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

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Abstract

The theory predicts that 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 country. Using dynamic panel data techniques and a sample of 60 countries over 1980-2011, we examine the impact of strengthening Intellectual Property Rights (IPRs) on income distribution of a country. Our results indicate that contrary to findings of previous research, strengthening of IPRs reduces income disparities within a country.

JEL Classification: F62, F63, O34.

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

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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.[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 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

[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)

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. 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 three specific ways. First, it includes both developing and developed countries in the sample. The empirical analysis has been conducted on an unbalanced panel of 60 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 1980-2011, which is more relevant as it overlaps with the timeline of compliance with TRIPs Agreement by the developing countries. Thirdly, this is a first study to employ GMM estimation technique to investigate the relation between IPRs and income distribution in a dynamic panel setting. As discussed in later sections, GMM estimates are more reliable and consistent as this method can take care of endogeneity bias as well as omitted variable bias, both of which are a serious concern in a dynamic unbalanced panel study.

The paper is organized as follows. Section 2 briefly reviews the existing theoretical and empirical literature on the subject. Section 3 describes the data and methodology used in the paper. Section 4 presents the empirical results and Section 5 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

[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.

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 1980-2011, 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.

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.

3. Data and Methodology

3.1 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 60 countries (27 developed and 33 developing), have been chosen for our analysis which cover the time period 1980-2011.The sample of countries is diverse, representing different income groups and regions[7].

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. Gini coefficient can be calculated in several ways-for gross income (before taxes and transfers), net income (after taxes and transfers) and consumption expenditure. The unit of analysis can be individual or household. The lack of comparable Gini coefficients -- both between countries and over time -- has long been a major obstacle in research on inequality. The Luxembourg Income Study (LIS) is considered to be the most reliable source of cross-nationally comparable income inequality data. The LIS provides inequality statistics calculated using a uniform set of assumptions and definitions on the basis of

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

microdata from national household income surveys. Unfortunately, LIS, at present, provides data for only 41 countries, that too largely rich ones and with very few observations from before 1990.

The other alternative is the World Income Inequality Database (WIID) created by the World Institute for Development Economics Research of the United Nations University (UNU-WIDER). This is an updated and expanded version of the Deininger and Squire (1996) dataset. The most recent version (WIID 3c) contains 6854 observations on Gini coefficients, covering 179 countries. However, Gini coefficients cannot be compared globally due to the differing methodologies in terms of geography, age, population covered, welfare definition, equivalence scale within and across countries and large data gaps over time. To ensure intertemporal and spatial comparability, Deininger and Squire recommended using only those observations that are based on same type of underlying data. But this strategy dramatically reduces the number of observations available for analysis. An alternative recommendation is to follow a constant adjustment procedure to deal with systematic differences in definition. For instance, Deininger and Squire (1996) recommend adding three points to net-income based inequality observations to make them comparable with gross-income based inequality observations. Alternatively, one can introduce additive dummy variable for those observations that relate to gross-income rather than net-income assuming that difference between Gross and Net income inequality measures remain constant over time. However, such kind of constant adjustments are fraught with problems. As Bergh (2005) point out that the difference between gross and net income Gini coefficients depends on the degree to which taxes and transfers are progressive and redistribute income from rich to poor. Consequently, constant adjustment introduces systematic errors into the data as the difference varies across countries and over time.

The Standardized World Income Inequality Database (SWIID) created by Fredrick Solt (Solt 2009) is the most comprehensive cross-national database of Gini indices across time. Taking Luxembourg Income study as standard, SWIID uses WIID (2.0), World Bank's PovcalNet and other databases to construct a cross-country panel of standardized Gini indices.[8]Instead of using a constant adjustment procedure to account for missing observations, Solt (2009, 2016) use various techniques to estimate the ratios between different types of Gini indices, focusing on information about the ratio in the same country nearby in time, to increase the number of comparable observations. Overall, the SWIID includes Gini estimates for gross and net income inequality for 174 countries from 1960 to 2013.Keeping in mind, the discussion above on construction and standardization of income inequality measures, our preferred measure for income distribution is the net income Gini index from Solt (2016). As a test of sensitivity, we also use gross income Gini index from Solt (2016) as dependent variable.[9]

To measure IPRs, we use the Ginarte and Park index, a widely used index for measuring strength of patent 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. But now, index has been extended to 122 countries and updated to 2010. 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 B for a detailed description of the index).

Some other measures of IPR protection do exist in the literature. Hamdan (2009) has constructed an IPR index based on the World Trade Organization's Trade-Related Aspects of Intellectual Property Rights

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

[9] We tried using other inequality measures from WIID for sensitivity analysis but could not get sufficient comparable observations on income distribution for running our panel regressions.

(TRIPS).Her index tracks TRIPs implementation of 53 developing countries. It is built for all the seven IPR categories mentioned in the TRIPS agreement and notes the compliance of each IPR category based on whether the legislation in the specified country meets the TRIPs mandated term of protection or not. However, her index is available only for the period of 1994-2007 and does not cover developed countries. Another measure of IPR protection is the IP index of Global Competitiveness Report (GCR) of World Economic Forum (WEF). GCR's IP index is based on WEF Executive Opinion Survey and is available from 2005. It gauges the perceived strength of IPRs in a particular country on the basis of perceptions of the survey's respondents about IPR protection in respondent's country. Being a survey-based index, this might not be a good choice for cross-country analysis as the index is highly subjective to the questions posed and the experts selected. Given these limitations of other IPR indices, Ginarte and Park index is the best available option.[10]

Besides IPRs, we include a number of other covariates in our specifications that may influence income inequality. Globalization is considered as one of the factors affecting income inequality. The exposure of 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 the 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, we have included two indicators of openness in our model – net FDI inflows as percentage of GDP (FDI) and sum of exports and imports of goods and services as percentage of GDP (TRADE OPENNESS).[11]

Thirdly, 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 (SCHOOLING) in our baseline model. SCHOOLING measures the level of educational attainment of population in a country. It is defined as average years of secondary schooling of population aged 15 years and above. The data for this variable has been taken from the Barro-Lee database.[12] The baseline model also includes log of real per capita GDP to correct for any distributional effects driven by income levels.

To examine the robustness of our results, we do sensitivity analysis by adding more covariates to our baseline specification. Good governance (institutions and policies that enforce property rights and restrain government corruption) are associated with lower income inequality (Knack and Anderson 1999). 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. Keeping these findings in mind, we have included two indicators of political rights and civil liberties from Freedom in the World report published by Freedom House. Countries are assigned scores from 1 to 7, with smaller values assigned to countries with greater liberties. Scores for political rights index are based on a checklist of questions broadly covering electoral process, political pluralism and participation,

[10] Ideally, it would be appropriate to do correlation analysis of the GP index with other indexes of IPR protection and do sensitivity analysis using other measures of IPR. But unfortunately, no other IPR index is available for sufficient number of countries and a long enough period to test our hypothesis in panel regressions. Therefore, we use the GP index.

[11] 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)

[12] 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

functioning of government. Similarly, scores for civil liberties index are based on questions related to freedom of expression and belief, rule of law, associational and organizational rights and individual rights.

Additionally, we test the robustness by incorporating Government consumption expenditure and inflation rate in our empirical tests. [13,14] Table 1.1 summarizes the variables used in our analysis. Table 1.2 present the descriptive statistics for the variables used in our study.

Table 1.1 Data definitions and sources

Variable	Definition	Source
NET INCOME GINI	Gini index on net income	SWIID 5.0
IPRS	Ginarte and Park Index	Ginarte and Park(1997) and Park(2008)
SCHOOLING	Average years of secondary schooling	Barro and Lee(2013)
PER CAPITA GDP	GDP per capita (constant 2005 US$)	World Development Indicators(WDI)
TRADE OPENNESS	Sum of exports and imports (% of GDP)	World Development Indicators(WDI)
FDI	Net FDI inflows (% of GDP)	World Development Indicators(WDI)
POLITICAL RIGHTS	Political Rights Index	FREEDOM HOUSE
CIVIL LIBERTIES	Civil Liberties Index	FREEDOM HOUSE
GOVT CONSUMPTION	General Government Final Consumption Expenditure (% of GDP)	World Development Indicators(WDI)
INFLATION	GDP Deflator (Annual Growth rate %)	World Development Indicators(WDI)

Table 1.2 Descriptive Statistics

Variables	N	Mean	Standard Deviation	Min.	Max
Net Income Gini	378	37.79	9.434	19.68	60.43
Gross Income Gini	378	46.17	6.667	27.03	69.08
FDI	378	2.709	3.365	-4.310	24.11
Government Consumption	378	15.53	5.362	4.080	38.68
Political Rights	378	2.384	1.637	1	7
Civil Liberties	378	2.660	1.498	1	7
Inflation	378	28.68	175.8	-6.215	2,523
Schooling	378	2.705	1.316	0.190	6.840
IPR	378	2.957	1.207	0.200	4.880
Trade Openness	378	72.46	52.34	13.04	410.2
Per capita GDP	378	14,148	15,089	192.8	59,002

[13]General government final consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defense and security, but excludes government military expenditures that are part of government capital formation.(Source: WDI)

[14] Inflation is measured as the annual growth rate of the GDP implicit deflator.GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency. (Source: WDI)

3.2 Model Specification

To analyse the effect of IPRs on income inequality, we formulate the following empirical model:

$$INCOME\ GINI_{it} = \beta_1 + \beta_2 . INCOME\ GINI_{it-1} + \beta_3 . IPRS_{it} + \beta_4 . Controls_{it} + \theta_t + \mu_i + \varepsilon_{it} \quad (1)$$

where i represents each country and t represents each 5 year period. $INCOME\ GINI_{it}$ refers to income inequality measured by the net income Gini index for country i in period t.The inclusion of lagged value of income inequality, $INCOME\ GINI_{it-1}$ accounts for the persistent and path-dependent nature of inequality which is affected by institutional and structural factors that are very slow to change. $IPRS_{it}$ uses the Ginarte and Park IPRs index. $Controls_{it}$ include the additional covariates presented above. μ_i is idiosyncratic and time-invariant country-specific fixed effect while θ_t is time-specific heterogeneity. ε_{it} is a normally distributed error term.

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 seven 5-year time periods.[15]

Eq. (1) is a dynamic panel specification where lagged dependent variable has been included along with country level fixed effect (FE). In this case, both OLS and FE estimation yield biased and inconsistent estimates.OLS estimation results in upward bias due to the positive correlation between lagged dependent variable and fixed effect whereas FE estimation results in downward bias due to negative correlation between within-transformed lagged dependent variable and within-transformed error term (Nickell 1981). Although as the time dimension T gets large, FE becomes consistent, however T is not very large in our study so the presence of "Nickell bias" cannot be denied[16].

Also, the above specification has potential endogeneity problem as causality may run in either direction for IPR, FDI and other variables. To cope with these problems and obtain consistent estimates, we estimate Eq. (1) using the two-step system Generalized Method of Moments (GMM) estimation technique.[17] This estimator combines the first-differenced regression equations with the level equations in a single system. It, then, jointly estimates using first-difference equations instrumented by lagged levels of regressors and using level equations instrumented by lagged differences of regressors (see Arellano and Bover, 1995, Baltagi, 2008).Generally, system GMM estimator provides consistent estimates in the presence of endogenous variables, country-specific effects and in situations with few periods and large countries.[18] However, the consistency of GMM estimates depends on whether instruments are valid (i.e. no correlation between the error term and the instruments) and on the absence of second order serial correlation in the first difference of the residuals. Both assumptions are tested using the Sargan-Hansen

[15] Except for the last sub-period 2010-2011 which is a two-year sub-period.

[16] We have 7 sub-periods for 60 cross-sectional units.

[17] See Arellano and Bond (1991) and Blundell and Bond (1998) for details. In one-step system-GMM, the weighting matrix makes use of differenced errors, whereas in the two-step version, the one-step residuals are used to compute a new weighting matrix.

[18] The difference GMM estimator can also be used in this context as explained by Arellano and Bond (1991). However, the difference GMM estimator often performs poorly when the number of periods, as in our case, is limited (Bond et al 2001). Moreover, the difference estimator does not allow for country specific effects.

test and Arellano-Bond (AB) test for second-order serial correlation respectively. If system GMM properly controls for endogeneity, we expect the coefficient of lagged dependent variable to lie between the OLS estimate which is biased upwards and the fixed-effect estimate which is biased downwards (Bond 2002).

4. Empirical analysis

We begin the empirical analysis by estimating Eq. (1) using three different methods: OLS, FE and system GMM. The dependent variable is country Gini index of net income. All regressions include period dummies and we account for heteroscedasticity by employing robust standard errors. Table 1 presents the regression results. Columns (1)-(2) report the OLS and FE estimates of our model. With respect to our key variable of interest, we find that the variable IPR is negatively correlated with income inequality which is contrary to the findings of theoretical literature on IPRs and income distribution. However, as discussed above, OLS and FE regressions can provide inconsistent estimates owing to reasons such as endogeneity, dynamic panel bias and omitted variable bias. Therefore, we focus mainly on system GMM results of Table 1. As we discussed earlier, system GMM, if valid, should produce a coefficient estimate of lagged Net Income Gini lying between the OLS and FE estimates. Indeed, we find this to be the case in our results. Also, the Arellano Bond (AB) test and Hansen test could not reject the null hypothesis of no serial correlation and instrument validity. We choose to treat IPR, FDI, lagged Net Income Gini and log of per capita GDP as endogenous variables with lags upto 4^{th} period as instruments. We treat Inflation and Schooling as pre-determined variables. As suggested by Roodman (2009a), we collapse the instrument set to reduce the number of moment conditions in order to avoid overfitting bias due to instrument proliferation. Also, since the estimated standard errors of the two step GMM estimates tend to be negatively biased, we eliminate the bias by using Windmeijer (2005) finite sample correction by using two-step robust GMM (Windmeijer, 2005; Roodman, 2009b). Also, Difference-in-Hansen statistics (not reported) show that all groups of instruments for endogenous variables are exogenous. Therefore, we attach our highest reliability on the system GMM results reported in Column (3) of Table 2.1.

From Column (3), we find that negative association between IPR and income inequality as per OLS and FE results of Columns (1)-(2) turns statistically significant. This result is in stark contrast to the findings of Adams (2008). Strengthening of IPRs does not worsen the income distribution but instead reduces disparities. We check consistency of this finding by introducing an interactive dummy (IPR*Developed Dummy) in our model. The interactive dummy IPR*Developed dummy checks for any differential impact of IPRs on income distribution in developed countries vis-à-vis developing countries. The coefficient on IPR remains significantly negative. However, there exists no significantly different income distributional consequences of strengthening on IPRs on developed countries (see Column 4 of Table 2.1).

Table 2.1 IPRs and Income Inequality

Dependent variable : Net Income Gini				
VARIABLES	**(1) OLS**	**(2) Fixed Effects**	**(3) System GMM**	**(4) System GMM**
Lagged Income Gini	0.915***	0.623***	0.707***	0.693***
	(0.021)	(0.046)	(0.089)	(0.099)
IPR	-0.347	-0.448	-1.081**	-1.097**
	(0.282)	(0.303)	(0.478)	(0.510)
Log of per capita GDP	-0.031	2.728**	-0.818	-0.123
	(0.233)	(1.259)	(0.964)	(1.121)
Trade Openness	-0.001	-0.001	-0.015**	-0.017**
	(0.003)	(0.011)	(0.007)	(0.007)
FDI	0.025	-0.003	0.143	0.131

	(0.062)	(0.058)	(0.137)	(0.129)
Schooling	0.230	0.197	0.131	0.152
	(0.139)	(0.356)	(0.888)	(0.876)
Inflation	-0.000	0.001**	0.001	0.001
	(0.001)	(0.000)	(0.002)	(0.002)
IPR*Developed dummy				0.007
				(0.599)
Developed dummy				-1.876
				(1.907)
Constant	3.306	-9.004	22.734**	18.114*
	(2.068)	(11.109)	(9.388)	(9.607)
R-squared	0.948	0.504		
Time dummies	YES	YES	YES	YES
Hansen test			0.332	0.327
AB test			0.173	0.158
Number of instruments			36	38
Number of countries		60	60	60
Observations	318	318	318	318

Notes: The results reported for the Hansen test and AB test are the p-values of the null hypothesis of the appropriate set of instruments and no second-order correlation respectively. Robust standard errors in parentheses. Developed dummy =1 for high income countries, 0 otherwise. *** p<0.01, ** p<0.05, * p<0.1

To test the robustness of our results, we introduce additional covariates – political rights, civil liberties and government consumption to our baseline specification. Column (1)-(2) of Table 2.2 reports results of the extended specification. Inclusion of additional covariates does not alter the main finding of IPRs having a significantly negative impact on income distribution. We undertake a second type of robustness check in which we take Gross Income Gini index as dependent variable in place of Net Income Gini index. Replacing Net Income Gini with Gross Income Gini reveals a negative coefficient on IPR akin to prior findings but significance on IPR disappears in one specification (Column 3 of Table 2.2).

Table 2.2 IPRs and Income Inequality – Robustness Tests

Dependent Variable	**Net Income Gini**		**Gross Income Gini**	
	(1)	**(2)**	**(3)**	**(4)**
VARIABLES	**System GMM**	**System GMM**	**System GMM**	**System GMM**
Lagged Income Gini	0.709***	0.720***	0.739***	0.715***
	(0.084)	(0.088)	(0.076)	(0.079)
IPR	-1.072*	-1.031	-0.563	-0.831*
	(0.537)	(0.660)	(0.549)	(0.475)
Log of per capita GDP	-1.202	-1.290	0.206	-0.173
	(1.031)	(1.080)	(0.977)	(0.877)
Trade Openness	-0.017**	-0.019**	-0.008	-0.012
	(0.008)	(0.008)	(0.009)	(0.010)
FDI	0.190	0.194	0.071	0.082
	(0.133)	(0.159)	(0.111)	(0.097)
Inflation	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Schooling	0.557	0.640	0.003	-0.386
	(0.853)	(0.832)	(0.867)	(0.844)
IPR*Developed dummy		0.219		0.699
		(0.639)		(0.519)
Government Consumption	-0.033	-0.026	0.156**	0.177**
	(0.089)	(0.079)	(0.063)	(0.068)
Political Rights	0.660*	0.736*	0.423	0.516
	(0.370)	(0.408)	(0.451)	(0.458)

Civil Liberties	-0.951	-1.053	-0.437	-0.655
	(0.657)	(0.807)	(0.723)	(0.680)
Developed dummy		-0.758		-0.949
		(2.065)		(1.767)
Constant	25.718***	25.669***	10.668	16.743*
	(8.905)	(9.231)	(8.030)	(8.549)
Time dummies	YES	YES	YES	YES
Hansen test	0.327	0.327	0.327	0.327
AB test	0.158	0.158	0.158	0.158
Number of instruments	38	38	38	38
Number of countries	60	60	60	60
Observations	318	318	318	318

Notes: The results reported for the Hansen test and AB test are the p-values of the null hypothesis of the appropriate set of instruments and no second-order correlation respectively. Robust standard errors in parentheses. Developed dummy =1 for high income countries, 0 otherwise. *** p<0.01, ** p<0.05, * p<0.1

The theory postulates that 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). On the contrary, we find that strengthening of IPRs leads to a decline in income inequality in most of the specifications. It needs to be analysed further the channels through which strengthening of IPRs can narrow down income differences.

As for the control variables, we find that FDI is associated with higher income inequality (albeit not in a statistically significant way). 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 were 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.[19] 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.

Our variable for trade openness is found to be significantly and negatively correlated with income inequality in most of the model specifications, suggesting that increased integration into the world economy improves the distribution of income in countries. Trade openness can have mixed effects on income distribution depending on relative factor abundance and productivity differences across countries, and the extent to which individuals obtain income from wages or capital. Besides raising skill premium, it could also increase real wages by lowering (import) prices. At the same time, increased trade flows could lower income inequality in developing economies by increasing demand and wages for abundant lower-skilled workers (Dabla-Norris et al 2015). 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.

[19] Own calculations based on data taken from UNCTADSTAT. (http://unctadstat.unctad.org/TableViewer/tableView.aspx). Data accessed on 20 Feb, 2015.

Our results suggest that Inflation which proxies for macroeconomic environment of a country has an insignificant role in raising 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 – log of per capita GDP is negatively associated with income inequality and schooling appears to widen income disparities in a statistically insignificant way.

5. **Conclusion**

Theoretical literature argues that 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 country. This paper empirically investigates the relation between IPRs and income distribution. This paper finds that strengthening of IPRs reduces income disparities within a country implying that income distributional consequences of strengthening IPRs are not that distortionary as suggested by theory. However, it needs to be analysed in detail the channels through which IPRs reduce income disparities in a country.

Annexure A: Sample of Countries

Developed	Developing
Australia	Bangladesh
Austria	Bolivia
Canada	Brazil
Chile	Bulgaria
Cyprus	China
Denmark	Colombia
Finland	Costa Rica
France	Dominican Republic
Germany	Ecuador
Greece	Egypt
Iceland	El Salvador
Ireland	Guatemala
Israel	Honduras
Italy	Hungary
Japan	India
Netherland	Indonesia
New Zealand	Jordan
Poland	Malaysia
Portugal	Malawi
Singapore	Mexico
South Korea	Pakistan
Spain	Panama
Sweden	Paraguay
Switzerland	Peru
Turkey	Philippines
United Kingdom	Senegal
United States	Sierra Leone
	South Africa
	Sri Lanka
	Thailand
	Tunisia
	Uruguay
	Venezuela

Annexure B. 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)

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