Impact of strengthening Intellectual Property Rights Regime on income inequality: An econometric analysis

Swati Saini and Meeta K Mehra

centre for international trade and development ,jnu

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Impact of strengthening Intellectual Property Rights Regime on income inequality: An Econometric Analysis

Swati Saini[1,2] and Meeta Keswani Mehra[3]

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.Our results indicate 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 to conform to the TRIPs requirements. IPRs tend to raise income inequality by generating a more skewed distribution of wages. 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 is more pronounced for developing countries that are experiencing higher per capita GDP growth rates. As for the developed countries included in the sample, the analysis seems to suggest that IPRs have led to a decline in income inequality over the study period.

JEL Classification: F62, F63, O34.

Key words: Developing countries, Globalization, Inequality, Intellectual Property Rights.

Corresponding author. Centre for International Trade and Development, School of International Studies, Jawaharlal Nehru University, New Mehrauli Road, New Delhi 110067, INDIA. Mobile: 91-9871733187. Email: swatisaini1128@gmail.com.

1. Introduction

[1] Ph.D. Scholar, Centre for International Trade and Development (CITD), School of International Studies (SIS), Jawaharlal Nehru University (JNU), New Delhi.
[2] We gratefully acknowledge the invaluable comments and suggestions received from Ananya Gosh Dastidar on the earlier version of the paper.
[3] Professor of Economics, Centre for International Trade and Development (CITD), School of International Studies (SIS), Jawaharlal Nehru University (JNU), New Delhi.

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.[4] 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.[5]

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; Lai 1997; 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. However, a major drawback of these studies is that, barring a few, most of them do not consider the distributional consequences of IPRs while evaluating the impact of IPRs on

[4] 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#criteria)

[5] 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)

overall welfare. IPRs can affect income distribution of a country through a direct channel, for example, through wage distribution. 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, 1999; Falvey, Foster and Greenaway 2006; Schneider 2005). However, to the best of our knowledge, there exists only one study that examines the relationship between IPRs and income inequality, which is by Adams (2008). 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 our 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.

Since, barring one study (i.e. by Adams 2008), almost all the existing studies that examine the impact of IPRs on income-inequality are theoretical in nature (see, for instance Chu and Peng (2011), Chu (2009a)), we intend to contribute to the existing literature on IPRs and income-inequality by carrying out an empirical investigation of the subject. We believe that, in comparison to Adams (2008), our 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 briefly reviews the existing theoretical and empirical literature on the subject. Section 3 discusses the methodology used in the paper. Section 4 describes the data. Section 5 presents the empirical results and Section 6 concludes.

2. Literature review

While there exists substantial body of theoretical and empirical literature on the impact of IPRs on economic growth (Helpman 1993; Lai 1997; Grossman and Lai 2004; Falvey, Foster, & Greenaway 2006; Schneider 2005), the studies that focus on the IPR–income inequality relationship are rather limited. Moreover, most of these attempt theoretical analyses of the issue.

Chu and Peng (2011) study the effects of IPR protection on income inequality across countries. They develop a two-country R&D-based growth model with wealth heterogeneity among households. In the model, both the North and the South invest in R&D, but North has a higher degree of innovative capability than South. Within this framework, they derive the following results. Firstly, strengthening patent protection in either country increases both countries' (a) economic growth by increasing R&D and (b) income inequality by raising the return on assets. They also derive the pre-TRIPs Nash equilibrium level of patent protection that is sub-optimally low as it ignores cross-country spillovers of patent protection. Also, North chooses a higher level of patent protection than South and imposing the North's higher level of patent protection on the South, as required by TRIPs agreement, increases (decreases) welfare in the North (the South). The authors find that there exists a critical level of cross-country spillover below (above) which global welfare is lower (higher) under TRIPs. This varying degree of cross-country spillover is captured by the importance of foreign goods in the domestic consumption basket. In the Nash equilibrium, the degree of the positive externality is determined by this structural parameter. When the share of foreign goods in domestic consumption is small, the cross-country spillovers of innovation are small as well. In this case, imposing the North's level of patent protection on the South makes the South worse off without making the North much better off, as both North and South are almost in a situation of autarky. Innovation in the North will not lead to a large increase in monopoly profits if foreign goods are not demanded in the South. Therefore, North will not be much better off and, as explained above, South is also worse-off due to deviation from its first-best response. Therefore, global welfare reduces unambiguously, if the share of foreign goods in domestic consumption is small.

Chu (2009a) also analyses the distributional consequences of patent policy in the United States, but considers the effects on income and consumption inequality arising due to an unequal distribution of wealth among the households. His model predicts that strengthening patent protection increases (a) economic growth by stimulating R&D investment, and (b) income inequality by raising the return on assets. Strengthening patent protection raises R&D as well as the equilibrium growth rate that drives up the rate of return on assets. This higher return on assets increases the income of asset-wealthy households relative to that of asset-poor households. However, whether it also increases consumption inequality depends on the elasticity of intertemporal substitution in consumption. If this elasticity is less (greater) than unity, strengthening patent protection would increase (decrease) consumption inequality.

Furthermore, the allowance of elastic labor supply creates an additional effect on income inequality through labor income.

As far as empirical studies are concerned, there exists only one empirical study so far, which analyses the income-distributional consequences of stronger IPRs. 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). The strength of IPRs in a country is measured by the Ginarte and Park index and income inequality is measured by the Gini index.[6] He estimates a system of four equations using the seemingly unrelated regressions (SUR) method. The results of the study indicate that globalization explains only 15% of the variance in income inequality. Stronger IPRs are positively correlated with income inequality. That is, increasing the Ginarte and Park IPR index by one (on a scale of zero to five) is associated with an increase in the Gini coefficient of 0.01 to 0.02 (on a scale of zero to one) in developing countries.

A major conclusion that can be drawn from this (rather limited) existing literature is that strengthening of IPRs has far-reaching effects on income distribution within a country. The distributional aspects of IPRs have not been studied in depth at all. This is a significant gap in the existing research. There is a need to study this aspect of debate on IPRs and welfare more closely. Our study constitutes a small yet important step in this direction. We propose to go beyond Adams (2008) in two specific ways. First, Adams (2008)'s study analyzed the impact of more stringent IPRs on income inequality in developing countries alone for the period of 1985-2001. During this period, TRIPs agreement had just about come into existence (on 1st January, 1995) under WTO, and developing countries had not begun to modify their domestic IPR regimes in compliance with the TRIPs agreement. We improve upon this by, firstly, taking the period of the study as 1995-2009, which corresponds to the time span when the developing countries actually started the process of complying with the TRIPs requirement. This helps us to capture more effectively the impact of strengthening IPRs. Secondly, The TRIPs agreement requires WTO members to meet certain minimum standards within a stipulated period of time, therefore, the burden of harmonizing the IPR system across countries largely falls on the shoulders of developing member countries as TRIPs agreement specifies the minimum standards to be fulfilled based on those enforced in developed countries. Thus, there is a possibility that the effect of stronger IPRs on income distribution in developed countries may not be too distortionary. An investigation of this possibility requires empirical substantiation that covers both developed and developing countries in the analysis. Adams's (2008) study focuses on the relationship between IPRs and income inequality in developing countries alone. We include both developed and developing countries in the study, which allows us to bring out more starkly the differences in the income-distributions implications of stronger IP protection between the two groups of countries.

3. **Theoretical Framework**

This section discusses the theoretical framework that constitutes the basis for the empirical analysis.

[6] The Gini index is measured as the Gini coefficient multiplied by 100. The Gini coefficient is a ratio with values between 0 and 1, with 0 representing perfect income equality and 1 being perfect inequality. The income inequality data is obtained from Chen, Datt and Ravallion (2004) POVCAL software, maintained on the World Bank's website.

The theoretical framework of our empirical research has been borrowed from Chu and Peng (2011). They develop a quality ladders model based on Grossman and Helpman (1991a) and extend it to a two-country setting with trade in intermediate inputs, and with wealth heterogeneity among households. In their model, there are two countries -- denoted as North and South. Both the North and the South invest in R&D, but North has a higher degree of innovative capability than the South. There is a continuum of identical households (except for the initial holding of wealth) on the unit interval $h \in [0,1]$ in each of the two countries- North (N) and South (S). In country N, household's $(h's)$ utility function is given by:

$$U^N(h) = \int_0^\infty e^{-\rho t} \ln C_t^n(h) dt,$$

where $C_t^n(h)$ denotes household h's consumption in country N at time t. $\rho > 0$ is the exogenous discount rate or the rate of time preference. Household h's share of financial assets at time 0 is exogenously given by $s_{v,0}^n(h) \equiv [V_0^n(h)/V_0^n]$ and it has a general distribution function with mean of one and standard deviation σ_v^n(i.e. coefficient of variation of wealth).[7]

From the household h's intertemporal optimization, the Euler equation is derived to be of the standard form given as:

$$\frac{\dot{C}_t^n(h)}{C_t^n(h)} = \frac{\dot{C}_t^n}{C_t^n} = r_t^n - \rho$$

where $\dot{C}_t^n(h)/C_t^n(h)$ is identical for all h and $r_t^n \equiv R_t^n - \dot{P_t^n}/P_t^n$ is the real rate of return on assets. Chu and Peng (2011) show that the aggregate economy is always on a unique and stable balanced-growth path and the distribution of assets is stationary along the steady state. Along the steady state or the balanced growth path, all the variables grow at some constant (or possibly zero) rate.

The income inequality is measured by the coefficient of variation of income, given by:

$$\sigma_Y^n \equiv \sqrt{\int_0^1 \left[s_{y,t}^n(h) - 1\right]^2 dh} = \left(\frac{\rho + g^n}{\rho + g^n + \varphi^n}\right) \sigma_v^n \qquad (1)$$

where the coefficient of variation of wealth σ_v^n is exogenously given at time 0. φ^n captures the productivity of R&D workers in country n. g^n is the rate of growth of consumption in the balanced growth path, such that

$$g^n \equiv \frac{\dot{C_t^n}}{C_t^n} = [(1-\alpha)\lambda^n + \alpha\lambda^s] \ln z. \qquad (2)$$

λ^i is the Poisson arrival rate of invention in country *i* , where *i = s, n* and *z > 1* is the exogenous quality improvement from each invention.

Holding ρ, φ^n and σ_v^n constant in Eq. (1), notably income inequality is found to be increasing in the growth rate of income. This follows from $\partial\sigma_Y^n/\partial g^n > 0$. An increase in patent protection in any country

[7] $V_0^n(h)$ is the value of financial assets owned by household *h* in country *n* at time 0.

improves the incentives for R&D. This causes labor to move from the production sector to the R&D sector, thus leading to an increase in economic growth (from eq.(2)). The higher economic growth raises income inequality in both the countries. Implicitly, a higher growth rate increases the real interest rates through the Euler equation which in turn, implies higher return on financial assets. This higher return on financial assets raises the income of financial asset-wealthy households relative to financial asset-poor households in each country. As a result, stronger IPRs increase income disparities among households within a country.

Further, Chu and Peng (2011) derive the pre-TRIPs Nash equilibrium level of patent protection that is sub-optimally low as it does not account for cross-country spillover effects of patent protection. Also, the North chooses a higher level of patent protection than the South. An imposition of the North's higher level of patent protection on the South, as required by TRIPs Agreement, increases welfare in the North but decreases welfare in the South, as South deviates from its best response, making it worse-off.[8] They find that there exists a critical degree of cross-country spillovers below (above) which global welfare is lower (higher) under TRIPs Agreement than in the absence of it. This varying degree of cross-country spillover is explained by the importance of foreign goods in domestic consumption. When the share of foreign goods in domestic consumption is small, cross-country spillovers of innovation are small as well. In this case, imposing the North's level of patent protection on the South makes the South worse off without making the North much better off. When foreign goods constitute a very small portion of domestic consumption, both North and South are almost in autarky. Innovation in the North will not lead to a large increase in monopoly profits if foreign goods are not demanded in South. Therefore, North will not be much better off and as explained above, South is also worse off due to deviation from its best response. As a result, global welfare will fall if the share of foreign goods in domestic consumption is small. The above finding implies that a sufficient degree of globalization is a necessary condition for the harmonization of IPR protection to improve global welfare. The TRIPs agreement is likely to have asymmetric effects on the North and the South.

Drawing on the main findings of Chu and Peng (2011), our 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 for any differential impact of IPRs on income inequality in developed vis-à-vis developing countries.

The following sections include a discussion on the data sources used in the study, the specific empirical relationship being estimated, and the associated hypotheses to be tested.

[8] South has lower innovative capability than North. Therefore, South has a lower level of patent protection before TRIPs but South has to increase its level of patent protection as required by TRIPs which makes it worse-off.

4. Data and Methodology

4.1. *Data*

The data have been obtained from various sources. Most of the data are obtained from the World Development Indicators, World Bank. A set of 65 countries (29 developed and 36 developing), have been chosen for our analysis which cover the time period 1995-2009.The sample of countries is diverse, representing different income groups and regions[9].

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.[10] Overall, the SWIID includes Gini estimates for gross and net income inequality for 171 countries from 1960 to 2011.[11] Therefore, our chosen measure for income inequality is the net income Gini index from SWIID.

To measure IPRs, we use the Ginarte and Park index, a widely used index for measuring strength of intellectual property rights. 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 Annexure C for a detailed description of the index).

Furthermore, our analysis also takes 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 magnitude of capital flows -- FDI in particular, and exchange rate fluctuations in this literature on openness and income inequality (Milanovic 2005, Dollar

[9] The countries included in the sample are listed in the Annexure A.

[10] http://myweb.uiowa.edu/fsolt/swiid/swiid.html .(Accessed on 20 December, 2013)

[11] 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.

and Kraay 2002, Beer 1999, Sylwester 2005, Meschi and Vivarelli 2009). Following this strand of literature, we have included two indicators of openness in our model – net FDI inflows as percentage of GDP (FDI) and imports of goods and services as percentage of GDP (IMP).[12] The variable IMP captures the importance of foreign goods in domestic consumption, which is a key factor in determining the implication of stronger IPRs on income inequality in Chu and Peng (2011).[13] The data for both of these variables have been taken from the World Development Indicators Database which is available on World Bank's website.[14]

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). We have included an indicator of secondary education (SEC EDU) in our model. 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 has been taken from the Barro-Lee database.[15]

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, we have included one indicator reflecting the political conditions of the countries in our 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 are taken from the Worldwide Governance Indicators (WGI) database.[16] (See Annexure D for explanation of methodology used for calculating these indices.)

[12] 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)

[13] 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).

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

[15] 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

[16] 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, we have also incorporated per capita GDP growth rates and annual population growth rates in our empirical tests. The coefficient of the variable GDP captures the relationship between income-inequality and income growth rate.[17] The coefficient of the variable POP indicates how the distribution of income changes as a country experiences growth in population.[18] The data for these two variables are also obtained from the World Development Indicators (WDI) database available on World Bank's website.[19] The following table summarizes the variables used in our analysis and the source from which these data are 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)

4.2. Model Specification

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

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

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

[17] 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)

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

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

In the above equation, $INCOME\ INEQ_{it}$ refers to income inequality measured by the Gini index for country i in period t. $IPRS_{it}$ uses the Ginarte and Park IPRs index. $SEC\ EDU_{it}$ measures the level of education attainment for country i in period t. $GDPGROWTH_{it}$ represents the annual growth rate of per capita GDP. IMP_{it} and FDI_{it} represent imports as a percentage of GDP and net FDI inflows as a percentage of GDP respectively. POP_{it} is the population growth rate. $POL\ STAB_{it}$ is the indicator for political stability and absence of violence. DC is the dummy variable which takes 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. We have also adopted the same approach. Our panel comprises of data averaged for three 5-year time periods.[20]

In our baseline model, the distributional implications of IPRS are 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 need to be evaluated at appropriate values of $GDPGROWTH_{it}$ .We evaluate these partial effects using the average of the averaged per capita GDP growth rates for the sub-period 2005-2009, separately for developed and developing countries in the sample.[21] To do this, we re-parameterize our baseline model as follows:

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

where $IPRS_{AVG}$ is the average value of Ginarte and Park IPR index for the period 2005-09 and $GDPGROWTH_{AVG}$ is the average of the averaged per capita GDP growth rates for the period 2005-09. In the reparameterized model, the variables $IPRS_{it}$ and $GDPGROWTH_{it}$ are measured as distances or

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

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

deviations from the average IPR and average of averaged per capita GDP growth rate values respectively.[22]

We expect a positive and significant coefficient of $IPRS_{it}$, similar to Adams (2008), who found a significant and positive relationship between IPRs and income inequality. We have included an interactive term for the IPR index and per capita GDP growth rate in our 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, we can conclude 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.

Further, the literature on openness and income inequality finds openness to be pro-inequality (Beer 1999, Barro 2000, Lundberg and Squire 2003, Meschi and Vivarelli 2009). Therefore, we expect our two indicators of openness-IMP_{it} and FDI_{it} to be positively related with income inequality. The variable $GDPGROWTH_{it}$ captures the relationship between economic growth and income inequality, which could be positive or negative. We expect the variable $POL\ STAB_{it}$ to be negatively related with income inequality as factors that facilitate good governance reduce income inequality (Knack and Anderson 1999). $SEC\ EDU_{it}$ is expected to have a negative sign as education imparts skills leading to decrease in skilled-unskilled wage gap (Calderon and Chong 2000).

5. Empirical results

This section discusses the key results of our study.

5.2. Basic Tests

The countries in our 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 need to be done to check for the presence of heteroscedasticity and autocorrelation in our data.

[22] 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 is performed to check for heteroscedasticity of the error term across countries. The null hypothesis is that the error variance is constant across countries. The p-value of the Wald test is 0.0000 which implies that the null hypothesis is rejected. There exists group-wise heteroscedasticity, that is, the error variance varies across countries. Similarly, Woolridge (2002) test is done to check for autocorrelation in our panel data. The null hypothesis is that there exists no first-order autocorrelation. The p-value of the Woolridge test is 0.0046 which is sufficiently low to reject the null hypothesis. This implies there also exists autocorrelation of order one. Thus, our diagnostic tests indicate that our error terms are heteroscedastic and autocorrelated.[23]

We have run regressions on both fixed effects (FE) and random effects (RE) specifications corrected for autocorrelation and heteroscedasticity.[24]Although the Hausman test favors FE over RE, we have chosen 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 RE approach is suggested more appropriate.

In our model, income inequality varies much more across countries than over time. The Gini coefficient (indicator of income inequality) reports 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 our 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 Annexure 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 our panel far exceeds the number of time periods.[25] For the reason stated by Kanwar (2003), RE would be a more appropriate choice. Therefore, we have chosen RE over FE estimation.

[23]Detailed results of the diagnostic tests are given in Annexure E.
[24]Regressions results of FE specification are given in Annexure F.
[25] We have data for three time-periods of five year interval for each of the 65 countries in our sample.

5.2. Discussion of results

Table 1.2 reports regression results of our RE model that has 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 find that the coefficient of the variable IPR is positively correlated with income inequality and is statistically significant (Column1 and 2).However, as previously discussed, the *total* marginal impact of an increase in IPR index is estimated by the following partial derivatives:

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

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

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

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

The value of ∂ INCOME $INEQ_{it}$ / ∂ $IPRS_{it}$ for developing countries, which is evaluated using the developing country averages is positive and statistically significant (see R1.1 in BOX 1). This corroborates our hypothesis that the strengthening of IPRs leads to a direct increase in income inequality. Stronger patent rights can 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 is evaluated using developed country averages is 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.

BOX 1.**Marginal effect of change in IPR index on income inequality**

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

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

[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)].

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 *are jointly significant at 1% level. The value of* ∂ *INCOME* $INEQ_{it}$ */* ∂ $IPRS_{it}$ *for developing countries evaluated using developing countries' GDPGROWTH average is 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 reject the null* ∂ *INCOME* $INEQ_{it}$ */*∂ $IPRS_{it}$ $|_{DC=1}$ = 0. *The coefficients* $(\beta_2 + \beta_{10})$ *and* $(\beta_4 + \beta_{11})$ *are jointly significant at 1% level.*

The value of $\partial INCOME\ INEQ_{it} / \partial IPRS_{it}$ for developed countries evaluated using developed countries' GDPGROWTH average is 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.

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. We would have liked 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, we could not attempt it due to scanty cross-sectional and time series data availability on wealth inequality.[26]

The closest empirical test that we could attempt 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, we assume 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). We find that the increase in per capita GDP growth rate leads to an increase in income inequality in both developed and developing countries, but the magnitude of increase in income inequality is 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) pronounced for developed (developing) countries. However, we cannot conclude anything precisely here, as we were unable to test for the indirect wealth effect of IPRs due to data constraints.

[26] 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 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 are not enough data points available for a cross-sectional study like ours.

BOX 2 Marginal effect of change in per capita GDP growth rate on income inequality

Marginal effect given by:

$\partial INCOME\ INEQ_{it} / \partial GDPGROWTH_{it} |_{DC=0} = \beta_{3.} + \beta_4 . IPRS_{it}$.

$\partial INCOME\ INEQ_{it} / \partial GDPGROWTH_{it} |_{DC=1} = (\beta_3 + \beta_{12}) + (\beta_4 + \beta_{11}).IPRS_{it}$.

For developing countries, we reject the null $\partial INCOME\ INEQ_{it} / \partial GDPGROWTH_{it} |_{DC=0} = 0$. *The coefficients* β_3 *and* β_4 *are jointly significant at 1% level. The value of* $\partial INCOME\ INEQ_{it} / \partial GDPGROWTH_{it}$ *for developing countries evaluated using developing countries' average value for IPRS is 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 reject the null $\partial INCOME\ INEQ_{it} / \partial GDPGROWTH_{it} |_{DC=1} = 0$. *The coefficients* $(\beta_2 + \beta_{10})$ *and* $(\beta_4 + \beta_{11})$ *are jointly significant at 1% level. The value of* $\partial INCOME\ INEQ_{it} / \partial GDPGROWTH_{it}$ *for developed countries evaluated using developed country average value for IPRS is 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, we find that FDI has a negative effect on income inequality but this effect is 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) finds 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 reports a positive correlation between FDI and income inequality whereas Sylwester (2005) finds that there is 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.[27] It is only in the 1990s that financial globalization and capital mobility have 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 finds that the coefficient of FDI is negative and, in a few cases, even significantly related to income inequality. He also finds that FDI's impact is sensitive to regional differences. FDI inflows are sensitive to the level of development of the countries (measured by lagged value of GDP per capita) included in his study's sample.[28]

[27] Own calculations based on data taken from UNCTADSTAT. (http://unctadstat.unctad.org/TableViewer/tableView.aspx). Data accessed on 20 Feb, 2014.

[28] 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.

Our variable for openness, captured by imports as a percentage of GDP, is 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 worsens the distribution of income in countries.[29] 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) assert that the volume of trade (openness) affects long run distribution of income. They find 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 we find that, with respect to our core controls - population growth rates have a significantly positive impact on income inequality. Political stability and absence of violence is negatively correlated with income inequality. Our results confirm that schooling appears to reduce income inequality (Chong and Calderon, 2000; Squire, 1998).

6. Concluding remarks

As discussed in the introductory section, against the backdrop of TRIPs Agreement, our study focuses 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 find 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 is more pronounced for countries that are experiencing higher per capita GDP growth rates.

As for the developed countries included in the sample, our analysis seems to suggest that IPRs have 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-

[29]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.

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.

Our research could be extended in several directions. In particular, the analysis could focus on the specific channels through which IPRs affect income inequality in developing countries, namely, through wage or asset inequality. This provides the scope for future research in this area. A second possible direction is to determine the impact of stronger IPRs on wages in different sectors of a developing economy. This will help in giving an insight into the sensitivity of wages in different productive sectors of a developing economy in response to more stringent IPRs.

Annexure A: Sample of Countries

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

Annexure 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

Annexure 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)

Annexure 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:

a. Voice and Accountability
b. Political Stability and Absence of Violence
c. Government Effectiveness
d. Regulatory Quality
e. Rule of law
f. 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.

Source : http://info.worldbank.org/governance/wgi/resources.htm#sources

Annexure 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

Annexure 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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