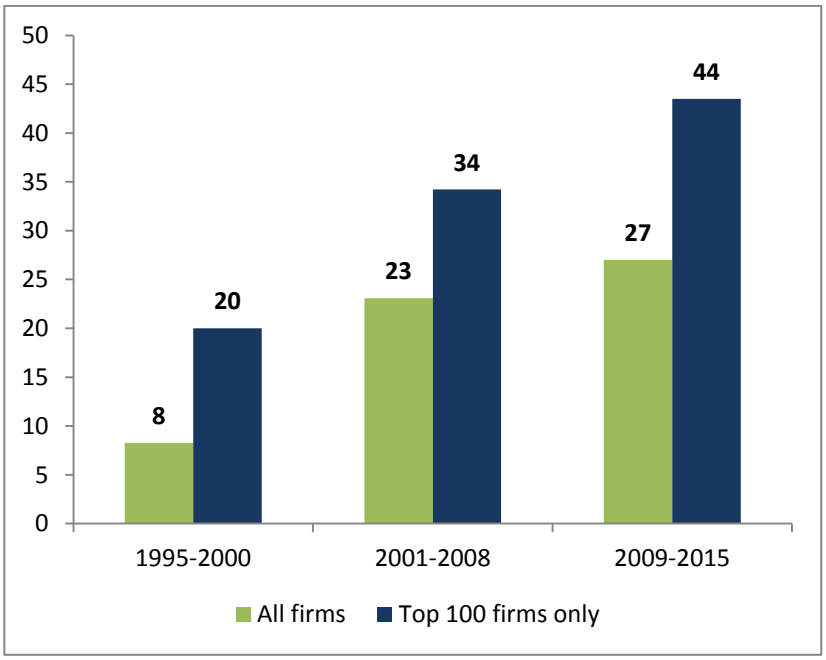
$$S_p = \frac{\sum_{t \in p} \sum_{j=1}^{Q} \sum_{i=1}^{N_j} (\pi_{ijt} - \widehat{\pi_{ijt}})}{\sum_{t \in p} \sum_{j=1}^{Q} \sum_{i=1}^{N_j} (\pi_{ijt})} \times 100 \qquad (3)$$

[1] Referring to note 6 of Chapter VI.
[2] The definition of sectors refers to nine of the ten main sectors of the first level of the Thomson Reuters Business Classification, excluding the "financials" sector.

Figure 6.1 in chapter VI (p 125) displays this measure graphically for each of the three defined time periods, for all firms in the sample (green column), as well as for the top one hundred firms only (blue column).

Furthermore, and in order to strengthen the independence of the benchmark for typical profits from actually observed total profits, we can exclude firms above a certain cut-off point in terms of their ROAs from the sectoral benchmark calculations, for example the top 5% of firms in any one sector. In this case, the results show that the overall trend of the share of surplus profits over time remains unchanged. Similarly, the gap between the performance of all firms (green column) and the top one hundred firms (blue column), respectively, remains of the same magnitude. However, the absolute shares of surplus profits in total profits increase slightly. (see Figure 6.1A below).

Figure 6.1A Share of surplus profits in total profits, 1995 – 2015 without top 5% firms in the benchmark *(Per cent)*



Source: UNCTAD secretariat calculations, based on UNCTAD's CFS database, derived from Thomson Reuters Worldscope Database.

B. Patent power and market concentration in developing countries[3]

Data and estimation

This section describes the variables that were used to estimate an econometric model of the rate of return (ROR) to sales (all in natural logs), in order to measure how patent power works to cement incumbent advantages. Three sectors - pharmaceuticals, chemicals, and information and communications technologies (ICT) - were chosen for the empirical analysis based on the fact that these sectors are characterized by firms that patent heavily, yet provide interesting sectoral differences in terms of the technological complexity of their products, product life cycle, and the ways in which they cope with imitation risks. The sectors are also heavily concentrated, thereby serving the purpose of understanding the links between greater patenting and market concentration.

Two data sources on global companies were chosen for the empirical analysis. The first is the U.S. Bureau of Economic Analysis (BEA), which conducts benchmark and annual surveys of U.S. multinational parent companies and their foreign affiliates around the world (*BE-10* and *BE-11* surveys), as well as benchmark and annual surveys of U.S. affiliates of foreign multinational companies (*BE-12* and *BE-15* surveys). The surveys provide detailed financial and operating data at the firm level.[4] The second is Thomson Reuters *Eikon* and *Datastream*, which provide data on private and public companies, with headquarters around the world. Data on patents granted by the U.S. Patent and Trademark office (USPTO) and data on patent citations as obtained from the National Bureau of Economic Research (NBER) Patent Data Project (PDP)[5] was used in addition to these data sources. A patent citation variable was constructed by creating a weighted count of patents, where each patent is weighted by the number of citations received during the first five years, adjusting for truncation bias. The number of citations a patent receives helps to control for patent quality in the analysis.

The BEA data on foreign affiliates of U.S. MNC in three developing countries – Brazil, India, and China – was used in order to study how patent reforms in those countries have affected the market sales and returns of those affiliate companies. These three countries were chosen on the basis that they are key markets for US companies in the developing world, and multinational companies with valuable intellectual property assets have especially been concerned with the protection of those assets in those three key markets. The three countries have therefore also enacted significant patent reforms since 1995.

Sectors were identified on the basis of four-digit NAICS codes (2002 version). For example, the pharmaceutical sector is coded 3254. The chemicals sector are those firms with NAICS classification codes 3251, 3252, 3253, and 3255 – 3259 inclusive. The ICT sector consists of firms essentially in technology hardware and software, with NAICS codes 3241 – 3246 inclusive and 5111 (software publishers).

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[3] *The statistical analysis of firm level data on U.S. multinational companies and their foreign affiliates, and U.S. affiliates of foreign multinational companies was conducted at the Bureau of Economic Analysis, United States (U.S.) Department of Commerce, under arrangements that maintain legal confidentiality requirements. Views expressed in this analysis do not necessarily reflect official positions of the U.S. Department of Commerce.*

[4] For a guide, see https://www.bea.gov/surveys/pdf/a-guide-to-bea-direct-investment-surveys.pdf.

[5] https://sites.google.com/site/patentdataproject/

The *Herfindahl-Hirshman Index (HHI)* is used to estimate the extent to which patents leads to market concentration in the USA,[6] which forms the base line of the analysis. In order to understand the relationship between market concentration and patent ownership and citations (where the latter helps to ascertain the 'strength' of certain patents owned by patents, over others which are not/ hardly cited, showcasing their importance), the HHI for sales, patent grants, and patent citations are computed for the firms, for example by industry (at the 4-digit NAICS level) and year.

The BEA data on foreign affiliates of U.S. MNCs in all the three developing countries – Brazil, India, and China – is then used to study how patent reforms in those countries have affected the market sales and returns to those affiliate companies. Given that systematic data on market concentration for local and foreign firms is not available in all the three countries, the analysis benchmarks the performance of foreign affiliates of U.S. MNCs against local publicly-listed companies. To this end, sales and profitability data is used to compute the normalized affiliate sales per worker series for each host country and industry pair (i.e., chemicals and pharmaceuticals, and ICT). The normalized sales measure is then compared to the trend in patent protection in the host country, using the updated index of patent rights in Park (2008). Sales were also converted to real 2009 dollars using the GDP deflator. As a measure of profitability, we examine the rate of return (ROA), defined as the ratio of net income to assets. The ROA here is the *mean* rate of return for each industry and host country pair for a given year in current values. We compare the ROA of the affiliates to that of the local indigenous companies.

In the empirical analysis therefore, as a first step, the sample of all MNCs in the USA are considered, where the effects of patenting on market concentration, and the effects of market concentration on firm profitability are examined. As a second step, the sales of US MNC affiliates (versus that of local publicly listed companies) as they correspond to patent reforms in Brazil, India, and China helps to examine the effects of patent reforms on firm profitability.

But since patents do not normally immediately result in profitable products/ marketable innovations, the analysis lags the patent variables by 'l' years.[7] It is important to lag the patent grants since a third factor (say, firm size) may be driving both the concentration of sales and patent ownership, which can confound the effects of patenting on market concentration. In addition, in the empirical analysis, the correlation between patenting and firm size is mitigated by the use of citations, which need not vary with firm size; that is, patent quality is not necessarily a function of the size of firms. Sectoral variables - CHEM, PHARM, and ICT are dummy variables, which equal one if the particular four-digit NAICS coded industry sector corresponds to one of the meta-sectors. In addition, given that some affiliates are in two or more industries (for example, chemical and pharmaceutical), the model controls for controls for a myriad of fixed firm and industry effects and interaction effects.

Results

The empirical results from the regression that compares the sales of US MNC affiliates and local, publicly listed companies in Brazil, China and India are presented in Table 1, which shows that the affiliates' rate of return (ROA) has a highly elastic response to a strengthening of patent rights. A 1% increase in the index of patent protection is associated with at least a 1.141% change in the ROA when all MNC affiliate firms across all the three sectors are taken collectively (see column 1). This elasticity could be as high as 2.114 if we control for firm productivity, or value added per worker (see column 2). In columns 3 and 4, we see that the latter effect is less pronounced tempered if we control for market share. This variable represents the ratio of the affiliates' sales to the domestic sales of the local headquarter companies. It is

[6] Comparative data for the three developing countries in the sample on market concentration is not available.
[7] In our regressions, l = 5 years, and the lag length was primarily dictated by the availability of the patent data.

intended to capture, albeit in a limited way, the contribution of the firm's market power on its rate of return. Since we do not have measures of concentration in the individual markets of India, Brazil and China, we use a proxy by examining the sales of the affiliate relative to those of the publicly listed host country firms; for instance, the sales of Brazilian head quartered companies in Brazil or Indian head quartered companies in India. The market ratio (Mkt Ratio) variable in Table 1 therefore helps measure the slice of the local market captured by the affiliate relative to the publicly listed local firms (but excluding other foreign companies, such as from Japan, the EU, and so forth). The larger the ratio, the more dominant the U.S. companies are in the local market. In column 4, we allow the 'Mkt Ratio' variable to vary by country and sector through its interaction with country fixed effects and industry fixed effects.

At the bottom of Table 5, we show the net effects of a 1% change in the patent rights index by country and sector by evaluating the coefficient estimates of the various dummies and interaction terms. We especially observe a highly elastic response of the rate of return to a strengthening of patent rights in the ICT sector in all three countries. The response is especially highest in the Indian ICT market. A strengthening of patent rights has a positive effect in the chemicals and pharmaceutical industry but the response is less elastic, except in India, where a 1% rise in the patent index is associated with a 1.116% rise in the ROA to chemical affiliates. In Brazil, the response is small in the chemicals industry, and even smaller in pharmaceuticals. A 1% strengthening of patent rights raises the ROA to U.S. drug company affiliates by only 0.093%. MNC Pharmaceutical affiliates here may have the benefits of entry barriers, other than patent rights, to help protect market returns in Brazil already, which is not captured by the model. In contrast, in India and China, where there is formidable competition from generics and other local firms, a rise in patent protection does more to protect pharmaceutical returns. A 1% rise in patent strength in India and China helps raise pharmaceutical ROA by 0.922% and 0.558% respectively.

The results show that that for the US MNC affiliates in the sample, rate of return and market power (to the extent that it is captured by the relative market size or share) are positively associated.

Table 1: Impact of Patent Rights on Affiliate Return in Brazil, India, and China

	(1)	(2)	(3)	(4)
VARIABLES	Rate of Return	Rate of Return	Rate of Return	Rate of Return
Patent Rights Index	1.141**	2.114***	1.687***	1.863***
	(0.495)	(0.509)	(0.540)	(0.537)
Value Added/Labor		0.487***	0.519***	0.502***
		(0.029)	(0.037)	(0.037)
Mkt Ratio			0.048*	-0.124**
			(0.025)	(0.063)
Country x Mkt Ratio				Incl.
Industry x Mkt Ratio				Incl.
Year effects	Incl.	Incl.	Incl.	Incl.
Country effects	Incl.	Incl.	Incl.	Incl.
Industry effects	Incl.	Incl.	Incl.	Incl.
Industry x Year	Incl.	Incl.	Incl.	Incl.
Industry x patent index	Incl.	Incl.	Incl.	Incl.

Country x patent index	Incl.	Incl.	Incl.	Incl.
Industry x country	Incl.	Incl.	Incl.	Incl.
Constant	-2.178***	-4.879***	-5.278***	-5.530***
	(0.280)	(0.317)	(0.388)	(0.396)
Observations	3,462	3,012	1,959	1,959
Adjusted R-squared	0.297	0.388	0.442	0.457

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Variables are in natural logs. Regressions absorb firm fixed effects.
Rate of Return = Net Income/Assets, Mkt Ratio = Ratio of Affiliate Sales to Local Headquarter Sales

Evaluated Impact of Patent Rights on ROR by country and industry

	Brazil	India	China
Pharmaceuticals	0.093	0.922	0.558
Chemicals	0.287	1.116	0.752
ICT	1.251	2.080	1.716

(Estimates based on column 4)