Does IPR protection affect high growth entrepreneurship? A cross-country empirical examination

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Abstract

The objective of this paper is to determine whether a country's level of intellectual property rights (IPR) protection influences high expectation entrepreneurship. Based on the Baumol's assumption that entrepreneurs, as an allocatable resource, can be reallocated from one domain to another by changing the relative profit prospects offered by the available economic activity alternative, we examine whether and how IPR protection affects the local entrepreneurship prevalence. Using a new entrepreneurship dataset from the Global Entrepreneurship Monitor (GEM), we undertake cross-country empirical investigation to answer the following questions: (i) does IPR protection affect the expectations of high growth entrepreneurship level; and (ii) whether a change in IPR protection affects developing and developed countries differently. We find few interesting results in the differences of IPR impact on developed versus developing countries. Further examination is required.

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1 Introduction

How does intellectual property rights (IPR) protection affect local economies? Given the impending deadline for the implementation of the Trade-Related Aspects of Intellectual Property Rights (TRIPS) by the year 2016, scrutiny of the effects of this global IPR protection system is required. This harmonized minimum IPR protection standard, in addition to the various World Trade Organization (WTO) agreements, narrows the policy space for governments in developing countries to build and develop their own capacities for innovation along similar lines of developed countries. We undertake to study the impact of IPR protection on local entrepreneurial activities to improve our understanding of how this policy will affect developing countries and their innovative activities We attempt to show that TRIPS is an institutional factor that impacts local entrepreneurial activities, according to their levels of economic development.

Examining how IPR system affects entrepreneurial activities is not a new research question. Direct empirical relationship between IPR protection and entrepreneurial activity has not been established particularly due to the difficulty of attributing the exploitation of entrepreneurial activities to the strengthened property rights (Shane, 2003). Using a new entrepreneurship dataset from the Global Entrepreneurship Monitor (GEM), we run cross-country empirical investigation to answer the following questions: i) does IPR protection affect local entrepreneurial activities; and ii) whether this impact varies across levels of economic development. Our study is timely because the cutoff date for TRIPS implmentation allows us to carry out a natural experiment to examine the impact of IPR protection, especially on developing and least developed countries (LDCs).

This paper is divided into 5 parts. In the following section we set the foundation for our investigation, briefly recalling the objective of TRIPS and its economic arguments and expounding on the theories of Baumol on the allocatability of entrepreneurs across economic activities. The third section provides information on the data collected for the empirical study and discusses specific aspects of the data. The penultimate section discloses, analyses and discusses the results of the empirical study. And finally the last section concludes with a brief summary of the paper.

2 TRIPS and its impact on entrepreneurship

In this section we build our case for pursuing our research question. First, we provide a brief outline of the TRIPS agreement as well as the current discussion on global IPR protection. We then utilize Baumol's proposition that entrepreneurs can be allocated across economic activities by changing the reward structure to show how TRIPS can impact countries of differing

levels of economic development. Finally, we set forth the propositions to carry out our empirical investigation.

2.1 TRIPS: global IPR protection regime

TRIPS was part of the Uruguay Round of negotiations' single package agreement signed in 1994 by members of the then-GATT (General Agreement on Tariffs and Trade) organization.[1] It is an internationally binding agreement that sets out minimum standards for the granting and protection of IPR in areas such as copyrights, trademarks and patents. The agreement contains certain margin of flexibility for member countries to implement its provisions smoothly in line with their own legal system and practice (TRIPS, Art. 1.1) and according to certain transitional arrangements (TRIPS, Art. 65). In general member countries are obliged to implement the agreement in its entirety one year after the date of entry into force of WTO agreements. However, developing countries are allocated an additional four years[2] to implement them, and in countries which has to introduce product patent protection in technological areas not in existence before, such as pharmaceutical products, an additional five years is applicable. During the Doha Ministerial, WTO extended this transitional arrangement for least-developed countries until 2013.[3] Unlike the international agreements administered by the World Intellectual Property Organization (WIPO)[4], TRIPS agreement is enforceable through the WTO's effective dispute settlement body (DSB). The most recent case between developed and developing countries to be brought to the DSB is the United States complaint against China's deficient IPR protection regime.

Global IPR protection is a highly controversial matter. For one, it has not been clearly established whether IPR has played a crucial role in economic development, even in countries with long traditions of IPR protection (Granstrand, 1999). Rather, historical examinations of economic growth in those countries show that IPR protection were strengthened and weakened according to national interests and needs (Khan, 2002; Granstrand, 1999).

Secondly, developing countries tend to be technologically dependent (see the comparison table of patent application fillings between residents and non-residents in LDCs). Global IPR system could exacerbate fundamental asymmetry between countries with few or no innovative capacities and those innovating at the technological frontier. Adoption of stronger IPR pro-

[1] The Marrakesh agreement stipulated that the GATT organization would be replaced by the World Trade Organization, and that all the agreements negotiated during the Uruguay Round of negotiations would be administered by the WTO.

[2] Except for obligations regarding the WTO's national- and most-favored nation treatments, in which case the initial one year deadline is applicable.

[3] Compliance with pharmaceutical patenting was also extended to 2016.

[4] WIPO succeeded the United International Bureaux for the Protection of Intellectual Property (BIRPI).

tection in developing countries would make it more costly and difficult to access knowledge in vital areas such as health and education sectors, and/or to catch-up with the world's technological frontier as countries like Hong Kong, Singapore, South Korea and Taiwan have done. These countries have managed to catch-up with the world's technological frontier by adopting a "soft" IPR regime, which enabled them to adopt, adapt and assimilate technologies from developed nations (Kumar, 2002).

Year	Non-resident patent application	Resident patent application
1995	172	73
1996	195 116	27
1997	261 141	6
1998	449 616	70
1999	570 676	18
2000	978 409	18
2001	1 352 635	23
2002	1 753 699	6

Table 1: Patent application by residents and non-residents in LDC (Source: WIPO, 2006)

Finally, it is not clear if extending IPR protection globally would increases society's welfare. In their theoretical analysis of examining the welfare implications of global IPR protection, Deardoff (1992), Grossman and Lai (2002), and Chin and Grossman (1990) argue that the gains from adopting global IPR regime would accrue only to inventing countries at the expense of the world. Stylized facts also raise questions as to whether the implementation of IPR regime globally would be beneficial. Developed countries, or countries innovating at the technological frontier, would gain from extended IPR protection in form of increased market for their innovations. However, the benefit for developing countries would vary according to several factors, notably their innovation capacity framework. The World Bank (2001) point out that: (1) LDCs usually do not have resources to devote to innovative activity and thus existence of any IPR regime is unlikely to benefit local innovation; (2) developing countries with some technological capabilities tend engage in adaptive innovation through reverse engineering; and (3) developing countries with more sophisticated technology capabilities gravitate toward higher IPR protection levels. Thus, while historical evidence show that the existence of IPR regime tended to reflect the nation's current national innovative capacities and capabilities will no longer hold true under the TRIPS regime and the effects of this regime is uncler. Other factors such as openness, market size, and macroeconomic policies also play a crucial role in determining how IPR affects the countries in

question (Correa, 2000; Bank, 2001). Furthermore it seems that IPR only enhances countries' welfare for some sectors, some innovations and under certain circumstances (Ferrantino, 1993; Helpman, 1993; Lall, 2003; Falvey et al., 2006).

Nevertheless, some gains are attributable to global IPR protection for countries. Inventing countries would be able to recoup their investments in research and development, and welfare increasing innovative activities could be stimulated. The table below outlines the static and dynamic costs and benefits for a given country resulting from stronger IPR system.[5]

Stronger IPR	Static	Dynamic
Cost	Knowledge purchased at monopoly price (above marginal cost of production), possible welfare loss	Barriers to access modifiable technologies increase
Benefits	Knowledge sold at monopoly price allows firms to recoup their R&D investments and capture economic rents	Innovative activities become more profitable, attracting more competitors in this domain.

Table 2: Cost and benefits of a stronger patent system

2.2 Effects of IPR on entrepreneurship

Recent literatures on the impact of IPR protection on developing countries have provided some insights on how it affects trade (Fink and Braga, 1999; Maskus and Penubarti, 1995), foreign direct investment (Smarzynska Javorcik, 2004; Lee and Mansfield, 1996; Mansfield, 1994), and economic growth (Thompson and Rushing, 1999; Rapp and Rozek, 1990), to name a few. We have undertaken to pursue research work in this area by shifting the focus of IPR study from the macroeconomic variable such as trade and FDI to microeconomic one, in particular the entrepreneurial firm. Our rationale for concentrating on entrepreneurial firms is because: i) entrepreneurs tend to spot changes in economic environment quickly enabling them to respond to these changes swiftly; and ii) as Shane (2003) states, "[a]lmost every explanation for business and, for that matter, capitalism itself, relies on entrepreneurship as a cornerstone."

[5] The cost of building a legal system is not considered in Table 1, which can be prohibitively high for countries where such system does not exist yet, or where the legal system functions ineffectively.

The link between IPR protection and entrepreneurship is a clear one, albeit not directly proven (Shane, 2003). IPR protection provides a mechanism for entrepreneurs to appropriate her returns to innovation. However the effectiveness of IPR protection and the extent to which the innovator can fully capture the returns varies according to the type of protection used and the nature of innovation (Teece, 1986). Once an innovator creates a novel product or service, she can either produce and commercialize it herself via firm formation á la Schumpeter (1942), or contract this innovation out to another firm with the necessary complementary assets to produce it either through licensing or a joint venture. For this research study, we focus on the link between IPR protection and firm formation. Shane (2001) using patent data assigned to Massachusetts Institute of Technology between 1980 and 1996, finds that the effectiveness of patents increased the probability that the new technology will be exploited through firm formation. Baumol's theory on entrepreneurs as an allocatable resource provides a suitable theoretical foundation explains this link better.

Baumol (1993) argues persuasively that entrepreneurs can be allocated across economic activities by changing the structure of rewards of those activities.[6] He points out that entrepreneurs exist in any economy and they tend to operate in domains that promise greatest monetary returns, although not necessarily in the innovative domain. He states that, "there are a variety of roles among which entrepreneur's effort can be reallocated; and some of those roles do not follow the constructive and innovative script that is conventionally attributed to them" (2002). Thus the areas in which the entrepreneurs function given the socio-economic system depends on the economy's payoff structure. Baumol further argues that entrepreneurs, when faced with a given set of alternative economic activities, can be reallocated from one activity to another by a change in the relative profit prospect from undertaking that particular activity *ceteris paribus*. And given the inherent characteristics of the entrepreneur, when the reward structure in an economy changes either due to political, institutional or market reasons, entrepreneurs will be the first few economic agents who would identify the opportunities from these changes and respond to them. As such, studying entrepreneurs' reaction to strengthening of IPR protection would likely suggest the direct effect of IPR protection on the economy.

Historical evidences from the United States give support Baumol's theory. Among the recent IPR changes in the United States include (cf. Sampat (2001)): i) widening patentability fields to include living organisms, software and business methods; ii) implementation of the Bayh-Dole Act which enables federally-funded research work to apply for patents; iii) court decisions

[6] We refer to *entrepreneurs* here generically, i.e. economic agents that can identify, evaluate and exploit profit opportunities in the economy through arbitrage, speculation or innovation.

in the 1980s and 1990s in favor of widening the scope of patents; and iv) the importance of patents to new innovative firms to be eligible on the NASDAQ. Technological advances, effective knowledge infrastructure and these IPR-friendly institutional changes have prompted an influx of entrepreneurs towards these innovative activities. For example, Shane (2004) examining the effect of Bayh-Dole Act on university patenting in the United States confirms that the introduction of the Act provided incentives for universities to increase patenting, especially in fields where "licensing provides an effective mechanism for acquiring new technical knowledge".

We apply Baumol's theory to link the relationship between entrepreneurship and IPR protection. We argue that strengthening IPR protection in a given country would change the payoff structure of the economy by increasing potential returns from undertaking innovative activities. This change in the payoff structure relative to other economic activities would then induce the allocation of entrepreneurs accross different economic domains, leading to a concentration of entrepreneurs in the innovation and technological areas.

2.3 Research questions

Using Baumol's theory, we attempt to establish a relationship IPR protection and entrepeneurship and examine whether this relationship differs across different levels of economic development, given the necessary preconditions. These necessary preconditions include sustainable national innovative capacity framework, stable macroeconomic conditions, openness and effective legal infrastructure. National innovative capacity, which includes education system, ensures that the entrepeneurs would have the necessary skills and infrastructure to carry out innovative activities (Lall, 2003). Stable macroeconomic conditions and effective legal infrastructure provides the environment for entrepreneurs to operate their firms effectively. And finally openness enables exchanges of new knowledge, allowing the entrepeneurs to learn and thus improve existing technologies.

IPR protection provides an incentive for innovative activities that encourages innovation, which can be commercialized through firm formation. The implementation of the TRIPS agreement introduces and strengthen IPR protection level in a country and makes legal innovative activities attractive and illegal imitative activities such as piracy more costly to undertake for economic actors. Theoretically, this would encourage more entrepeneurs in innovative activities. Put in another way, stronger IPR protection should encourage the presence of higher levels of entrepreneurial opportunities and thus facilitate the undertaking of more entrepreneurial activities.

Proposition 1 *Stronger IPR protection encourages more entrepreneurial activities.*

Most of the analyses examining the effects of IPR protection on countries differentiate between high and low development level countries, and we follow this correctly identified assumption in our research as well. Several studies find different effects of IPR protection for different development levels. Falvey et al. (2006) conducted an empirical analysis of the link between IPR and economic growth and finds that low and high income countries are positively and significantly affected by IPR protection but not for middle income countries. They conclude that middle income countries "may have offsetting losses from reduced scope for imitation." This suggests that there is a U-shaped relationship between IPR protection and economic development. Interestingly, Smith (1999) in her examination US exports to developing countries find that the strength of IPR protection had a stronger impact on exports to developing countries with strong absorptive capacity. Thus, the impact of IPR protection on entrepeneurship would differ according to their levels of economic development. This leads us to our second testable hypothesis:

Proposition 2 *The effect of IPR protection on entrepreneurial activities differs according to income levels*

In the following section, we explain our methodology for carrying out our test of the hypotheses.

3 Methodology

Outside the confines of developed economies, the effect of IPR protection on creating entrepreneurial opportunities and encouraging the exploitations of these opportunities is not clear. This is due to difficulty in finding a proxy to capture this activity. Firstly not all developing countries have had IPR protection or have adequately enforced IPR until the recent TRIPS agreement. Thus the usual measure of entrepreneurial activity via firm formation, along the lines of Shane (2001) of using patent data, is not feasible. Secondly cross-country comparison of entrepreneurship activities has been made difficult due to differing definitions of entrepreneurship and the method of collection. This is why we resort to using high expectation entrepreneurship data and refrain from exploiting the patent data.

3.1 Data

We examine high expectation entrepreneurship data collected from GEM consortium for 55 countries over the time period of 2002 – 2006. High expectation entrepreneurship refers to the subset of entrepreneurs who expect their businesses to employ at least 20 employees over the next 5 years. This measure is preferable over the patent data for two reasons: (i) it allows for

cross-country comparison of entrepreneurial activities across various income levels and (ii) it does not depend on the enforcement of IPR protection in order to capture the exploitation of opportunities via firm formation.

3.1.1 Dependent variable

Schumpeter's entrepreneur is both an innovator and part of the engine of economic growth. It has been difficult to adequately capture a measure of entrepreneurship that proxies Schumpeter's entrepreneur. We choose to focus on high expectation entrepreneurship variable as our dependent variable. This variable proxies the prevalence of high growth entrepreneurship, thus it captures the kind of entrepreneurial activity that generates employment crucial for economic development. Autio (2005) examines this measure in detail and argues that high expectation entrepreneurial activity accounted for "the bulk of expected new jobs by startups and newly formed businesses" (p. 8). He further concludes that policies designed to encourage knowledge transfer from universities or R&D firms to spin-offs could have a positive impact on high expectation entrepreneurship (p.11).

There is another variable collected by the GEM consortium that may reflect the kind of entrepreneurial activities that we would like to capture better. This variable is referred to as the *high growth potential entrepreneurship* which are defined as new ventures that expect to have: i) high growth intentions (proxied by plan to employ more at least 20 employees in the next five years); ii) innovativeness in product or service (captured by looking at expected market expansion impact); iii) international distinctiveness (measured by percentage of customers living abroad); and iv) employs new technological base in its production (technology cannot be widely avaible more than a year before). However, there are several empirical drawbacks to using this data, particularly in regards to its reliability and consistency of capturing this variable over the years that we are interested in.

We collect annual aggregated data from the Global Entrepreneurship Monitor on various measure of entrepreneurship (please refer to appendix for the list and their definitions). The database collection began in 1998, but we choose the time period of 2002 to 2006 based on the availability of widest possible range of country income levels in the database. The data covers approximately 55 countries but not all data is available for all countries in the time frame selected for this study.

The GEM survey asks individuals if they are in the process of establishing a new business, referred to as nascent entrepreneurship, or owning/managing a baby business, termed as baby business. Of the individuals who have responded affirmatively to either one of these entrepreneurship activities, they are further asked if they expect their business to employ at least 20 employees in the next 5 years. This is the definition of high expectation entrepreneurship.

3.1.2 Predictor variable

The other variable of interest, besides the high expectation growth entrepreneurship variable, is the intellectual property rights (IPR) protection variable. There have been two approaches in quantifying the strength of IPR protection: legislation- and survey-based approaches, both approaches have been criticized because of their respective collection and quantification methods. The legislation-based approach, exemplified by Ginarte and Park (1997), has been criticized for overestimating the level of protection accorded because it had only taken into consideration the enforcement element of IPR protection. On the other hand the survey-based approach, typified by the Yale survey from Levin et al. (1987) and Lee and Mansfield (1996), is considered subjective, perhaps reflecting some "ideological tendencies" of those who built the survey and those who answered it (Kauffman et al., 2004).

We use the IPR enforcement index collected by the World Economic Forum (WEF) as a measure of IPR strength because of its coverage of countries over the time period of investigation. This index is built based on answers from local professionals and is bi-annually published in the WEF annual Global Competitiveness Report. Furthermore, this index captures the enforcement component of IPR protection which reflects the current law perspectives and practices on its protection. The survey asked whether, "[I]ntellectual property protection in your country is: (1=weak or non-existent, 7=equal to the world's most stringent)." Responses from the experts are tabulated and averaged for each country in question.

3.2 Control variables

We include factors other than IPR protection that have been found to be a significant factor in the determination of entrepreneurship activities. By doing so, we control for factors that could influence IPR protection and ensure that the variable that we am concerned with, IPR protection, influences the high expectation entrepreneurship beyond what previous researchers have found. The variables we employ here are to control for macroeconomic determinants of entrepreneurship. All of the control variables are from the World Bank's World Development Indicator 2007. A list of their definition can be found in the appendix.

Entrepreneurship rates have been found to be higher during economic boom periods and decline during economic recessions. We chose the variable GDP growth rate to proxy for economic growth of the economy.

High inflation rate tend to indicate times of economic instability, wherein which it has been found that entrepreneurship activity decreases. We use the inflation rate as measured by the GDP deflator of a country to control for times of economic instability.

Highfield and Smiley (1987) argue that low unemployment rate posi-

tively influence firm formation. However, they stipulate that under "opportunistic" competition, high unemployment rate positively influence firm formation because the cost of attracting and hiring qualified workers would be lower.

It is more difficult to open a new firm when the cost of borrowing money is high. Audretsch and Acs (1994) in their study on the relationship between new firm startups and macroeconomic fluctuations, use the average three-month interest rate paid on the U.S. Treasury Bills. However, given that we do not have access to all of the government bond rates for each country in our study, we use real interest rate as a proxy to measure the cost of capital.

3.3 Descriptive statistics

We have 55 countries in our sample, both developed and developing countries between 2002 and 2006. However, we end up with an unbalanced panel dataset due to the missing data in some years. We also had to drop our observation on Chinese Taipei due to the lack of data reported by the World Bank on the macroeconomic variables.

Table 1 summarizes the variables in this study. Note that the mean for high expectation entrepreneurship is approximately 1 percent. This indicates that on average only 1 percent of the total working population in the countries studied are engaging in high expectation type of entrepreneurship. The highest high expectation entrepreneurship percentage of the total working population is found in Chile with 4.5 percent in 2002, China with 3.8 and 3.1 percent in 2002 and 2006 respectively, and Colombia with 3.4 percent in 2006. Further examination of this entrepreneurship variable for developing countries shows that the mean of high expectation entrepreneurship rate is 1.3 percent of the population, slightly higher than for the whole sample. Just for comparison, range of high expectation entrepreneurship variable for the United States is from 1.04 to 2.18 percent of the population.

Variable	Obs	Mean	Std. Dev.	Min	Max
High expectation entrepreneurship	174	1.021	0.835	0.000	4.530
Economic growth rate	269	3.959	3.238	-11.032	17.855
Real interest rate	186	5.824	9.617	-9.710	84.050
Inflation rate	269	4.937	6.213	-6.347	44.134
Unemployment rate	153	8.477	5.017	1.500	30.700
IPR	271	4.499	1.255	2.200	6.600

Table 3: Descriptive statistics

Table 2 is a correlation table between the important variables we collected for this study. As the table shows, the highest correlation between any two independent variables is -0.54 between IPR proxy and the inflation

rate. While the table shows that there is no problem of multicollinearity, or high correlation problem, it does suggest that the factors that we are using in our investigation are not completely independent of one another.

Simple Pearson pairwise correlation of high expectation entrepreneurship variable and economic growth proxy measured by GDP growth rate show a positive and significant correlation, reaffirming Autio's earlier argument that this variable may positively influence economic growth. Notice that the Pearson pairwise correlation between the high expectation entrepreneurship variable and the IPR protection variable is negative and significant; however the variable "IPR*dev" which is found by interacting the IPR protection variable with the dummy for developing countries (dev), the correlation is positive and significant. This indicates that there is different effect when we consider the sample as a whole and when we consider developing countries only.

	1	2	3	4	5	6	7
1. High expectation entrepreneurship	1						
2. Growth rate	0.1917*	1					
3. Real interest rate	0.0257	-0.2896*	1				
4. Inflation rate	0.3049*	0.0409	0.0465	1			
5. Unemployment rate	-0.1306	-0.1414*	0.2538*	0.3324*	1		
6. IPR	-0.2606*	-0.3248*	-0.1042	-0.5391*	-0.3899*	1	
7. IPR* dev	0.2096*	0.3253*	0.1799*	0.3452*	0.4176*	-0.6397*	1

Table 4: Correlation table

4 Analysis

The purpose of this study is to examine whether a country's level of IPR protection influences local entrepreneurial activity across countries of differing economic development activities. We test the two following hypotheses: i) *stronger IPR protection encourages more entrepreneurial activities;* and ii) *the effect of IPR protection on entrepreneurial activities differs according to income levels.*

4.1 Regression method

We collect data for 55 countries over the period 2002 and 2006 but are left with an unbalanced panel set of approximately 134 observations. We test for heteroskedasticity and reject the null hypothesis that there is no cross-section heteroskedasticity in our panel set. Thus, we correct for the groupwise heteroskedasticity and the correlation of the error term over time by running normal Ordinary Least Square (OLS) regression clustering by

country with robust standard errors. We also run Generalized Least Square (GLS) regression, correcting for panel heteroskedasticity. We report and analyze the results in the following subsections. Given our panel heteroskedasticity assumption, the GLS estimation is more efficient and preferred over the OLS with cluster by country estimation. We report both OLS with cluster and the GLS regression for completeness.[7] The OLS with cluster regression although not efficient in the case of panel heteroskedasticity is reported because its estimates will be correct in either case of with or without panel heteroskedasticity.

4.2 Results

4.2.1 Proposition 1

Our first hypothesis is that stronger IPR protection encourages more entrepreneurial activities. We run the test using the following model:

$$y_{it} = \alpha + \beta_{it} x_{it} + \varepsilon_{it}$$

where x_{it} represent all the explanatory variables, including the IPR measure. Table 4 reports our findings from a normal OLS regression, clustering robust standard errors by countries. The F-statistics test finds that all the coefficients in the models are significant.[8] The R-square values improve the as we move from the baseline model to Model 4.[9]

Model 1 shows that the coefficients of GDP growth rate and inflation rate are positively related to the entrepreneurship variable, and are statistically significant from zero. Interestingly the unemployment rate is negatively related to the dependent variable, and statistically significant from zero. Model 2 adds the intellectual property rights variable. As in Model 1, the coefficients GDP growth rate and inflation rate are positively related to the entrepreneurship variable, and statically significant from zero. However, the IPR variable is negatively related to the entrepreneurship variable but statistically significant from zero.

4.2.2 Proposition 2

We test the second hypothesis, i.e. whether the impact of IPR protection on entrepreneurship differs according to levels of economic development.

[7] The OLS with cluster regression although not efficient in the case of panel heteroskedasticity is reported because its estimates will be correct in either case of with or without panel heteroskedasticity.

[8] The F statistics tests that the coefficients on the regressors listed in the table are all jointly zero.

[9] The R^2 is usually improves when one adds more variables, and so a more adequate measure to capture whether the variables added improves the model is the adjusted R^2. However, we do not report the adjusted R^2 because it is not available.

We create a dummy variable called *dev*, which differentiates countries that are developed from those who are developing following the World Bank classifications. The dummy takes a value of 1 if the country in question is a developing or least developed country and 0 if otherwise. The regressions for this hypothesis is shown in both Tables 5 and 6 as Models 3 and 4.

Models 3 and 4 are replicas of models 1 and 2 but with the interaction terms of developing countries. We test:

$$y_{it} = \alpha + \beta_{it} x_{it} + \delta_{it} x_{it} * dev + \varepsilon_{it}$$

where "dev" is a dummy variable that takes on the value 1 if the country is a developing nation and 0 otherwise. All the coefficients for the whole sample in Model 3 are insignificant except for unemployment rate, which is negatively related to the entrepreneurship variable and statistically significant from zero. In Model 4, the unemployment rate is negative and statistically significant from zero for the whole sample. The growth rate interaction and the unemployment interaction terms are positive and statistically significant from zero. IPR variable, for developing countries, is negative and statistically significant from zero.

Checking for robustness, we test whether the coefficients between the two samples (whole sample and developing countries' sample) are the same and reject the null hypothesis that they are. This implies that IPR level and strength affects countries with different income levels differently.

	Model 1	Model 2	Model 3	Model 4
GDP growth rate	0.0701***	0.0620**	0.0605	0.0168
	(0.023)	(0.026)	(0.051)	(0.053)
Real interest rate	-0.00179	-0.00259	0.0237	0.0277
	(0.011)	(0.011)	(0.019)	(0.018)
Inflation rate	0.0609***	0.0544***	0.0398	0.032
	(0.014)	(0.018)	(0.04)	(0.042)
Unemployment rate	-0.0363***	-0.0382***	-0.0721*	-0.111**
	(0.0091)	(0.01)	(0.041)	(0.046)
IPR		-0.0473		0.0553
		(0.095)		(0.11)
*GDP growth rate*dev*			0.0785	0.168**
			(0.061)	(0.068)
*Real interest rate*dev*			-0.00105	-0.000862
			(0.00077)	(0.00055)
*Inflation rate*dev*			-0.081	-0.0592
			(0.064)	(0.068)
*Unemployment rate*dev*			0.0342	0.0939*
			(0.033)	(0.047)
*IPR *dev*				-0.253**
				(0.12)
Constant	0.724***	1.025	0.839**	0.913
	(0.14)	(0.62)	(0.39)	(0.85)
N	86	85	56	55
R-squared	0.24	0.24	0.42	0.47

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: OLS regression with heteroskedastic panel

	Model 1	Model 2	Model 3	Model 4
GDP growth rate	0.0740***	0.0676***	0.0762***	0.0445***
	(0.0092)	(0.014)	(0.018)	(.017)
Real interest rate	0.00521	0.000795	0.0198*	0.0200*
	(0.0053)	(0.0074)	(0.011)	(0.011)
Inflation rate	0.0662***	0.0616***	0.0396***	0.0333**
	(0.0061)	(0.0091)	(0.014)	(0.014)
Unemployment rate	-0.0379***	-0.0349***	-0.0709***	-0.0940***
	(0.0037)	(0.0055)	(0.012)	(0.012)
IPR		-0.0197		0.0874*
		(0.038)		(0.051)
*GDP growth rate*dev*			0.0592*	0.135***
			(0.032)	(0.035)
*Real interest rate*dev*			-0.000833***	-0.000998**
			(0.00029)	(0.00042)
*Inflation rate*dev*			-0.0577*	-0.0304
			(0.03)	(0.033)
*Unemployment rate*dev*			0.0301**	0.0842***
			(0.012)	(0.017)
*IPR *dev*				-0.259***
				(0.059)
Constant	0.633***	0.751***	0.766***	0.557**
	(0.06)	(0.27)	(0.099)	(0.27)
N	86	85	56	55
ID	41	40	36	35
Log-likelihood	-35.42894	-37.44926	-11.39054	-10.21097

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: GLS regression with heteroskedastic panel

4.2.3 Discussion of the results

The results from our regressions are interesting but preliminary. The results show that for developed countries, increases in the IPR regime positively affect the formation of high growth expectation entrepreneurship but negatively for the developing countries. This suggests that for developed countries marginal strengthening of IPR protection level facilitates more entrepreneurial activities, partially confirming our application of Baumol's theory. By strengthening IPR protection, innovative activities become more rewarding and there is a surge in this particular type of entrepreneurship. However, based on the evidences that we currently have, we cannot confirm whether there is a shift of entrepreneurs from one domain to another.

As for the developing countries, this marginal increase in IPR protection leads to decrease in the current entrepreneurial activities, contradicting Baumol's theory. There are two possible explanations for this interesting

result. The first possible explanation is that there is no reallocation process in developing countries particularly because there is no scope for this process to take place. For example, it could be the case that the national innovative framework has been insufficient to facilitate the types of entrepreneurial activities that are IPR-sensitive. Even if the national innovative framework is conducive to IPR-sensitive entrepreneurial activities, it is likely that these type of entrepreneurs cannot be spontaneously generated nor can shift from one entrepreneurial acitivity to another take place instantaneouly. Thus a longer time period is required to carefully study this reallocation effect. A second possible explanation has to do with the legality of the entrepreneurial activity. Perhaps what we are witnessing with the decrease in entrepreneurial activity given the strengthening of IPR protection is an exit of entrepreneurial firms due to the "illegality" of their activity. Stated in a different way, strengthening IPR protection increases the cost of undertaken this "illegal" activity and thus firms would have to exit or prefer not to enter that particular activity. Consider India's case as an example. Prior to TRIPS, India allowed process patenting but not product patenting. This enabled Indian generic producers to copy a drug and re-engineer it using a different processes. Post-TRIPS, this type of innovative activity is now "illegal" and the producers would have to stop their infringement of the product patent. If the second explanation is the case, then this interesting result for developing countries would also partially confirm Baumol's theory. Again, we are not able to deduce that there is a reallocation effect due to the limitations of the data that we have gathered.

Our empirical model suffers from data problems. In particular, due to the methodology and collection of the dependent variable, we are not privy to know whether the entrepreneurial firms are IPR-sensitive or not. This brings several drawbacks to our investigation. Arguably, the entrepreneurial firms in developed countries are IPR-sensitive and as such would respond positively to the strengthened IPR system. However, the same cannot be said for entrepreneurial firms captured by the data for developing countries. As mentioned earlier, we could've circumvented this data problem by using the high growth potential entrepreneurship variable, which seems to track innovativeness of the firm. However, because we cannot confirm the reliability and consistency of this variable, we choose not to use it.

Further research investigation is needed in this subject matter. It would be useful to have a longer time period to properly assess the allocation effect of entrepreneurs in an economy. Furthermore, capturing the sectors in which these entrepreneurs participate would allow us to better assess the applicability of Baumol's theory in practice.

5 Conclusion

Our examination of the impact of IPR protection on high expectation entrepreneurship yields interesting results. High expectation entrepreneurship responds positively to IPR protection in developed countries but negatively in developing countries. For developed countries the result partially concurs with Baumol's theory. An increase in IPR protection makes IPR-sensitive activities more attractive as these activities now yield higher payoffs in comparison to other activities. While the Baumol's theory may partially apply in developed countries, our result shows the contrary for developing countries. The negative relationship suggest that strengthening IPR protection is costly for their local high expectation entrepreneurs. As we have discussed in our previous section, two possible explanations can justify this interesting results. For one, developing countries may not have adequate supply of entrepreneurs who can readily participate in IPR-sensitive activities. Thus, the problem for developing countries can be attributed to problem of production rather than problem of allocation of entrepreneurship. Secondly, it is possible that the types of entrepreneurial activities captured by high expectation entrepreneurship variable may have been "legal" prior to TRIPS and "illegal" post-TRIPS. Therefore an exit of high expectation entrepreneurs is likely given the costliness of participating in this "illegal" activity.

Our research sheds adds to the discussion of how TRIPS impact developing countries. Given our preliminary research finding, TRIPS may not be beneficial for developing countries. However this may reflect certain supply-side constraints, such as human capital, that responds negatively to this institutional change. It is clear that TRIPS is not a magical solution to entrepreneurial, R&D and innovation deficit in developing countries. Sufficient and sustainable national innovative capacity framework as well as other institutional framework should be in place to support the developmental growth of the economy. Our research sheds light on the importance of examining strategic complementarities between various institutional changes and processes. For example, studying the evolution of IPR regime and the transformation of education system would perhaps generate a better view of how these institutional changes affect economic activities. Milgrom and Roberts (1990) underline the importance of mutual complementarities of institutional changes that should be adopted together to enhance the positive impact that these changes would bring to the economy. There is, thus, potential for systemic transformation that results entirely from the positive feedback effects that each institutional change has on the other changes. When properly managed, such strategic complementarities among institutions can account for the emergence of a persistent pattern of change.

However, further study should be undertaken to better assess the situation.

A Appendix

Measure	Proxy	Units	Source
Entrepreneurship	High expectation entrepreneurship	% of total working population	GEM
Economic growth	GDP growth	% change annually	WDI
Cost of capital	Real interest rate	%	WDI
Economic stability	Inflation rate	% change annually	WDI
Ease of hiring	Unemployment rate	Total unemployment as a % of total labor force	WDI
IPR protection	IPR index	1 to 7 scale	WEF

Table 6: Variables collected

Variable	Obs	Mean	Std. Dev.	Min	Max
High expectation entrepreneurship	63	1.319	1.016	0.058	4.530
Economic growth rate	129	5.093	3.719	-11.032	17.855
Real interest rate	101	7.323	12.579	-9.710	84.050
Inflation rate	129	7.914	7.549	-3.855	44.134
Unemployment rate	76	10.637	6.010	1.500	30.700
IPR	127	3.428	0.783	2.200	5.100

Table 7: Descriptive statistics for developing countries

Variable	Obs	Mean	Std. Dev.	Min	Max
High expectation entrepreneurship	111	0.852	0.660	0.000	3.911
Economic growth rate	140	2.913	2.277	-1.198	11.900
Real interest rate	85	4.043	3.067	-4.050	12.120
Inflation rate	140	2.193	2.476	-6.347	14.286
Unemployment rate	77	6.345	2.328	2.900	11.400
IPR	144	5.444	0.718	3.800	6.600

Table 8: Descriptive statistics for developed countries

B List of countries in the sample set[10]

United Arab Emirates	Argentina*
Australia	Austria
Belgium	Brazil*
Canada	Switzerland
Chile*	China*
Chinese Taipei	Colombia*
Czech Republic	Denmark
Germany	Ecuador*
Spain	Finland
France	United Kingdom
Greece	Hong Kong
Croatia	Hungary
Indonesia*	India*
Ireland	Iceland
Israel	Italy
Jamaica*	Japan
Jordan*	South Korea
Latvia*	Mexico
Malaysia*	Netherlands
Norway	New Zealand
Peru*	Philippines*
Poland*	Portugal
Russia*	Singapore
Slovenia*	Sweden
Thailand*	Turkey*
Uganda*	Uruguay*
United States	Venezuela*
South Africa	

[10] Countries with asteriks (*) are developing countries as classified by the World Bank.

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