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**South-South trade: The extent of China's pharmaceutical exports sensitivity to Africa's market capacity and intellectual protection strength.**

**By**

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## **Abstract**

*The extent to which Chinese pharmaceutical exports are sensitive to Africa's market and institutional capacities are examined. The paper applies international trade theory to capture Africa's market and institutional capacities, especially intellectual property rights protection (IP) from the perspective of South-South trade. The results show that, overall, IP is insignificant even though the direction of effect on trade (positive) appears to suggest some market expansion effect. However, when the level of development is controlled for, the direction of influence of IP suggest that there is some market power effect within countries in the upper middle income and market expansion effect within countries in the lower middle and low incomes.<sup>1</sup> This market expansion appear to be greater for low income countries than lower middle income groups. Further, the results show that there is a positive shift effect of IP protection on pharmaceutical exports. That is, the estimate of this trade is larger for countries with relatively strong IP protection (114.21) than for countries with weak IP protection (96.70). Finally, Africa's IP presents mixed results in enhancing market capacity but the direction of influence indicate market expansion ( increase) of Chinese pharmaceutical exports. See Table 1:*

## **Introduction**

In 2001, China joined the World Trade Organization (WTO), six years after the WTO was formed. Although it was not the first time China experienced rule based trading system, her accession was widely anticipated. China was a pioneer of the formation of the General Agreement on Tariffs and Trade (GATT) in 1948 and indeed one of the 23 original signatories. However, due to political ideological reasons part of China opted out in 1949. Nearly four decades later, China started to rejoin GATT in 1986 which culminated in the Accession to the WTO a decade and half later in December 2001.

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<sup>1</sup> Market expansion effect occurs when strengthening IPRs in the importing country reduces imitation of foreign technology by local firms by ensuring embodied technologies in imports thus boosting trade. On the other hand, market power effect occurs when strengthening IPRs grants monopoly power to importing country firm by providing exclusive rights to products and technologies hence curtailing trade.

Like most members, China joined the WTO so as to enjoy lower tariff rates from the member countries. As a rule-based system non-member exports are often subject to much higher and even prohibitive tariff rates. Even though some member countries were not happy, in the end there was general feeling that denying market for China's rapidly expanding economy will isolate significant world trade. Besides, there was fear among some members that China might resort to predatory and aggressive industrialization that might curtail free trade.

An industry that has been substantially affected by China's accession to the WTO is the pharmaceutical. Since China's accession to the WTO, leading pharmaceutical companies have established research and development (R&D) centers in major Chinese cities. This is largely attributed to government legalization of foreign ownership of retail pharmacies in 2003 and existence of extensive science and technology research bases that cut costs for the industry. This has spurred activities in the industry with new outward-orientation policies. Pharmaceutical products from China are increasingly found in developing countries markets. This is fueled by what is increasingly being seen as South-South trade. In particular, recent China-Africa cooperation is an important part of such South-South cooperation aimed at addressing the current economic situations.

After several decades of diplomatic ties, trade 'courtships' and cooperation there is a growing 'New found' partnership between Africa and China. This partnership in trade is intended to be mutually beneficial. However, in order for China to increase trade and investment, part of the conditionalities is that Africa must provide conducive environment in terms of improved market and institutional capacities, including protection of intellectual property rights. Ironically, China has been accused of laxities in similar trade, economic and institutional reforms including weak institutions. But what are the expectations of a country with history of weak intellectual protection (China) from countries of similar or even weaker intellectual protection?

### **Theory and dynamics of IPR and trade**

To answer this question one needs look examine the theory, dynamics and link between IPRs and trade. First, the theory literature on IPRs and trade is inconclusive on whether weak or strong IPRs regime enhance or decreases trade. Two countervailing effects are often discussed. On one hand is the market expansion effect where strong IPRs expand international markets available to

exporters by ensuring exclusive rights to the technologies embodied goods flowing across borders. This enhances more trade. On the other hand, there is market power effect where strong IPRs curtails trade by ensuring temporary monopoly over protected technologies, especially among foreign firms. Even though the effect of strengthening IPRs on trade has been examined the direction of this effect is still theoretically and empirically inconclusive. For example, several studies reveal that strengthening IPRs can increase or decrease trade (Maskus & Penubarti, 1997; Ferratino 1993; Smith 2002).

Looking the dynamics in terms of strengthening IPRs, especially within the developing and LDCs one can see that there has been marginal improvement largely because of Trade Related Intellectual Property Rights (TRIPs) minimum requirements and pressures from developed countries. Although it's tempting to argue that since Africa mainly produces primary products it has no business in strengthening its intellectual property protection, the presence of numerous multinational pharmaceutical companies involved in drug manufacturing and importing of generic copies of patented drugs would make one think otherwise.

As per the Ginarte & Park (2005) IPR index<sup>2</sup>, the mean Africa index is smaller than China, suggesting that the latter has relative IPR strength. This may have trade implications. According to Helpman (1993) weak IPRs is not likely to improve terms of trade for the country with stronger protection. In this case, Africa's weaker IPRs is not likely to increase the price of the Chinese pharmaceutical exports relative to imports. In other word, Africa as a whole could be a disincentive for Chinese production of intellectual property and/or a disincentive to allow intellectual property flows to Africa. And because of presence of pharmaceutical firms (both domestic and foreign), there are chances that embodied technologies could be reproduced or reverse engineered. This will depend on how Africa enhances her market capacities. Although in the context of North-South dimension, and starting from the assumption of the North having

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<sup>2</sup> The IPR index is based on Ginarte and Park (1995, 2000 and 2005) index which incorporates five aspects of patent laws for all countries around the world; the extent of coverage, membership in international patent agreements, duration of protection, provision for loss of protection, and enforcement mechanisms. The index is often scored from 0 to 5, with higher values indicating stronger patent protection.

stronger IPR, Burch et al (2001) using game theory show that strong IPRs in the South acts as incentives for Northern further production of intellectual property, the implications of the findings of these studies in the case of South-South trade remain little understood.

Thus examination of strengthening IPRs within South-South dimension could not have come a better time. In particular, in light of the Africa-China cooperation, many questions remain unanswered: (1) Do Africa's marginal strengthening of IPRs granting monopoly powers to China based firms inducing them to export less because of monopolistic behaviors? (2) Do Africa's marginal strengthening of IPRs granting exclusive rights to technologies embodied in pharmaceutical imports thus increasing exports to Africa? (3) Do Africa's institutional capacities such as intellectual property protection increase market capacities in increasing trade in pharmaceuticals?

The objectives of this paper are to empirically seek answers to the above questions. With this objective the following hypotheses are examined.

*Hypothesis 1: Africa's intellectual protection increase Chinese pharmaceutical product exports.*

*Hypothesis 2: Africa's intellectual protection increase Chinese pharmaceutical products, especially in upper middle income countries than low income groups.*

*Hypothesis 3: Chinese export in pharmaceutical products is larger for countries with relatively strong IP than for those with weak IP protection.*

*Hypothesis 4: Africa's IP enhances her market capacity and hence increases Chinese pharmaceutical exports.*

## **Method**

I use gravity trade model to analyze trade of pharmaceutical products from China to Africa. However, before doing so it is noteworthy to review the theory behind these trades. Theoretical

underpinning of the gravity trade models is typically used in estimating bilateral flows. It shows value of exports of particular commodities from one country to another.

Various forms of the gravity model are often presented. One of these models as presented by Redding and Venables (2004 ) hereafter (RV model ) is written in more compact way as:

$$n_j p_j x_{jk} = n_j p_j^{1-\sigma} (t_j T_{jk} t_k)^{1-\sigma} E_k G_k^{1-\sigma} \quad (1)$$

where  $n_j$  the set of varieties produced in  $j$ ;  $X_{jk}$  country  $k$ 's consumption of a single product variety from the set  $n_j$  assuming all varieties are symmetric;  $T_{jk}$  is shipping cost and  $t_j$  and  $t_k$  are the ad valorem cost factors. The RHS (1) contains exporter and importer country characteristics. RV model (2004) decompose these characteristics into market capacity of the importer  $E_k(G_k/t_k)^{\sigma-1}$ , which depends among other things on importers total expenditure on differentiated products, transportation cost and price index in each country,  $G_k$  defined over the prices of individual varieties produced in  $j$  and and exported to  $k$ ,  $P_{jk}$ . The term  $n_j(p_j t_j)^{1-\sigma}$  captures supply capacity of the exporting country  $j$ . RV model shows that supply capacity of exporting country capture all unobserved and observed characteristics that affect her bilateral trade with importers. On the other hand, market capacity of an importing country captures all observed and unobserved characteristics that affect her trade with exporters.

The RV (2004) model further defines this decomposition as follows:

$$m_j = E_j(G_j/t_j)^{\sigma-1}, \quad s_j = n_j(p_j t_j)^{1-\sigma} \quad (2)$$

The RV (2004) model is further presented in more compact way as follows:

$$V_j = n_j p_j \sum_{k \neq j} x_{jk} = s_j \sum_{j \neq k} (T_{jk})^{1-\sigma} m_k = s_j M_j \quad (3)$$

where  $V_j$  is value of exports of  $j$ ;  $s_j$  is supply capacity of exporter;  $m_j$  is market capacity of exporter and  $M_j$  is foreign-market access of  $j$ .

### **Empirical Specifications**

Following this theory international trade flows across pairs of countries are specified in terms of supply capacity of the reporter and market capacity of the partner using generalized gravity model. In this paper I present China's export of pharmaceuticals to African countries as a function of African countries' market and institutional capacities. Market capacities include variables like per capita income while institutional capacities include strength of intellectual protection. Thus:<sup>34</sup>

$$\log T_{ijk} = \beta_0 + \beta_1 \log\left(\frac{Y_k}{N_k}\right) + \beta_2 \log(N_k) + \beta_3 \log(D_{jk}) + \beta_4 \log(P_k) + \varepsilon_{jk} \quad (4)$$

where  $\beta_0 = \gamma_0 + \gamma_1 \ln(Y_j/N_j) + \gamma_2 \ln Pop_j$ ;  $T_{jk}$  is the value of bilateral trade flows of pharmaceutical industry  $i$  from  $j$  i.e. China to an African country  $k$ ;  $(Y_k/N_k)$  are the respective per capita GDP of  $k$ ;  $N_k$  is the population sizes of country  $k$ ;  $D_{jk}$  is the geographic distance between China and country  $k$ ;  $\varepsilon_{jk}$  is log-normally distributed disturbance term. Specification (4) is the base equation where  $\beta_1 > 0$ ,  $\beta_2 > 0$ ,  $\beta_3 > 0$ ,  $\beta_4 < 0$  the priori signs.

Next, in order to examine the extent of sensitivity of China's pharmaceutical export to the relative strength of Africa's intellectual protection, introduce level of economic development as a proxy for market capacity. In this regard, I grouped these countries into three development categories following World Bank's definition. The aim here is to see whether the sensitivity of

<sup>3</sup> Notice that since China is the only source country,  $j$ , all her supply capacity variables are treated as constant and hence are included in the intercept.

<sup>4</sup> China (source country) is indexed  $j$ . Destination African country is indexed  $k$ , and  $k = 1, \dots, 47$

pharmaceutical exports to Africa's IPRs vary with level of economic development. To capture these effects I estimate the following specification (5):

$$\begin{aligned} \log T_{ijk} = & \beta_0 + \beta_1 \log\left(\frac{Y_k}{N_k}\right) + \beta_2 \log(N_k) + \beta_3 \log(D_{jk}) + \beta_4 (P_k * D_1) + \beta_5 (P_k * D_2) \\ & + \beta_6 (P_k * D_3) + \beta_7 (P_k * D_4) + \varepsilon_{jk} \end{aligned} \quad (5)$$

where D1, D2, and D3 are dummy variables<sup>5</sup>.

Further, I consider the effect of strength of IPRs on pharmaceutical trade flows varies with market capacity variables such economic size of countries. In this regard, I introduce a dummy variables  $d_h$  and  $d_L$ .  $d_h$  takes a value one for those countries whose IP index is greater than the African mean.  $d_L$  takes a value one for those countries whose IP index is less than the African mean. Applying this definition I estimated the following specification (6):<sup>6</sup>

$$\begin{aligned} \log T_{jk} = & \beta_{0L} + \beta_{0h} + \beta_{1L} \log(d_L * (Y_k / N_k)) + \beta_{1h} \log(d_h * (Y_k / N_k)) + \beta_{2L} \log(d_L * N_k) + \\ & + \beta_{2h} \log(d_h * N_k) + \beta_{3jk} \log(D_{jk}) + \varepsilon_{jk} \end{aligned} \quad (6)$$

Equation (6) allows for the effects of intellectual protection policies on the market capacities of the importers via the intercept terms and on the effect of each market capacity variable via the slope-interaction terms.

<sup>5</sup> These dummies are defined in Table 1 and represent Upper middle income, lower middle income and lower income groups.

<sup>6</sup> These dummies are defined in Table 1 and represent Upper middle income, lower middle income and lower income groups

## **Data**

I chose the year 2006 because (1) it marks five years after China joined the WTO (2) because it marks the first half of the 12-year period starting from the date of accession in which there exists a special Transitional Safeguard Mechanism in cases where imports of products of Chinese origin cause or threaten to cause market disruption to the domestic producers of other WTO members.<sup>7</sup>

I estimate bilateral trade between China (source) and African countries (destination). This estimation covers the year 2006. The data is from various source.

The choice of pharmaceutical industry is important because the industry tend to have technologies or products with self-replicating qualities that make imitation by others less costly. Given that pharmaceutical products and processes are patented TRIPs Agreement confers minimum rights of the patent owner to prevent unauthorized persons from using the patented process and making, using, offering for sale, or importing the patented product or a product obtained directly by the patented process. IPRs are particularly relevant to such products or processes.

Data for the commodities in this sector/industry is obtained from United Nations COMTRADE data base. Specifically, the three-digit level of the Standard International Trade Classification (SITC) is used in getting the trade data. As pointed out by Bowen *et al* (1998), it is consistent to adopt the 3-digit SITC level as equivalent to the industry definitions of the International Standard Classification (ISIC).

Indicators of size and market capacities such as per capita income and population are obtained from the World Bank's world development indicators (WDI).

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<sup>7</sup> China has enormously benefitted from this phase in terms of penetrating the world markets. This is the phase where China's imports enjoyed some kind of concession because prohibitions, quantitative restrictions or other measures originally slapped against her imports were phased out in accordance with WTO Agreement and in accordance with the protocol of Accession.

Finally, the IPR index is based on Ginarte and Park (1995, 2000 and 2005) index which incorporates five aspects of patent laws for all countries around the world; the extent of coverage, membership in international patent agreements, duration of protection, provision for loss of protection, and enforcement mechanisms. The index is often scored from 0 to 5, with higher values indicating stronger patent protection.

## **Results**

In the base gravity model, distance appears to have not only the wrong sign but also turns out to be insignificant. This is unlike most gravity estimations. One explanation could be that there is very little variation of distance within the Africa. The distance between China and any country on the continent appears to be the same. So, this variable could as well included in the intercept.

Indicators of importing countries market capacity variables such per capita income and population highly significant. These variables also indicate the demand pull that exists for Chinese products. since the focus of the paper is IP, I hypothesized that trade in pharmaceutical varies with IP (patents). In other words, IP as standalone increases trade. This hypothesis sought country-specific effects of IP protection on trade in pharmaceuticals. Overall, it turns IP is insignificant even though the direction of effect on trade (positive) appears to suggest some market expansion effect.

Further, the paper investigates whether Africa's IPRs affect Chinese pharmaceuticals, especially when the relative development levels of these countries are taken into account. World Bank classifies countries into four income level categories – low, lower middle, upper middle and high incomes. With exception of Equatorial Guinea, none of the Africa countries falls into the high income group. However there is variation these countries too. Following the World Bank's country classification, I grouped African countries into one or the other of low, lower middle and upper middle categories. Each of this development dummy is interacted with IPRs to demonstrate sensitivity of Chinese pharmaceutical industry exports to the strength of national IP when countries are grouped by level of development. The results in Table 1 shows that level of development does not interact with IPRs to meaningfully impact on pharmaceutical trade. Even though insignificant the direction of influence suggest that there is some market power effect within countries in the upper middle income and market expansion effect within countries in the

lower middle and low incomes. This market expansion appear to be greater for low income countries than lower middle income groups.

In examining the relative strength of Africa's IP the results show that there is a positive shift effect of IP protection on pharmaceutical exports. That is, the estimate of this trade is larger for countries with relatively strong IP protection (114.21) than for countries with weak IP protection (96.70). Thus, the magnitudes of these shifts are not only consistent with predictions, but also are statistically different. A conclusion that can be drawn from this result is that African countries' IP protection policies increases trade in pharmaceuticals by enhancing her overall market access capacity.

Finally, in assessing hypothesis 4 the results show that African countries' IP protection tend to increase their market capacities. Specifically, the slope estimates for countries with stronger IP protection tend to be smaller than the corresponding estimates for countries with weak protection. This finding is contrary to expectation. For example, per capita GDP has an elasticity (0.69) that is larger for countries with weak protection than for countries with relatively stronger IP protection (0.26). However, population has an elasticity that is larger for countries with stronger IP protection policies (1.39) than for countries with weak policies (1.21). However, the elasticity of trade with respect to per capita is insignificant for countries with relatively strong protection. A conclusion that can be made from the empirical results of this paper is that African countries' IP protection policies increase pharmaceutical trade by affecting their market capacities.

Table 1: Trade, importer market capacity and intellectual protection - Pharmaceutical industry

Dependent Variable: Log Trade values pharmaceuticals (\$)

Independent Variables	Specification		
	4	5	6
GDP per capita	0.48** (0.21)	0.72* (0.39)	
Population	1.20*** (0.17)	1.17*** (0.18)	
Distance	0.64 (1.51)	0.56 (1.59)	0.78 (1.65)
IP	0.23 (0.94)		
IP*UMC		-0.09 (0.49)	
IP*LMC		0.11 (0.51)	
IP*LIC		0.25 (0.45)	
LowerIP			96.70*** (22.76)
RHIP			114.21*** (37.41)
LowerIP*GDP per capita			0.69* (0.40)
LowerIP*Pop.			1.21*** (0.21)
RHIP*GDP per capita			0.26 (0.22)
RHIP*Pop.			1.39*** (0.20)
Constant	-15.15 (15.12)	-15.75 (15.76)	
<i>R</i> -squared	0.61	0.61	0.99
<i>N</i>	47	47	47

**Notes:** Robust standard errors are in parentheses. \*\*\* Significant at 1% level, \*\*Significant at 5% level, \* Significant at 10% level. All variables are expressed in logs except dummy variables. IP = intellectual protection (ranges from 0 to 5). UMC = 1 if a country categorized as upper middle income and 0 otherwise; LMC = 1 if country categorized as lower middle income and 0 otherwise, LIC = 1 if country is categorized as low income and 0 otherwise. LowerIP = 1 if an importer country IP is less than mean all African IP index. RHIP = 1 if an importer country IP is greater mean all African IP index. UMC, LMC and LIC replace dummies D1, D2 and D3 in equation (2).

## **Conclusion**

Indeed when the variation of African countries IP strength is taken into account there appear to be a positive shift effect of IP protection on pharmaceutical exports. That is, the estimate of this trade is larger for countries with relatively strong IP protection (114.21) than for countries with weak IP protection (96.70). Finally, Africa's IP presents mixed results in enhancing market capacity but the direction of influence indicate market expansion ( increase) Chinese pharmaceutical exports. This result may have implications, especially in the perspective of South-South trade which is often overlooked.

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