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LINKAGES BETWEEN INTELLECTUAL PROPERTY RIGHTS REGIME AND INCOME INEQUALITY

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Abstract:

This paper examines the impact of strengthening Intellectual Property Rights (IPRs) on within-country income inequality for a cross-section of 65 developed and developing countries for the time period 1995-2009.The results indicated that strengthening of IPRs led to an increase in income inequality in WTO-member developing countries after they started modifying their national IPR regimes to conform to the TRIPs requirements. IPRs tend to raise income inequality by generating a more skewed distribution of wages. Stronger IPRs increased the demand for skilled labor force as it raised the return on R&D activities. This caused a relative increase in skilled labor wages, creating a wage bias in favor of skilled labor against unskilled labor, thus aggravating income inequality within a developing country. Moreover, the effect on inequality was more pronounced for developing countries that were experiencing higher per capita GDP growth rates. As for the developed countries included in the sample, the analysis seemed to suggest that IPRs led to a decline in income inequality over the study period.

Keywords: *Developing countrie; Globalization; Inequality; Intellectual Property Rights.*

1. Introduction

Intellectual Property (IP) refers to products or ideas that are creations of an individual's mind. Intellectual Property Right (IPR) refers to the legal right conferred on the holder of such ideas for exclusive use of its intellectual capital. The increased globalization of markets has made it possible for firms to sell their products in other countries and to choose foreign destinations for production and investment purposes. But this benefit has come at a cost, as globalization has also made it easier for intellectual property to be accessed and copied (through imitation or reverse engineering) in countries that provide weaker IPR protection.

This consideration has led to the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs), a product of the Uruguay Round (1986-1994) of trade negotiations. The TRIPs Agreement, for the first time, provides for certain minimum standards for protection and

enforcement of IPRs among the World Trade Organization (WTO) member countries. The Agreement provides varied conditions for different areas of IP. Basically, it covers seven areas of IPR, which include copyright, patents, trademarks, industrial designs, geographical indications, semiconductor topographies and undisclosed information. In light of the development goals of member countries, the Agreement has set differentiated timelines across countries, depending on their level of development. Developing countries have been given additional time to implement the applicable changes to their national IP laws, basically in terms of two tiers of transition. The transition period for developing countries expired in 2005, that is to say that these became fully TRIPs compliant. In comparison, the transition period for the least developed countries (LDCs) to become TRIPs compliant was extended to 1 July, 2013 and further until 1 January 2016 for the pharmaceutical patents, with the possibility of further extension.[1] The TRIPs Council comprising of all WTO members, agreed on 11 June, 2013 to extend this deadline to 1 July 2021 for the LDCs to protect IP under the WTO's TRIPs agreement, with a further extension possible when the time comes.[2]

Following the TRIPs Agreement, a body of research has now emerged that focuses on the potential impact of TRIPs and IPRs on international technology transfer and diffusion, economic growth and welfare. Most of the theoretical literature that analyzes welfare implications of IPRs has come to the conclusion that North (developed countries) tends to benefit and South (developing countries) loses in terms of welfare due to more stringent IPR protection in the South (Helpman 1993; Grossman and Lai 2005; Chu and Peng 2011). The channels of technology transfer and the ability of the South to take advantage of the technology to which it is exposed play a major role in ascertaining welfare implications of stronger IPRs. Further, strengthening of IPRs can have repercussions on income distribution of a country also. Stronger patent rights can increase wage inequality by increasing the return to research and development (R&D) and the wage rates of R&D workers, who are mostly skilled labor (Cozzi and Galli 2009). More stringent IPRs can also raise income inequality indirectly via differences in income growth rates. For instance, Chu and Peng (2011) postulate that strengthening of IPRs spurs growth rates, which raises disparities in wealth distribution, leading to an increase in income inequality. A higher growth rate increases the real interest rates through the Euler equation. Higher real interest rates imply higher return on assets. This higher return on assets increases the income of the asset-wealthy households relative to the asset-poor households in each country.

As far as empirical studies are concerned, there exist several that focus on the relationship between IPRs and economic growth (Gould and Gruben 1996; Thompson and Rushing 1996,

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[1] WTO recognizes LDCs as countries which have been designated as such by the United Nations. Countries are classified as Least developed based on their Gross national income per capita, Human Assets index and Economic Vulnerability index.(For details, see http://www.un.org/en/development/desa/policy/cdp/ldc/ldc_criteria.shtml#crit
[2] It does not exempt the LDCs entirely from applying the TRIPs agreement. It does give them the freedom to choose whether or not to protect trademarks, patents, copyright, industrial designs, geographical indications or any other form of intellectual property covered by the agreement. If they do protect it and several do have some intellectual property laws, then they have to apply provisions on non-discrimination. But this extension of transition period does not cover the patents on pharmaceuticals. The separate transition period for least developed countries to protect patents on pharmaceuticals remains the same.(Source -www.wto.org)

1999; Falvey, Foster and Greenaway 2006; Schneider 2005). Adams (2008) examines the relationship between IPRs and income inequality for a cross-section of 62 developing countries over a period of 17 years (1985-2001). He finds that strengthening of IPRs produces a significantly worsening effect on income inequality, implying that income inequality is raised.

The motivation for this paper stems from the fact that a higher economic growth prospect due to strengthening of IPRs loses its relevance if the benefits of higher growth are reaped only by a section of the society or concentrated in a group within the economy. Given that income inequality is a social concern, these distributional consequences should also be taken into consideration while studying the welfare implications of IPRs. The objective of this study is to fill this significant gap in the literature on IPRs by formally studying the distributional consequences of strengthening of IPRs on both developed and developing countries.

Since the TRIPs agreement requires WTO members to meet certain minimum standards of IP protection within a stipulated period of time, the onus of harmonization of IPRs largely falls on developing member countries. In light of this, it will be interesting to study how the enforcement of a stronger IPR regime has affected income-inequality in these developing countries. This study attempts to examine the impact of strengthening IPRs on income inequality in WTO-member developing countries after they initiated the process of complying with the requirements of the TRIPs agreement. Alongside, the study aims to use variables such as net FDI inflows, imports, secondary education enrolment rates, and population growth rates as controls, so as to clearly delineate the effect of IPRs on income distribution.

Drawing on the main findings of Chu and Peng (2011), this empirical analysis set out the hypothesis that strengthening of IPRs leads to an increase in income inequality in WTO-member developing countries, while controlling for variables such as net FDI inflows, imports as a percentage of GDP, per capita GDP growth rates and literacy levels (i.e. attainment of secondary education). We test for both the direct and indirect channels through which strengthening of IPRs can increase income inequality. Stringent IPRs raise income inequality directly, for example, through wage distribution and indirectly via growth rates through the channel of wealth distribution as postulated by Chu and Peng (2011). The analysis also tests for any differential impact of IPRs on income inequality in developed vis-à-vis developing countries.

It is believed that, in comparison to Adams (2008), this study is an improvement in at least two specific ways. First, it includes both developing and developed countries in the sample. The empirical analysis has been conducted on a balanced panel of 65 developed and developing countries. The aim is to study the impact of strengthening IPRs on income inequality in both developed and developing countries, and also check whether the effect on income inequality is different between the two groups of countries. Second, the analysis covers the time period 1995-2009, which is more relevant as it overlaps with the timeline of compliance with TRIPs Agreement by the developing countries.

The paper is organized as follows. Section 2 discusses the data and methodology used in the paper. Section 3 presents the empirical results and Section 4 concludes.

2. Data and Methodology

2.1. Data

The data was obtained from various sources. Most of the data were obtained from the World Development Indicators, World Bank. A set of 65 countries (29 developed and 36 developing), was chosen for our analysis which cover the time period 1995-2009.The sample of countries was diverse, representing different income groups and regions[3].

The most widely used measure of income inequality is the Gini coefficient (Gini index). Its value typically ranges from 0 to 1(100). A low Gini coefficient (Gini index) indicates a more equal distribution, with 0 corresponding to complete equality, while a higher value of the Gini coefficients (Gini indices) indicates more unequal distribution, with 1 (100 on the percentile scale) corresponding to complete inequality. The lack of comparable Gini coefficients -- both between countries and over time -- has long been a major obstacle in research on inequality. Gini coefficients cannot be compared globally due to the differing methodologies within and across countries and large data gaps over time. The Standardized World Income Inequality Database (SWIID) (Solt 2009) is the most comprehensive cross-national database of Gini indices across time. The SWIID standardizes Gini estimates from all major existing resources of inequality data, including UNU-WIDER (2008), the WorldBank's POVCALNET and other sources.[4] Overall, the SWIID includes Gini estimates for gross and net income inequality for 171 countries from 1960 to 2011.[5] Therefore, our chosen measure for income inequality was the net income Gini index from SWIID.

To measure IPRs, the Ginarte and Park index, a widely used index for measuring strength of intellectual property rights was used. It has been developed by Park and Ginarte (1997) and extended by Park (2008). Initially, the index was constructed for 110 countries quinquennially from 1960 to 1990. Park (2008) updated the index to 2005 and extended it to 122 countries. Five categories of patent laws have been examined: (1) extent of coverage, (2) membership of international patent agreements, (3) provisions for loss of protection, (4) enforcement mechanisms, and (5) duration of protection. Each of these categories (per country, per time period) scores a value ranging from 0 to 1. These five categories of the index pertain to the aggregate economy as a whole. The unweighted sum of these five values constitutes the overall value of the patent rights index. The index, therefore, ranges in value from 0 to 5. Higher values of the index indicate stronger levels of protection. (See Appendix C for a detailed description of the index).

Furthermore, this analysis also took into the effect of a range of other variables on income inequality. For instance, the literature also focuses on globalization in explaining for income inequality in the South. The exposure of developing countries to international markets is measured by the degree of trade protection, the share of imports and/or exports in GDP, the

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[3] The countries included in the sample are listed in the Appendix A.

[4] http://myweb.uiowa.edu/fsolt/swiid/swiid.html .(Accessed on 20 December, 2016)

[5] Gross income inequality estimates are calculated using gross income of households. Gross income is income before deduction of taxes and addition of transfers. Similarly, net income inequality estimates are based on net income which is defined as income after deducting taxes and adding transfers.

magnitude of capital flows -- FDI in particular, and exchange rate fluctuations in this literature on openness and income inequality (Milanovic 2005, Dollar and Kraay 2002, Beer 1999, Sylwester 2005, Meschi and Vivarelli 2009). Following this strand of literature, two indicators of openness in the model – net FDI inflows as percentage of GDP (FDI) and imports of goods and services as percentage of GDP (IMP) were included.[6] The variable IMP captured the importance of foreign goods in domestic consumption, which was a key factor in determining the implication of stronger IPRs on income inequality in Chu and Peng (2011).[7] The data for both of these variables was taken from the World Development Indicators Database which was available on World Bank's website.[8]

Education should also be taken into account while explaining within-country income inequality. An increase in education implies an increase in the supply of skilled labor force, a decrease in the relative skilled/ unskilled wage differential and an overall decrease in income inequality (Meschi and Vivarelli 2009).Therefore, an indicator of secondary education (SEC EDU) was included. SEC EDU measures the level of educational attainment of population in a country. It is defined as the percentage of population aged 15 years and above who have completed their secondary education. The data for this variable was taken from the Barro-Lee database.[9]

Additional insights into the factors that affect income inequality are derived from the political economy models that attribute an important role to political and governance structure of a country in determining the extent of income disparities. The existence of political and civil liberties and higher education levels restrict the ability of a rich minority to influence economic policy in its own interest and, therefore, lead to lower income inequality. Good governance (institutions and policies that enforce property rights and restrain government corruption) are associated with lower income inequality (Knack and Anderson 1999). Keeping these findings in mind, one indicator reflecting the political conditions of the countries was included in this analysis. Political stability and absence of violence measures the perceptions about the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism. The data for this indicator was taken from the Worldwide Governance Indicators (WGI) database.[10] (See Appendix D for explanation of methodology used for calculating these indices.

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[6] Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP.(Source :World Development Indicators from World Bank)

[7] Imports of goods and services represent the value of all goods and other market services received from the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments.(Source : World Development Indicators from World Bank).

[8] www.data.worldbank.org   (Accessed on 20 December, 2013)

[9] http://www.barrolee.com/ (Accessed on 22 January, 2013).Barro-Lee Dataset provides educational attainment data for 146 countries in 5-year intervals from 1950 to 2010

[10] The Worldwide Governance Indicators (WGI) are a research dataset produced by Daniel Kaufmann (Brookings Institution), Aart Kraay (World Bank Development Research Group) and Massimo Mastruzzi (World Bank Institute).WGI summarizes the views on the quality of governance provided by a large number of enterprises, citizens and expert survey respondents in industrial and developing countries. These data are gathered from a

Besides the above-mentioned explanatory variables, per capita GDP growth rates and annual population growth rates were included in the empirical tests. The coefficient of the variable GDP captures the relationship between income-inequality and income growth rate.[11] The coefficient of the variable POP indicates how the distribution of income changes as a country experiences growth in population.[12] The data for these two variables were also obtained from the World Development Indicators (WDI) database available on World Bank's website.[13] The following table summarizes the variables used in our analysis and the source from which these data were obtained.

Table 1.1: Data definitions and sources

Variable	Definition	Source
INCOME INEQ.	Gini index on net income	Solt (2009)
IPRS	Ginarte and Park Index	Ginarte and Park(1997) and Park(2008)
SEC EDU	Percentage of population aged 15 and over who have completed their secondary education.	Barro and Lee(2013)
GDP	Annual percentage growth rate of GDP per capita based on constant local currency.	World Development Indicators(WDI)
IMP	Imports of goods and services as percentage of GDP	World Development Indicators(WDI)
FDI	Net FDI inflows as percentage of GDP	World Development Indicators(WDI)
POP	Annual population growth rate in percentage terms	World Development Indicators(WDI)
POL STAB	Perceptions of the likelihood that the government will be destabilized or overthrown	World Governance Indicators(WGI)

2.2. Model Specification

The empirical analysis was based on a balanced panel of 65 countries covering the time period of 1995-2009. Our baseline econometric model was specified as follows:

number of survey institutes, think tanks, non-governmental organizations, international organizations, and private sector firms.

[11] Annual percentage growth rate of GDP per capita is based on constant local currency. GDP per capita is Gross Domestic Product divided by midyear population.GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.(Source: WDI)

[12] Population growth (annual %) is the exponential rate of growth of midyear population from year *t-1* to *t*, expressed as a percentage.(Source: WDI)

[13] www.data.worldbank.org (Accessed on 20 December, 2016)

$$INCOME\ INEQ_{it} =$$
$$\beta_1 + \beta_2.IPRS_{it} + \beta_3.SEC\ EDU_{it} + \beta_4.GDPGROWTH_{it} + \beta_5.GDPGROWTH_{it}.IPRS_{it} +$$
$$\beta_6.IMP_{it} + \beta_7.FDI_{it} + \beta_8.POP_{it} + \beta_9.POL\ STAB_{it} + \beta_{10}.IPRS_{it}.DC +$$
$$\beta_{11}.GDPGROWTH_{it}.IPRS_{it}.DC + \mu_{it}. \tag{3}$$

In the above equation, $INCOME\ INEQ_{it}$ refered to income inequality measured by the Gini index for country i in period t. $IPRS_{it}$ used the Ginarte and Park IPRs index. $SEC\ EDU_{it}$ measured the level of education attainment for country i in period t. $GDPGROWTH_{it}$ represented the annual growth rate of per capita GDP. IMP_{it} and FDI_{it} represented imports as a percentage of GDP and net FDI inflows as a percentage of GDP respectively. POP_{it} was the population growth rate. $POL\ STAB_{it}$ was the indicator for political stability and absence of violence. DC was the dummy variable which took the value of 1 for developed countries and 0, otherwise.

The data sources and definitions have already been discussed in the previous section. Since Ginarte and Park index for intellectual property rights and Barro-Lee education indicators are available quinquennially, the most common approach adopted in the existing empirical literature is to use data averaged over five-year periods to deal with this problem of missing data (Kanwar 2003). Data is averaged in order to remove short-term variation that may obscure the long-term effects, and since the variable of main interest – the Ginarte and Park index -- for IPR protection is only available quinquennially. The same approach was adopted for this analysis. The panel comprised of data averaged for three 5-year time periods.[14]

In the baseline model, the distributional implications of IPRS were separately captured for developing and developed countries by the partial derivatives expressed below:

$$\partial\ INCOME\ INEQ_{it}\ /\ \partial\ IPRS_{it}\ |_{DC=0} = \beta_2 + \beta_4.GDPGROWTH_{it}$$

  [For developing countries (i.e. for DC = 0)].

$$\partial\ INCOME\ INEQ_{it}\ /\ \partial\ IPRS_{it}\ |_{DC=1} = (\beta_2 + \beta_{10}) + (\beta_4 + \beta_{11}).GDPGROWTH_{it}$$

  [For developed countries (i.e. for DC = 1)].

These partial effects of IPRs were to be evaluated at appropriate values of $GDPGROWTH_{it}$ .These partial effects were evaluated using the average of the averaged per capita GDP growth rates for the period 1995-2009, separately for developed and developing countries in the sample.[15] To do this, the baseline model was re-parameterized as follows:

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[14] Three 5-year time periods were 1995-1999, 2000-2004 and 2005-2009.Therefore, there were three data points for each country, for a total of 195 observations.

[15] Since data for Ginarte and Park IPR index and Barro-Lee education indicators is available quinquennially, I have used data that has been averaged for three 5-year sub-periods. To evaluate total marginal effect of IPRs on income inequality, therefore, I have used deviations of average GDP per capita growth rates from the average of the averaged GDP per capita growth rates.

$INCOME\ INEQ_{it} =$
$\beta_1 + \beta_2.IPRS_{it} + \beta_3.SEC\ EDU_{it} + \beta_4.GDPGROWTH_{it} + \beta_5.(GDPGROWTH_{it} - GDPGROWTH_{AVG}).(IPRS_{it} - IPRS_{AVG}) + \beta_6.IMP_{it} + \beta_7.FDI_{it} + \beta_8.POP_{it} + \beta_9.POL\ STAB_{it} + \beta_{10}.IPRS_{it}.DC + \beta_{11}(GDPGROWTH_{it} - GDPGROWTH_{AVG}).(IPRS_{it} - IPRS_{AVG}).DC + \beta_{12}.GDPGROWTH_{it}.DC + \mu_{it}.$ (4)

Where $IPRS_{AVG}$ was the average value of Ginarte and Park IPR index for the period 1995-09 and $GDPGROWTH_{AVG}$ was the average of the averaged per capita GDP growth rates for the period 21995-09. In the re-parameterized model, the variables $IPRS_{it}$ and $GDPGROWTH_{it}$ were measured as distances or deviations from the average IPR and average of averaged per capita GDP growth rate values respectively.[16]

A positive and significant coefficient of $IPRS_{it}$ is expected akin to Adams (2008), who found a significant and positive relationship between IPRs and income inequality. An interactive term for the IPR index and per capita GDP growth rate is included in the panel regression. This interactive term captures the conditional relationship between IPRs and income inequality. It measures the effect of strengthening of IPRs on income inequality conditional on per capita GDP growth rate. Higher rate of economic growth is, generally, positively associated with greater investments and higher employment-generating processes that provide greater access to jobs and income to a larger number of people. Therefore, this interactive term is important as it reveals how IPRs affect income inequality differentially, depending upon the GDP growth rate per capita of the country. If the coefficient of $GDPGROWTH_{it}.IPRS_{it}$ is found to be positive and significant, it can be concluded that IPRs raise income-inequality more for countries experiencing higher rates of economic growth per capita. Else, if the coefficient of the interactive term is negative and significant, then the increase in inequality due to strengthening of IPRs is offset, and more so for countries exhibiting a higher rate of economic growth per capita. In fact, if this coefficient is significantly negative, then turning points in Gini index cannot be ruled out.

3. Results and Discussions

This section discusses the key results of the study.

3.1. Basic Tests

The countries in the sample are quite heterogeneous. For example, they have different economic sizes, implying that the variance of the error term is unlikely to be constant across countries; instead, it is likely to vary with the size of the economy. Failure to take this into account would mean that the estimated model would assign a greater weight to a country with a higher GDP per capita (i.e. countries with larger error variances) than to the smaller ones (with lower GDP per capita) causing misleading results. Therefore, diagnostic tests were done to check for the presence of heteroscedasticity and autocorrelation in data.

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[16] For the developed countries, these distances have been measured from the average IPR and average of averaged GDPGROWTH values of 4.31 and 1.96% respectively. Similarly, the distances have been measured from the average IPR and average of averaged GDPGROWTH values of 3.36 and 4.55% for developing countries.

The modified Wald test for group-wise heteroscedasticity was performed to check for heteroscedasticity of the error term across countries. The null hypothesis was that the error variance was constant across countries. The p-value of the Wald test was 0.0000 which implied that the null hypothesis was rejected. There exists group-wise heteroscedasticity, that is, the error variance varies across countries. Similarly, Woolridge (2002) test was done to check for autocorrelation in our panel data. The null hypothesis was that there exists no first-order autocorrelation. The p-value of the Woolridge test was 0.0046 which was sufficiently low to reject the null hypothesis. This implied that there also exists autocorrelation of order one. Thus, the diagnostic tests indicate that error terms are heteroscedastic and auto correlated.[17]

Regressions were run on both fixed effects (FE) and random effects (RE) specifications corrected for autocorrelation and heteroscedasticity.[18] Although the Hausman test favored FE over RE, the study chose RE specification over FE one because the latter explores the relationship between the predictor and the outcome variables within an entity (country, person, company, etc.). It ignores time-invariant variables that might affect the dependent variable. Any potential bias stemming from possibly omitted time-invariant variables does not bias the FE estimation, since the individual-specific intercepts capture the effects of these variables. However, by eliminating the effects of omitted heterogeneity through FE estimation, the valuable information stemming from the variation between individuals is lost as well. Higher standard errors and thus imprecise parameter estimates are the consequence of ignoring the variation between individuals (Durlauf et al 2005: 629-631). In such cases where explanatory variables are time-invariant, RE approach is more appropriate.

In this model, income inequality varies much more across countries than over time. The Gini coefficient (indicator of income inequality) reported between-country standard deviation of 9.901 units and within-country standard deviation of 2.402 units. The characteristics of this variance cannot be examined by the techniques that eliminate cross-country effects and focus exclusively on the within-country relationships (i.e. FE estimators). Moreover, most of the explanatory variables included in this study exhibit greater between-country variations than within-country variations, indicating that a significant amount of valuable information would be lost if FE specification is used.(Table B.1. in Appendix B reports the decomposed standard deviations of the variables included in the model.) Also, Kanwar (2003) states that the advantage of the RE model follows from the fact that estimating a FE model implies not only substantially fewer degrees of freedom but also rules out all information that may be available by directly comparing individual units. This would provide misleading results particularly when the number of individual units in a panel exceeds the number of time periods, for, in such a situation, we must make efficient use of the information across individual units to estimate that part of the behavioral relationship under study which contains variables that (are hypothesized to) differ substantially across the units. The number of countries in the panel far exceeds the number of time periods.[19] For the reason stated by Kanwar (2003), RE would be a more appropriate choice. Therefore, we chose RE over FE estimation.

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[17]Detailed results of the diagnostic tests are given in Annexure E.

[18]Regressions results of FE specification are given in Annexure F.

[19] There was data for three time-periods of five year interval for each of the 65 countries in the sample.

3.2. Discussion of Results

Table 1.2 reports regression results of RE model that had been corrected for autocorrelation and heteroscedasticity using the method of Feasible GLS (FGLS). FGLS is the method suggested when the form of heteroscedasticity has to be estimated before applying GLS. FGLS estimates the unknown parameters of the regression model when the true error variance-covariance matrix is not known. FGLS uses an estimated error variance-covariance matrix to find the parameters of the model (Greene 2003).

Table 1.2: Regression coefficients for the impact of IPRs on income inequality corrected for autocorrelation and heteroscedasticity

	Dependent Variable: Net income Gini coefficient	
Time Period	1995-2009	
Independent Variable	(1)	(2)
IPR	0.9746** (0.3659)	1.8067** (0.1611)
GDPGROWTH	-0.7538** (0.2279)	0.0458 (0.0502)
IPR*GDPGROWTH	0.2368** (0.0755)	-
$(IPR-IPR_{AVG}).(GDP-GDP_{AVG})$		0.2272** (0.0649)
SEC EDU	-0.1023** (0.0167)	-0.0995* (0.0172)
FDI	-0.0679 (0.0485)	-0.0611 (0.0493)
IMP	0.0328** (0.0099)	0.0324** (0.0100)
POP	3.1452** (0.2496)	2.5932* (0.2664)
POL STAB	-3.7614** (0.2062)	-3.7194* (0.1894)
IPR*DC	-1.8541** (0.2045)	-2.1917* (0.1847)
(IPR*GDPGROWTH)*DC	-0.0112 (0.0320)	-
$(IPR-IPR_{AVG}).(GDP -GDP_{AVG})$*DC	-	0.4573* (0.1865)
GDPGROWTH*DC	-	0.2981* (0.1285)
cons	36.8462** (1.1805)	34.9324** (0.8419)
Number of countries	65	65

Standard errors in parenthesis. **significant at 1% level of significance.* significant at 5% level of significance

Column 1 reports the regression results of regression equation (3) (i.e. the baseline model) and Column 2 reports the regression results of the regression equation (4) (i.e the re-parameterized model). With respect to our variables of key interest, we found that the coefficient of the variable IPR was positively correlated with income inequality and was statistically significant (Column1 and 2).However, as previously discussed, the *total* marginal impact of an increase in IPR index was estimated by the following partial derivatives:

$$\partial\ INCOME\ INEQ_{it}\ /\ \partial\ IPRS_{it}\ |_{DC=0} = \beta_2 + \beta_4.GDPGROWTH_{it} \tag{5}$$

   [For developing countries (i.e. for DC = 0)].

$$\partial\ INCOME\ INEQ_{it}\ /\ \partial\ IPRS_{it}\ |_{DC=1} = (\beta_2 + \beta_{10}) + (\beta_4 + \beta_{11}).GDPGROWTH_{it} \tag{6}$$

[For developed countries (i.e. for DC = 1)].

The value of ∂ INCOME INEQ$_{it}$ / ∂ IPRS$_{it}$ for developing countries, which was evaluated using the developing country averages was positive and statistically significant (see R1.1 in BOX 1). This corroborates the hypothesis that the strengthening of IPRs lead to a direct increase in income inequality. Stronger patent rights increase wage inequality by increasing the return to R&D and the wages of R&D workers, who are generally employed as skilled labor (Cozzi and Galli 2009). The strengthening of IPRs not only directly raises income inequality at given GDP growth rates, but this direct effect of IPRs on income inequality is more pronounced for countries experiencing higher levels of GDP growth rates.

However, the value of ∂ INCOME INEQ$_{it}$ / ∂ IPRS$_{it}$ for developed countries that was evaluated using developed country averages was found to be negative and statistically significant, implying that IPRs tend to decrease income inequality in developed countries (see R1.2 in BOX 1). This is quite plausible as these countries do not experience a high skilled-unskilled wage bias as majority of the workforce is skilled. Therefore, strengthening of IPRs improves the income distribution. Furthermore, most of the developed countries had instituted a stringent IPRs regime even before the TRIPs agreement came into force. As a result, the worsening effect of IPRs on income distribution is more pronounced for developing countries.

Strengthening of IPRs can affect income distribution indirectly through the channel of wealth of distribution as postulated by Chu and Peng (2011). More stringent IPRs lead to an increase in income growth rate. This income growth rate raises the rate of return on financial assets which creates disparities in the distribution of wealth among households (the wealth effect) which in turn, exacerbates income inequality. It would have been good to empirically test for this indirect relationship between IPRs and income inequality, working through the channel of wealth inequality by using a model of simultaneous equations; However, it could not be attempted due to scanty cross-sectional and time series data availability on wealth inequality.[20]

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[20] The empirical literature related to wealth or asset inequality, generally, uses data on land distribution as the proxy for wealth distribution. However, land distribution data has its own limitations. The data on land distribution is provided by Food and Agriculture Organization (FAO).FAO conducts a World Census of Agriculture under which it provides a common framework within which individual countries perform agricultural census approximately every

Box 1: Marginal effect of change in IPR index on income inequality

Marginal effect of change in IPR index on income inequality was given by:

∂ INCOME INEQ$_{it}$ / ∂ IPRS$_{it}$ $|_{DC=0}$ = β_2 + β_4. GDPGROWTH$_{it}$

   [for developing countries (i.e. for DC = 0)].

∂ INCOME INEQ$_{it}$ / ∂ IPRS$_{it}$ $|_{DC=1}$ = (β_2 + β_{10}) + (β_4 + β_{11}). GDPGROWTH$_{it}$

   [for developed countries (i.e. for DC = 1)].

Result 1.1 (R1.1) For developing countries, we reject the null ∂ INCOME INEQ$_{it}$ /∂ IPRS$_{it}$ $|_{DC=0}$ = 0. The coefficients β_2 and β_4 were jointly significant at 1% level. The value of ∂ INCOME INEQ$_{it}$ / ∂ IPRS$_{it}$ for developing countries evaluated using developing countries' GDPGROWTH average was 1.817. This implies that a unit increase in IPR index (on a scale of 0 to 5) leads to 1.817 units increase in Gini index (on a scale of 0 to 100) when evaluated at average of averaged per capita GDP growth rates for developing countries.

Result 1.2 (R1.2) For developed countries also, we rejected the null ∂ INCOME INEQ$_{it}$ /∂ IPRS$_{it}$ $|_{DC=1}$ = 0. The coefficients (β_2 + β_{10}) and (β_4 + β_{11}) were jointly significant at 1% level. The value of ∂ INCOME INEQ$_{it}$ /∂ IPRS$_{it}$ for developed countries evaluated using developed countries' GDPGROWTH average was found to be - 0.3715. This implies that a unit increase in IPR index (again on a scale of 0 to 5) leads to 0.3715 unit decrease in Gini index (on a scale of 0 to 100) when evaluated at average of averaged per capita GDP growth rates for developed countries.

The closest empirical test that could be done to capture this indirect effect of IPRs on income inequality is by assuming that strengthening of IPRs causes an increase in GDP growth rates and then, evaluating how this increase in per capita GDP growth rate affects income inequality. The existing literature on IPRs and economic growth is of the view that the effect of IPR protection on growth depends on the level of development of a country. It is positively and significantly related to growth for low- and high-income countries, but not for middle-income countries (Falvey, Foster, & Greenaway 2006; Schneider 2005). Therefore, it is assumed that more stringent IPRs lead to an increase in income growth rates based on the findings of the existing empirical literature on the subject and study the total marginal impact of per capita GDP growth rates on income inequality evaluated at average level of IPR protection (see BOX 2). It was found that the increase in per capita GDP growth rate lead to an increase in income inequality in both developed and developing countries, but the magnitude of increase in income inequality was more for developed countries as compared to developing countries. This might suggest that the intensity of the indirect wealth effect of IPRs on income distribution is more (less)

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ten years. The country results are collected by the FAO into a summary census which is published decennially. Since it is a decennial census, there were not enough data points available for a cross-sectional study like this.

pronounced for developed (developing) countries. However, nothing can be concluded precisely here, as the indirect wealth effect of IPRs could not be tested due to data constraints.

Box 2 Marginal effect of change in per capita GDP growth rate on Income Inequality

Marginal effect given by:

∂ INCOME INEQ$_{it}$ / ∂ GDPGROWTH$_{it}$ $|_{DC=0}$ = $\beta_{3.}$ +β_4. IPRS$_{it}$.

∂ INCOME INEQ$_{it}$ / ∂ GDPGROWTH$_{it}$ $|_{DC=1}$ = (β_3 + β_{12}) + (β_4 + β_{11}).IPRS$_{it}$.

For developing countries, we rejected the null ∂ INCOME INEQ$_{it}$ / ∂ GDPGROWTH$_{it}$ $|_{DC=0}$ =0. The coefficients $\beta_{3.}$and β_4 were jointly significant at 1% level. The value of ∂ INCOME INEQ$_{it}$ / ∂ GDPGROWTH$_{it}$ for developing countries evaluated using developing countries' average value for IPRS was 0.008. This implies that a unit percentage point increase in GDPGROWTH) leads to 0.008 units increase in Gini index (on a scale of 0 to 100) when evaluated at average value of IPR index of developing countries.

For developed countries also, we rejected the null ∂ INCOME INEQ$_{it}$ / ∂ GDPGROWTH$_{it}$ $|_{DC=1}$ =0. The coefficients (β_2 + β_{10}) and (β_4 + β_{11}) are jointly significant at 1% level. The value of ∂ INCOME INEQ$_{it}$ / ∂ GDPGROWTH$_{it}$ for developed countries evaluated using developed country average value for IPRS was 0.033. This implies that a one percentage point increase in GDPGROWTH leads to 0.033 units increase in Gini index (on a scale of 0 to 100) when evaluated at average value of IPR index of developed countries.

Further, FDI had a negative effect on income inequality but this effect was significant at higher levels of significance only (at around 20% with a p-value of 0.183). Empirical studies done in the past have provided mixed evidence on the relationship between income inequality and FDI. Choi (2006) found that the increase in the FDI intensity, measured by inward, outward and total FDI stock as a percentage of GDP, increases the income inequality. Beer (1999) also reported a positive correlation between FDI and income inequality whereas Sylwester (2005) found that there was no strong positive association between FDI and changes in income inequality in LDCs over the time period 1970-1989. But, one of the reasons for this result may be that FDI inflows did not play a significant role in the economies of the LDCs during the earlier time period considered. The average annual FDI inflows flowing to LDCs was only 0.43% as a percentage of GDP during the period of 1980-89. The average annual FDI inflows to LDCs increased to 1.62% during the period 1990-1999.[21] It was only in the 1990s that financial globalization and capital mobility assumed greater importance for developing countries' economies. Owing to this, FDI did not register any significant effect on the distribution of income. Similar to our results, Adams (2008) also found that the coefficient of FDI was negative and, in a few cases, even significantly related to income inequality. He also found that FDI's impact was sensitive to regional

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[21] Own calculations based on data taken from UNCTADSTAT.
http://unctadstat.unctad.org/TableViewer/tableView.aspx). Data accessed on 20 Feb, 2016.

differences. FDI inflows were sensitive to the level of development of the countries (measured by lagged value of GDP per capita) included in his study's sample.[22]

The variable for openness, captured by imports as a percentage of GDP, was found to be significantly and positively correlated with income inequality (0.033) in all the model specifications, suggesting that increased integration into the world economy worsened the distribution of income in countries.[23] Trade can affect income distribution of a country through many channels. For instance, when developing countries liberalize trade, they become more exposed to technologies and innovations produced in the more advanced countries, which leads to a general bias in the demand for labour that is endowed with higher skills, a consequent increase in wage differentials between skilled and unskilled labor force, and so an increase in inequality in developing countries (Meschi and Vivarelli 2009). Similarly, Calderon and Chong (2001) asserted that the volume of trade (openness) affects long run distribution of income. They found that the composition of exports also matters as primary commodity exporting countries, of which most are developing ones, are associated with an increase in income inequality, while manufacturing goods exporting countries, of which most are developed, are found to experience a decline in income inequality.

Bearing in mind that a positive sign in the corresponding coefficient of an explanatory variable indicates a worsening in the distribution of income it was found that, with respect to the core controls - population growth rates had a significantly positive impact on income inequality. Political stability and absence of violence was negatively correlated with income inequality. The results confirmed that schooling appears to reduce income inequality (Chong and Calderon, 2000; Squire, 1998).

4. Conclusions and Recommendations

As discussed in the introductory section, against the backdrop of TRIPs Agreement,this study focused on the analysis of the impact of strengthening IPRs on income distribution in developing countries after they became members of WTO in 1995, and initiated the process of complying with the requirements of the TRIPs Agreement. We found that strengthening of IPRs has led to an increase in income inequality in WTO-member developing countries after they started modifying their national IPR regimes in accordance with the TRIPs requirements. Intuitively, IPRs tend to raise income inequality by generating a more skewed distribution of wages. The underlying notion is that stronger IPRs increase the demand for skilled labor force as it raises the return on R&D activities. This causes a relative increase in skilled labor wages, creating a wage bias in favor of skilled labor against unskilled labor, thus aggravating income inequality within a developing country. Moreover, the effect on inequality was more pronounced for countries that are experiencing higher per capita GDP growth rates.

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[22]He has regressed the dependent variable at a time T against the independent variables at a previous time period (T-$1, T$-2, or T-3) depending on the availability of Gini data.

[23]Imports as a percentage of GDP captures the importance of foreign goods in domestic consumption and therefore, the degree of integration of the domestic economy with the world economy in our empirical model just it has been used in Chu and Peng (2011)'s theoretical model.

As for the developed countries included in the sample, the analysis seemed to suggest that IPRs h led to a decline in income inequality over the study period. This can be due to the pre-existence of a strict IPR regime in developed countries way before the TRIPs Agreement came in to effect. This, combined with the fact that developed countries' workforce is largely skilled, IPRs have little scope to worsen income inequality in developed countries.

In terms of policy implications, the immediate impact of intellectual property protection is to benefit financially those who have the knowledge and inventive power, and to increase the costs of access to non-holders of knowledge. In a majority of developing countries, with weak scientific and technical infrastructure, the benefits in the form of stimulus to domestic innovation will be limited and in addition, they will face the costs arising from the protection of (mainly foreign) technologies. Thus, the costs and the benefits of the system as a whole may not be equitably distributed. IPRs should promote agricultural production by stimulating invention and new technologies in agricultural sector in developing countries. Most developing countries do not have a strong technological base which could benefit from IP protection but they do have genetic resources and traditional knowledge, which have value both to them and to the world at large. These are not necessarily IP resources in the sense that they are understood in developed countries, but they are certainly resources on the basis of which protected intellectual property can be, and has been, created (CIPR 2002). Therefore, this kind of resources also should be protected so that the owners of traditional form of knowledge and resources can get their due.

Appendix A: Sample of Countries

Developed Countries				Developing Countries			
Austria	Greece	Poland	United Kingdom	Bolivia	El Salvador	Mexico	South Africa
Canada	Iceland	Portugal	United States	Brazil	Fiji	Morocco	Sri Lanka
Chile	Israel	Russian Federation		Bulgaria	Honduras	Nicargua	Swaziland
Cyprus	Italy	Singapore		China	Hungary	Pakistan	Thailand
Czech Republic	Japan	South Korea		Colombia	India	Paraguay	Tunisia
Denmark	Lithuania	Spain		Costa Rica	Indonesia	Panama	Ukraine
Finland	New Zealand	Sweden		Dominican Republic	Jordan	Peru	Uruguay
France	Netherland	Switzerland		Ecuador	Malaysia	Philippines	Vietnam
Germany	Norway	Turkey		Egypt	Mauritius	Romania	Venezuela

Appendix B: Summary Statistics
Table B.1. Decomposed Standard Deviations

		Standard Deviation
INCOME INEQ	overall	10.139
	between	9.901
	within	2.402
IPRS	overall	0.929
	between	0.816
	within	0.452
SEC EDU	overall	12.663
	between	12.311
	within	3.217
GDP	overall	2.170
	between	1.576
	within	1.499
IMP	overall	24.945
	between	24.597
	within	4.842
FDI	overall	3.438
	between	2.686
	within	2.163
POP	overall	0.850
	between	0.813
	within	0.260
POL STAB	overall	0.884
	between	0.867
	within	0.191

Appendix C. Construction of the Ginarte and Park IPR Index

1	**Coverage**	**YES**	**NO**
	Patentability of pharmaceuticals	1/8	0
	Patentability of chemicals	1/8	0
	Patentability of food	1/8	0
	Patentability of surgical products	1/8	0
	Patentability of microorganisms	1/8	0
	Patentability of utility models	1/8	0
	Patentability of software	1/8	0
	Patentability of plant and animal varieties	1/8	0
2	**Membership in international treaties**	**YES**	**NO**
	Paris convention and revisions	1/5	0
	Patent cooperation treaty	1/5	0
	Protection of new varieties (UPOV)	1/5	0
	Budapest treaty (microorganism deposits)	1/5	0
	Trade-related intellectual property rights(TRIPs)	1/5	0
3	**Duration of protection**	**Full**	**Partial**

		1	$0<f<1$
4	**Enforcement mechanism**	**Available**	**Not available**
	Preliminary(pre-trial) injunctions	1/3	0
	Contributory infringement	1/3	0
	Burden of proof reversal	1/3	0
5	**Restrictions on patent rights**	**Does not exist**	**Exists**
	Working requirements	1/3	0
	Compulsory licensing	1/3	0
	Revocation of patents	1/3	0

where f is the duration of protection as a fraction of 20 years from the date of application or 17 years from the date of grant(for grant based patent systems).Overall score for patent rights index: sum of points under (1)-(5).Source: Park,W.G. (2008)

Appendix D: Methodology used in construction of Worldwide Governance Indicators

The Worldwide Governance Indicators report on six broad dimensions of governance for over 200 countries over the period 1996-2011:
1) Voice and Accountability
2) Political Stability and Absence of Violence
3) Government Effectiveness
4) Regulatory Quality
5) Rule of law
6) Control of Corruption

Political stability and absence of violence measures perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism.

The WGI are composite governance indicators based on 30 underlying data sources. The WGI compile and summarize information from 30 existing data sources that report the views and experiences of citizens, entrepreneurs, and experts in the public, private and NGO sectors from around the world, on the quality of various aspects of governance. The WGI draw on four different types of sources of data:

1) **Surveys of households and firms** (9 data sources including the Afrobarometer surveys, Gallup World Poll, and Global Competitiveness Report survey),
2) **Commercial business information providers** (4 data sources including the Economist Intelligence Unit, Global Insight, Political Risk Services),
3) **Non-governmental organizations** (9 data sources including Global Integrity, Freedom House, Reporters Without Borders), and
4) **Public sector organizations** (8 data sources including the CPIA assessments of World Bank and regional development banks, the EBRD Transition Report, French Ministry of Finance Institutional Profiles Database).

These data sources are rescaled and combined to create the six aggregate indicators using a statistical methodology known as an unobserved components model (UCM). The composite measures of governance generated by the UCM are in units of a standard normal distribution,

with mean zero, standard deviation of one, and running from approximately -2.5 to 2.5, with higher values corresponding to better governance.

Appendix E: Results of Diagnostic tests
E.1   Test Results for Heteroscedasticity

Modified Wald test for groupwise heteroskedasticity in cross-sectional time-series FGLS regression model

H_0: $\sigma_i^2 = \sigma^2$ for all i

chi2 (65) = 1.0e+05

Prob>chi2 = 0.0000

E.2 Test Results for Autocorrelation

Wooldridge test for autocorrelation in panel data

H_0: no first-order autocorrelation

F(1,   64) =   8.594

Prob > F =   0.0047

Appendix F: Regression coefficients for the impact of IPRs on income inequality corrected for autocorrelation and heteroscedasticity for FE model.

	Dependent Variable: Net income Gini coefficient
Time Period	**1995-2009**
	Fixed Effects
Independent Variable	
IPR	0.2130 (1.013)
GDPGROWTH	-0.9735 (0.761)
IPR*GDPGROWTH	0.2430 (0.210)
SEC EDU	-0.1047* (0.036)
FDI	-0.1057 (0.088)
IMP	0.0359* (0.018)
POP	2.829* (0.672)

POL STAB	-3.0211* (0.731)
IPR*DEVELOPED	-2.0826* (0.411)
Cons	41.2934* (3.797)
Number of countries	65

Standard errors in parenthesis. *significant at 1% and 5% level of significance.

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