Does intellectual property lead to economic growth? Insights from a novel IP dataset

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INTRODUCTION

The purported positive effect of strong intellectual property (IP) protections on economic growth in developing countries is a thesis so widely affirmed among economists studying this relationship that it has almost become an article of faith. And yet the results of empirical research into this relationship are much more ambiguous (Table 1). Determining the true relationship between the strength of a country's IP protections and its economic growth, as well as the mechanism by which that relationship occurs, is of critical importance to policy makers looking to wield this instrument constructively. This is the project taken up by E. Richard Gold, Erica Shadeed, and Jean-Frédéric Morin in their 2019 paper "Does intellectual property lead to economic growth? Insights from a novel IP dataset." In the paper, the authors report on the results of three separate but complementary analyses they conducted aimed at unraveling the contradictory effects of IP protections on economic growth in developing countries.

Table 1 Summary of results of recent empirical studies

Effect of IP on…	Results
Innovation	Positive: • Kanwar and Evenson (2003) • Chen and Puttitanun (2005) • Schneider (2005) Negative: • Hudson and Minea (2013) • Lerner (2009) U-shaped according to level of development: • Kanwar and Evenson (2003) • Hudson and Minea (2013) • Chu *et al.* (2014)
GDP per capita (middle income countries)	Negative: • Kim *et al.* (2012) No relationship/undetermined: • Falvey *et al.* (2006)
GDP per capita (low income countries)	Positive: • Falvey *et al.* (2006) Negative: • Kim *et al.* (2012)

GDP, gross domestic product.

METHODOLOGY

The central research question that Gold et al. seek to answer in this paper is *What is the effect of different levels of Intellectual Property (IP) protection on developing economies' economic growth and how does it occur?* For the purposes of this paper, I'll be focusing on only the first part of this question–i.e., the effect of different levels of IP protection on developing economies' economic growth.

The unit of analysis for the study was all developing countries with a population greater than 1 million for the period 1995-2011, for which data was available. This period was chosen to coincide with the initial coming into force of the TRIPs agreement as a means of measuring the countries' adoption of IP rules that are specific to the more onerous US demands for increased IP protection.[1] This approach yielded a final sample size of 124 countries and 2143 country-years.

For their analysis, Gold et al. rely on multiple linear regression to analyze the target relationship. All the regressions used make use of fixed effects estimation, which enabled the authors to better control for unobserved heterogeneity that varies across individual countries but remains constant across time periods.[2] The independent variable under investigation was the level of IP protection in each developing country, as measured by alignment with US standards. The dependent variable was economic growth, as measured by GDP per capita. Finally, five standard indicators of economic growth from the World Bank were included to serve as controls.

To estimate the average impact of a country's level of IP protections on its per capita GDP, the following model was used:

$$\widetilde{G}_{it} = \beta_1 \widetilde{IP}_{i(t-2)} + \beta_2 \widetilde{E}_{it} + \beta_3 \widetilde{PG}_{it} + \beta_4 \widetilde{GCF}_{it} + \beta_5 \widetilde{EF}_{it} + \beta_6 \widetilde{G}_{i(t-5)} + \widetilde{\eta}_{it}$$

Where,

$\widetilde{G}_{it}$ is the GDP per capita of country *i* for year *t*

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[1] E. Richard Gold, Erica Shadeed, and Frédéric Morin, "Does intellectual property lead to economic growth? Insights from a novel IP dataset," *Regulation & Governance* (2019) 13, 107–124.

[2] Ibid.

$\beta_1 \widetilde{IP}_{i(t-2)}$ is the level of IP protections in country *i* for year *t*-2 years[3]

$\beta_2 \widetilde{E}_{it}$, $\beta_3 \widetilde{PG}_{it}$, $\beta_4 \widetilde{GCF}_{it}$, $\beta_5 \widetilde{EF}_{it}$, $\beta_6 \widetilde{G}_{i(t-5)}$ are standard individual level control variables approximating the various elements of economic growth[4]

The coefficient of interest is the effect size on the interaction between IP Index, $\beta_1 \widetilde{IP}_{i(t-2)}$, and GDP per capita, $\widetilde{G}_{it}$. The results of this analysis are given in Table 2.

Table 2 The total effect of IP on growth

Income Class	L-	L+	LM-	LM+	UM-	UM+	All Dev
Variable	GDPPC	GDPPC	GDPPC	GDPPC	GDPPC	GDPPC	GDPPC
IP INDEX (2-YEAR LAG)	*0.000573*	**0.00270***	**0.0105****	**0.0117*****	**0.0273***	**0.0224***	**0.0135*****
GDPPC (5-YEAR LAG)	0.539***	0.0767	0.342	0.115	0.509*	0.344	0.624***
ECONOMIC FREEDOM	0.00212*	0.00377**	0.00882*	0.00913	−0.0164	−0.00283	0.00627
ENROLMENT	0.00866**	0.0155***	0.0269**	0.0375***	0.0170*	0.0612***	0.0341***
POPULATION GROWTH	0.000274	−0.00450	−0.00345	−0.00588	−0.00884	−0.0217***	−0.00510
GROSS CAPITAL FORMATION	0.000478	0.000406	0.00475	0.0102**	0.0197*	0.0400**	0.00518
N	183	198	166	178	127	143	994
R^2	0.651	0.524	0.644	0.726	0.539	0.730	0.732

$^{***}P < 0.001$;

$^{**}0.001 < P < 0.01$;

$^{*}0.01 < P < 0.05$. All models with fixed country and year effects; standardized coefficients reported. GDPPC, gross domestic product per capita; IP, intellectual property; L, lower; LM, lower-middle; UM, upper-middle.

FINDINGS

The results of the authors' analysis were consistent with the thesis that increased levels of IP protection have a positive effect on economic growth for developing countries. Specifically, the authors found that, on average, for a given country *i* and year *t*, a one unit increase in the IP Index score[5] was associated with a US$0.0135 annual increase in GDP per capita[6] holding all other variables fixed. This association was highly statistically significant at a p value of < 0.001.

[3] This variable was lagged 2 years in order to further emphasize directionality of causation, but no further to mitigate the risk of introducing additional confounding factors. See ibid, 113.

[4] Specifically, the Mankiw et al. (1992) variation on the Solow–Swan growth model (Solow 1956; Swan 1956) was used.

[5] See Appendix 2 for variable definitions and data sources.

[6] Gross domestic product measured in 2005 US dollars, divided by population.

More interestingly, these effects peak for lower-to-middle income countries and largely fall away for both lower and higher income countries, as classified by the World Bank's income classification system.[7] In particular, the authors found the strongest significance of the correlation ($P < 0.01$) between the level of IP protections and economic growth[8] in both lower lower-middle (LM-) and upper lower-middle (LM+) countries, with significance waning for both upper lower-income (L+) and lower upper-middle (LM-) income countries. Results were not statistically significant in lower lower-income (L-) or upper upper-middle income (UM+) countries.

DISCUSSION

The IP Index developed for this study comprises 9 indicators, each ranging from a minimum value of 0 to a maximum value of 1. Higher scores indicate closer alignment with US -style protections. Scores across indicators are additive, such that each indicator receives equal weight and the index ranges theoretically from a minimum value of 0 to a maximum value of 9 (see Appendix 3). Relative to such a small scale, how substantial is an effect of just a few pennies per year in GDP per capita per one unit increase in IP Index score?

The average GDP per capita in terms of 2005 US dollars from 1995-2011 for countries in the lower-middle income classification was $1,466.77.[9] An effect of US$0.0135 in absolute dollar terms, therefore, represents an increase of approximately .0009% of total GDP per capita for these countries. By this scale, a change in IP Index score from 0 to 9–the most drastic change possible by this scale–would still only yield an expected average increase in GDP per capita of about 12 cents, or .0083%, holding all other variables fixed.

If we restrict our analysis to just lower-middle income countries, the magnitude of the effect is even more modest. For lower lower-middle income countries (LM-), the expected effect of a one-point increase in IP Index score is US$0.0105 (.0007%), while for upper lower-middle income countries (LM+), it is US$0.0117 (.0008%).

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[7] Ibid., 114.

[8] i.e., via the two hypothesized mechanisms of inward technology transfer and domestic inventive activity.

[9] "GDP per capita (constant 2010 US$)." World Bank. https://data.worldbank.org/indicator/NY.GDP.PCAP.KD?end=2015&start=1995.

On the surface of it, these numbers don't seem particularly impressive. However, without more information about how impacts measured in terms of GDP per capita are evaluated (e.g., if pennies added annually is large or small or somewhere in between) or some further basis against which to compare it (e.g., the measures reported by other empirical studies), that's about all we can say on that topic. It is worth noting, however, that the authors provide no explicit interpretation of these measurements, except in relation to other coefficients measured (e.g., b_1 being five times larger than b_2, etc.).[10] The reader should keep this context in mind for the critiques that follow.

OMITTED VARIABLES 1: FEATURES OF EMERGING MARKETS

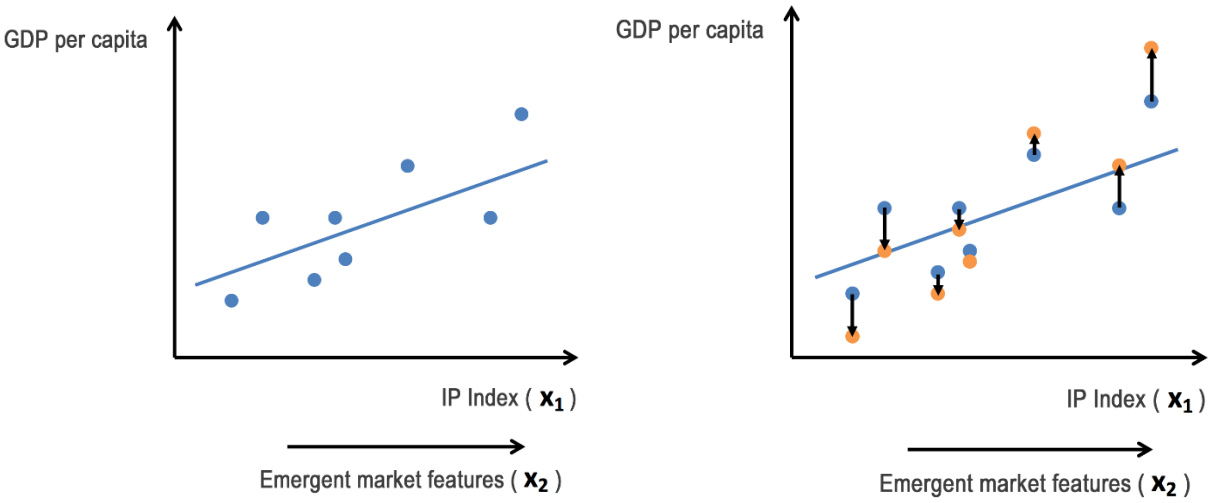
The model used to measure the total effect of a countries' level of IP protections on its GDP per capita omits several important variables that I would expect to bias the authors' estimate of the coefficient of interest. Specifically, it excludes key political and economic factors shared by a large proportion of low-middle income developing countries that make them attractive prospects for foreign investment, including rapid growth, attractive risk-return profiles for investors, and high demand for investment capital. These features are defining characteristics of so-called emerging market economies.[11] We can represent these features as a vector of variables corresponding to each of these qualifying features (X_2).

Such factors would be expected to have a significant positive relationship with both GDP per capita as well as IP Index score as having stronger IP protections–at least on paper–helps ready these countries' economies and political situation for additional investment. Consequently, X_2 would vary with IP Index (i.e., the correlation between X_{1i} and X_{2i} is greater than 0). Since the coefficient for this omitted variable, b_2, is greater than 0, whenever X_{2i} increases, Y_i increases as well, and vice-versa. Compared to the case where X_{2i} is fixed, this moves the observed points as shown in Figure 1-a below.

[10] E.g., see Gold et al., 108, 119, and 121.

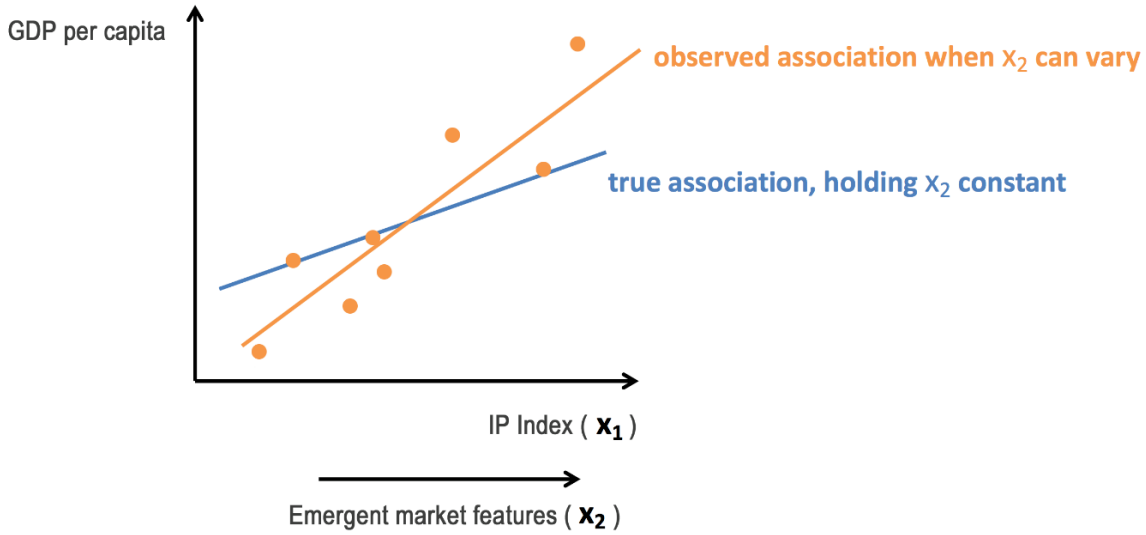
[11] Kimberly Amadeo, "Emerging Market Countries and Their Five Defining Characteristics," TheBalance.com, July 11, 2019, https://www.thebalance.com/what-are-emerging-markets-3305927.

Figure 1-a. Graphical analysis of omitted emergent market variables



If the analysis above is correct, then we can't interpret the estimation of the IP Index coefficient as the effect of the level of IP protections on GDP per capita holding these other (unobserved) variables fixed. Therefore, we can't interpret the effect as causal. The omission of these variables biases the model of the relationship between IP Index and GDP per capita upward we should expect the true relationship to be significantly lower than what was observed. Given the small size of the effect to begin with, it may even disappear altogether.

Figure 1-b. Graphical analysis of true vs. observed relationship



CRITIQUE 2: Growth in China

The model omits another significant variable as well–growth in China. Specifically, it fails to account for how China's rapid growth during this period was sustained largely by free trade agreements with developing countries, which traded development investment for access to natural resources (Figure 2).

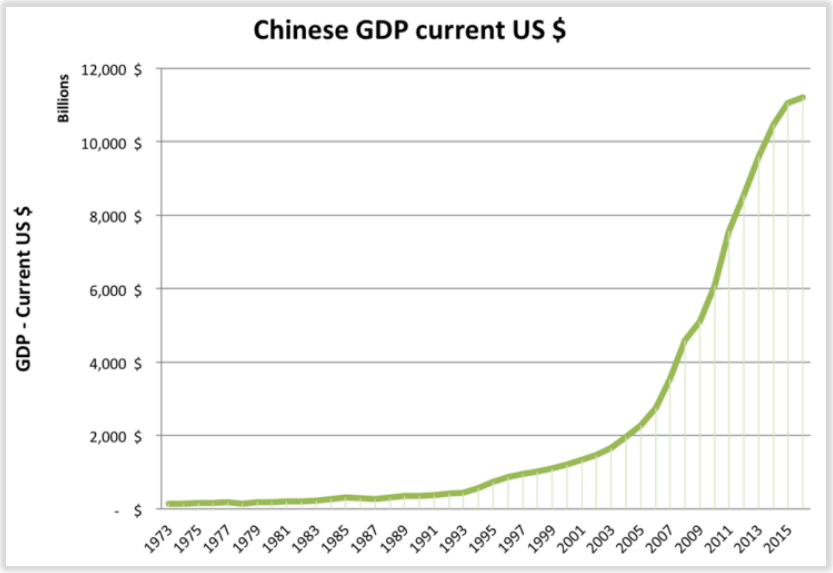


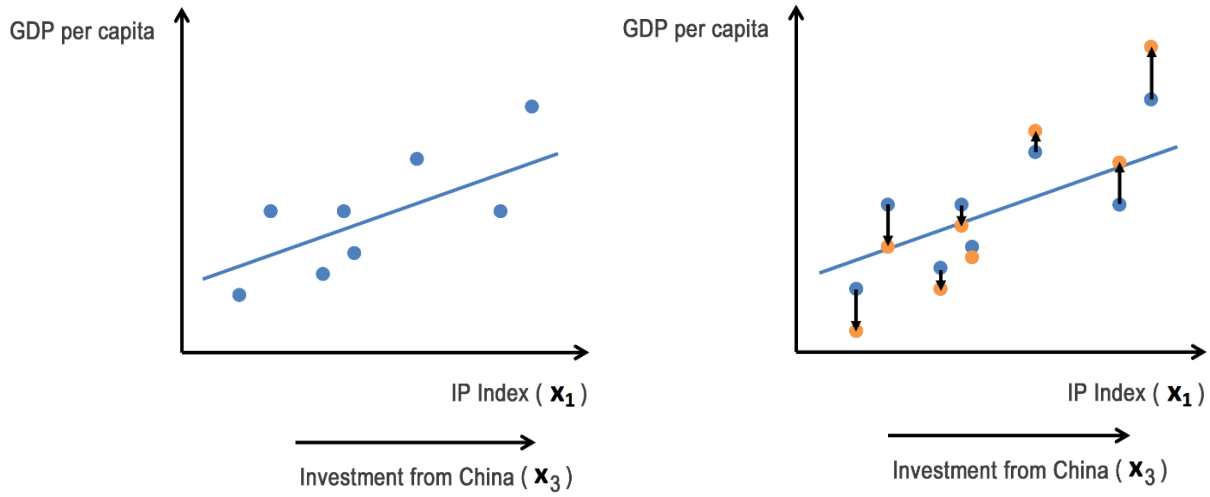
Figure 2. Economic growth in China, 1973-2015

In other cases, simple demand for commodity exports from these often resource rich countries would have driven their economic growth.

This trend runs parallel to the one mentioned above in that China often pursues trade relationships where the existing balance of power works in their favor, which includes many of the same features that make these countries appealing for foreign investment more generally. Consequently, I would expect there to be at least some degree of overlap between the effects of these two omitted variables. However, if a country with the aforementioned qualities was also actively engaged in trade relations with China during this boom period, I would expect this to significantly amplify the magnitude of the observed effect.

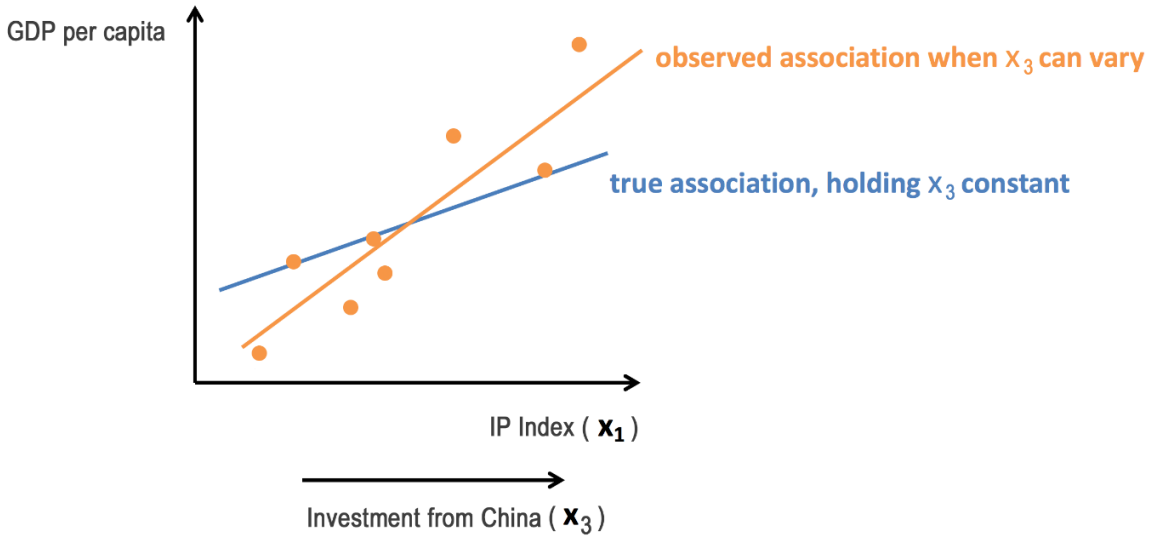
Being involved in these sorts of trade relationships with China would have a significant positive relationship with a countries' GDP per capita, and to a lesser extent, its IP Index score (for the reasons mentioned above). It would, therefore, be expected to vary with IP Index. Again, since the coefficient for b_3 is greater than 0, whenever X_{3i} increases, Y_i increases as well, and vice-versa. Compared to the case where X_{3i} is fixed, this would move the observed points as shown in Figure 3-a below.

Figure 3-a. Graphical analysis of omitted investment from China



If this analysis is accurate, the omission of this variable would further bias the observed association of a countries' IP Index score and GDP per capita upward relative to the true association. We should therefore expect the model of the true relationship to have a much flatter, more modest slope, as shown in Figure 3-b. Depending on the magnitude of this bias relative to the initial effect size–which, again, appears to be very small–we may expect the effect to disappear altogether.

Figure 3-b. Graphical analysis of true vs. observed relationship



CONCLUSION

The regression model that Gold et al. use to measure the average effect of the level of IP protections on the GDP per capita of developing countries suffer from the omission of several important variables, including a number of variables shared in common by emerging market economies (high demand for capital, attractive risk-return profiles, etc.) as well as parallel growth trends in China, which were sustained largely by the purchase of raw materials from lower-middle income countries. Because these variables are omitted, they are, by definition, not being held constant in the model. We therefore cannot interpret the IP Index coefficient *causally*, i.e., as the effect of IP protections on GDP per capita holding all other variables fixed.

On average, the omitted variables vary with the countries' level of IP protections, leading us to expect a significantly flatter slope for the model of the true relationship. The author's estimate, therefore, likely represents an upper bound on the truth. The true effect is likely much lower. Given that the magnitude of the observed effect is seemingly so small to begin with (just a few additional pennies in GDP per capita per year), a decrease of any size would be worrisome, as it threatens to eliminate the effect altogether, and with it, the central conclusion of this analysis. Insofar as the paper's second and third analyses rely on the conclusions drawn in the first, the paper fails to deliver on its core promises and leaves much of the initial ambiguity it aimed to resolve intact.

WORKS CITED

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APPENDIX 1. Overview of paper

OVERVIEW

Research question

What is the effect of different levels of Intellectual Property (IP) protection on developing economies' economic growth and how does it occur?

Unit of analysis

All developing countries with a population greater than 1 million for which data was available.

Treatment

Level of IP protection from 1995-2011, as measured by alignment with US standards

Control

5 standard indicators of economic growth from the World Bank

Outcome

Economic growth, as measured by per capita GDP

APPENDIX 2: Variable definitions and data sources

Variable	Definition	Source
IP INDEX	The index comprises 9 indicators, each ranging theoretically from a minimum value of 0 to a maximum value of 1. In each case, higher scores indicate closer alignment with US -style rules. Scores across indicators are added, such that each indicator receives equal weight and the index ranges theoretically from a minimum value of 0 to a maximum value of 9. 1) Patentability of plants (excluding plant variety protection): If no, 0; if neither specifically permitted nor prohibited, 0.5; if yes, 1. 2) Copyright term of 70 years or more after death: If no, 0; if yes, 1. 3) Prohibition of the dissemination of technology used to circumvent measures that control access to copyrighted works: If no, 0; if prohibition is on commercial dissemination only, 0.5; if prohibition covers non-commercial dissemination as well, 1. 4) Ratification of UPOV91: If no, 0; if yes, 1. 5) Ratification of WIPO internet copyright treaty: If no, 0; if yes, 1. 6) Ratification of the Brussels Convention on satellite signal: If no, 0; if yes, 1. 7) Requirements for the protection of pharmaceutical data for at least five years: If no, 0; if yes, 1. Note that protection "against unfair commercial use" and "against disclosure by a third party" without a specific time limit of five years or more were not considered sufficient. 8) National or regional exhaustion of patent rights (as opposed to international exhaustion): If no, 1; if yes, 0. In the case of South Africa and the Philippines, which adopt national exhaustion but create an exception for pharmaceuticals, a score of 0.5 was assigned. 9) Compulsory licenses may granted: If only for anti-competitive practices or national emergencies, 1; if only for anti-competitive practices, national emergencies, failure to work, insufficient working, or use for use of a dependent patent, 0.5; if for any reasons beyond those already listed, 0.	WIPO and national government websites.
INCOME CLASS	Each year, the World Bank classifies countries into one of 4 categories: Low Income (L), Lower Middle Income (LM), Upper Middle Income (UM) and High Income (not studied), based on estimates of gross national income per capita in the previous year. To further refine these groups, if a country was at or above the median GDP per capita of its INCOME	World Bank

	CLASS in a given year, it was placed in the plus group for that year (L+, LM+, UM+), and if it was below the median in a year it was placed in the minus group for that year instead (L-, LM-, UM-). ALLDEV is the group of all developing countries across all years L, LM and UM.	
ECONOMIC FREEDOM (ECOFREE)	The Index of Economic Freedom, published every year since 1995, aims to provide a measure of the extent to which governments allows for the free movement of labor, capital and goods in their countries. It is a composite measure of 10 factors organized around four broad categories of freedom, each scored out of 100 and averaged to give an overall score, with each given equal weighting. These categories are: 1. Rule of Law (property rights, freedom from corruption) 2. Limited Government (fiscal freedom, government spending) 3. Regulatory Efficiency (business freedom, labor freedom, monetary freedom) 4. Open Markets (trade freedom, investment freedom, financial freedom)	The Heritage Foundation and the Wall Street Journal
ENROLMENT	The total enrollment in tertiary education, regardless of age, expressed as a percentage of the total population of the five-year age group following on from secondary school leaving.	World Bank (Note: All World Bank Data is from the 2014 publication of the World Development Indicators)
POPULATION GROWTH (POPGROWTH)	Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of the country of origin.	World Bank
GROSS CAPITAL FORMATION (GCF)	From the World Bank: Gross capital formation, expressed as a percentage of GDP consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and "work in progress."	World Bank

	According to the 1993 SNA, net acquisitions of valuables are also considered capital formation.	
GDP PER CAPITA (GDP)	Gross domestic product measured in 2005 US dollars, divided by population.	World Bank
LOG IP IMPORTS (IP IMPORTS)	Total value of merchandise IMPORTS with an IP component. This is the sum of machinery and transport equipment, parts and components for electrical and electronic goods, chemicals and related products, electronics excluding parts and components, in thousands of dollars. (Log transformed)	UNCTAD
LOG USPTO APPS (USPTO)	The number of applications a given country submitted to the United States Patent and Trademark office in a given year. (Log plus one transformed)	USPTO
LOG PCT DESTINATION	The number of designations made by rights holders to a given country's patent office seeking patent protection through the PCT system in a given year. This is labeled as 'PCT national phase entries – Total Count by Filing Office' in the WIPO Statistics Database. (Log plus one transformed)	World Intellectual Property Organization Statistics Database
LOG PCT ORIGIN	The number of applications made by rights holders seeking patent protection from a given country through the PCT system in a given year. This is labeled as 'PCT national phase entries – Total Count by Applicant's Origin' in the WIPO Statistics Database. (Log plus one transformed)	World Intellectual Property Organization Statistics Database