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

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1. Introduction

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 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. Zhang et al (2017), on the contrary, find that strengthening of IPRs in domestic country reduces income disparities in the presence of cross-country divergence in IPR protection and consequent, skilled mobility.

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). Most of these studies indicate that a growth-enhancing effect of IPR protection depends on country characteristics. IPRs are positively and significantly related to economic growth in high-income and low-income countries but not in middle-income countries. 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.

As it is evident from above discussion, strengthening of IPRs has far-reaching effects on income distribution within a country. However, the distributional aspects of IPRs have not been studied in depth at all. 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 extend Adams (2008) study 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 differs across countries depending on their level of development. 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. Additionally, our study utilizes the most comprehensive income inequality data retrieved from the latest SWIID version 5.0 dataset. Also our study employs LSDVC and panel GMM estimation techniques which corrects for dynamic panel bias, unobserved heterogeneity, endogeneity and omitted variable bias.

The rest of this paper is organized as follows. Section 2 describes the data and econometric methodology used in the paper. Section 3 presents the empirical analysis and Section 4 concludes.

2. Data and Methodology

2.1 ***Data***

The data have been obtained from various sources. Most of the data are obtained from the World Development Indicators, World Bank. Our dataset is an unbalanced panel of 55 countries covering the time period 1980-2011.The sample of countries is diverse, representing different income groups and regions[1].

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 World Income Inequality Database (WIID 2.0) created by the World Institute for Development Economics Research of the United Nations University (UNU-WIDER), World Bank's PovcalNet and other databases to construct a cross-country panel of standardized Gini indices.[2] 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 gross and net Gini estimates for 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).[3]

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

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[1] The countries included in the sample are listed in Table A.1 in the Appendix.
[2] http://myweb.uiowa.edu/fsolt/swiid/swiid.html .(Accessed on 20 December, 2015)
[3] 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.

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.

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 (Milanovic 2005, 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).

Education should also be taken into account while explaining within-country income inequality. An increase in education implies an increase in the supply of skilled labor force, a decrease in the relative skilled/ unskilled wage differential and an overall decrease in income inequality (Meschi and Vivarelli 2009). Therefore, we have included SCHOOLING (defined as average years of secondary schooling of population aged 15 years and above) in our baseline model. The data for this variable has been taken from the Barro-Lee database.[4] The baseline model also includes log of real per capita GDP to correct for any distributional effects driven by income levels.

Theoretically, it is argued that economies with good redistributive policies such as progressive taxes and social transfers are able to mitigate income inequality (see e.g. Rothstein 1998, Aberg 1989)[5]. Therefore, following Dabla-Norris et al (2015), we include a proxy for redistributive policies which is a simple average of the three relevant sub-indexes (transfers and subsidies, public consumption and public investment) of the size-of-the-government index of Fraser Institute Index.

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).As proxies for institutional quality, we include 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. Additionally, we incorporate a proxy for macroeconomic stability, Inflation Rate (measured using GDP deflator from WDI), in our empirical tests.[6]

Table 1.1 summarizes the variables used in our analysis. Table A.2 in Appendix provides descriptive statistics of the variables included in our empirical model.

Table 1.1 Data definitions and sources

[4] http://www.barrolee.com/ (Accessed on 22 January, 2016).Barro-Lee Dataset provides educational attainment data for 146 countries in 5-year intervals from 1950 to 2010

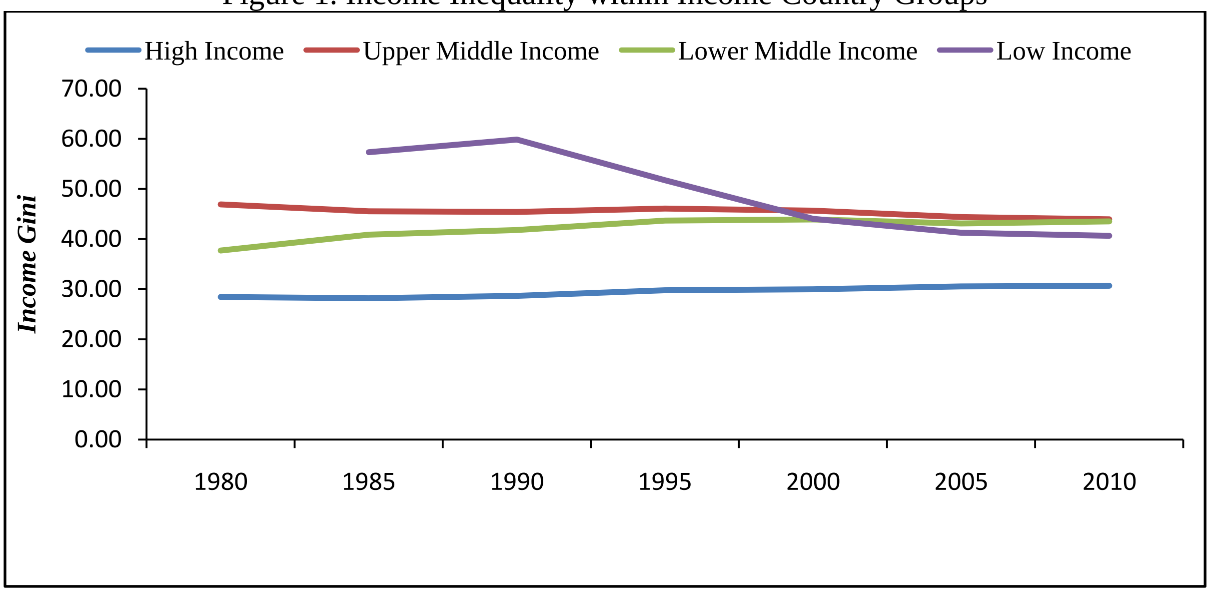
[5] We thank an anonymous referee for suggesting about the role of redistributive policies.

[6] 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)

Variable	Definition	Source
NET INCOME GINI	Gini index on net income	SWIID 5.0
GROSS INCOME GINI	Gini index on gross 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 SPENDING	Simple average of the three relevant sub-indexes(transfers and subsidies, public consumption and public investment) of the size-of-the-government index	Fraser Institute
INFLATION	GDP Deflator (Annual Growth rate %)	World Development Indicators(WDI)

It will be useful to analyze a more detailed picture of income inequality for our sample of countries. Figure 1 reveals how average income inequality varies across different income groups[7]. The average income inequality is highest in upper-middle income countries followed by lower-middle income countries. High income countries have lowest income inequality. It seems that income inequality in low income countries have declined after 1990s. However, this trend should be studied with caution as we do not have a good representation of low income countries.[8]

Figure 1. Income Inequality within Income Country Groups

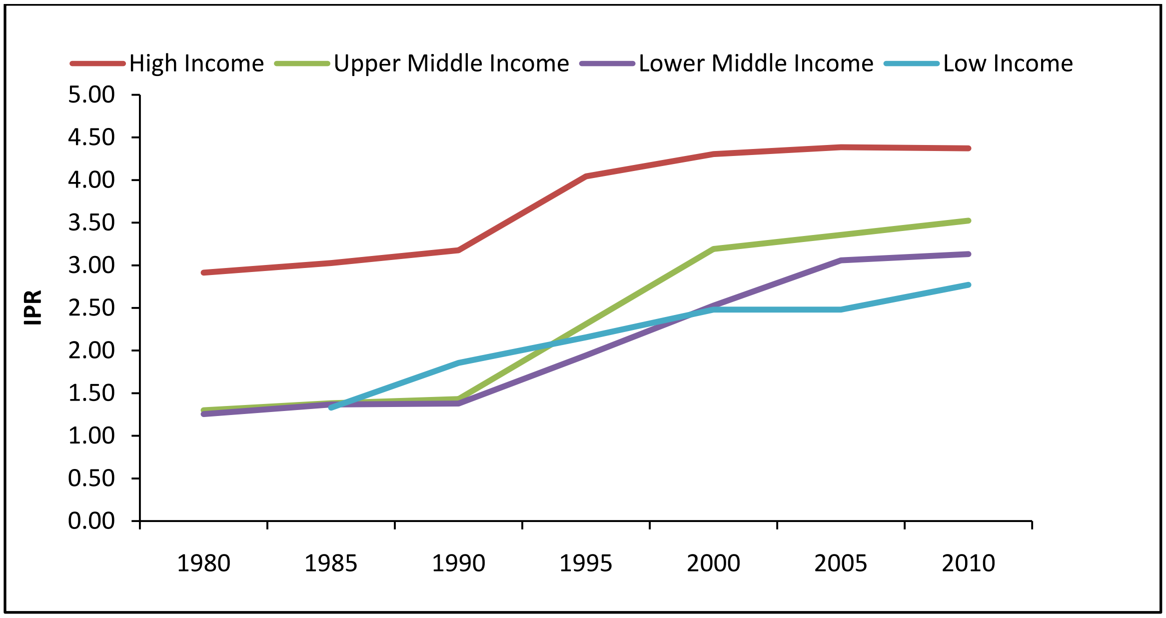


Source: Solt Database

[7] The income groups have been classified on the basis of World Bank country classifications at the end of the sample period.
[8] We have only Malawi and Sierra Leone from low income group in our sample of countries.

Figure 2 takes a closer look at the evolution of the average IPR scores for different income groups over time. While all the country groups (by income) exhibit a rise in their average index score over time, the high income countries followed by upper-middle income countries exhibit the largest magnitude of increase in their average index score.

Figure 2 Average IPR protection by Income groups



Source: Ginarte and Park (1999, 2005)

*2.2 **Model Specification***

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

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

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. $IPRS_{it-1}$ uses the Ginarte and Park IPRs index .We have used one-period lagged IPR index as it takes time for tighter IPRs to spur innovation and therefore, affect income distribution. $Controls_{it}$ include the additional covariates presented above. μ_i is idiosyncratic and time-invariant region-specific fixed effect while θ_t is time-specific heterogeneity. ε_{it} is a normally distributed error term.

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.[9]

However the inclusion of lagged value of income inequality leads to another problem of endogeneity. 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).

The most widely used approach to cope with potential endogeneity problem in first-order dynamic panel specification is to use the two-step system Generalized Method of Moments (GMM) estimation technique. [10] 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).
However, a weakness of GMM estimators is that their properties hold for N tending to infinity. Therefore, this method is only efficient asymptotically and can provide severely biased and imprecise estimates in panel data with a small number of cross-sectional units[11]. Since we have a small sample consisting of 55 cross-sectional units only, GMM designed for "small T, large N" may not be appropriate. Therefore, we have adopted an alternative approach of Least Squared Dummy Variables Corrected (LSDVC) estimation which is more suitable for small panels. This is a relatively new methodology proposed by Kiviet (1995), Judson and Owen (1999), Bun and Kiviet (2003) and extended to unbalanced panels by Bruno (2005). However, we have estimated Eq. (1) using two-step system Generalized Method of Moments (GMM) methodology also and have presented the results of this alternative specification.

In the next section, we estimate equation (1) using the Pooled Ordinary Least Squares (OLS), Fixed Effects (FE), LSDVC and GMM-SYS methodologies. The first method is affected by both heterogeneity and endogeneity; the second method takes countries' heterogeneity into account whereas both third and fourth methods take both heterogeneity and endogeneity into account.

3. Empirical Analysis

Columns (1)-(2) of Table 3.1 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. 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.

[9] Except for the last sub-period 2010-2011 which is a two-year sub-period.
[10] 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.
[11] We gratefully acknowledge an anonymous referee for pointing out this weakness of GMM estimators.

Therefore, we focus mainly on LSDVC results of Table 3.1. From Column (3), we find that negative association between IPR and income inequality as per OLS and FE results of Columns (1)-(2) is still 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.

However, the impact of tighter IPRs on income distribution of a country may depend on a country's ability to innovate. Generally, more developed countries have higher capacity to innovate than developing countries. To check whether the relationship between IPRs and income inequality is contingent upon the level of development of a country (or capacity to innovate), we include an interactive term for the IPR index and log of per capita GDP in other specifications in column (4) –(6) of Table 3.1. As Column (4) reveals, the estimated coefficient on the interactive term is positively significant implying that the strengthening of IPRs raises income inequality more for countries at higher level of development. To test the robustness of our results, we introduce additional covariates – political rights, civil liberties and inflation rate to our baseline specification in Column (5) of Table 3.1. Inclusion of additional covariates does not alter the main finding of IPRs having a significant impact on income distribution which is conditional upon the level of development of a country.

The coefficient of IPRs is negatively significant in all the specifications, showing a value ranging from 0.9 to 0.75 (Column (1) – (6) of Table 3.1) which implies that strengthening of IPRs improves income distribution of a country. Zhang et al (2017) find a similar result, that is, strengthening of IPRs reduces income inequality in domestic country in the presence of cross-border differences in IPRs and consequent mobility of skilled labour. However, the impact of tighter IPRs is also contingent upon ability to innovate which is captured by the positively significant interactive term. These two opposite effects reveal that there exists a threshold level of development (capacity to innovate) for IPRs to exacerbate income inequality.

Therefore, following Ford et al (2008) approach, we take the derivative of our econometric specification with respect to IPR and set it equal to zero to determine the threshold value of log of per capita GDP required to turn the total effect of IPR on income inequality positive. That is,

$$\begin{aligned} INCOME\ GINI_{it} &= \beta_1 + \beta_2 . INCOME\ GINI_{it-1} + \beta_3 . IPRS_{it-1} + \beta_4 . IPRS_{it-1} \\ &* \log GDP_{it-1} + \beta_5 . Controls_{it} + \theta_t + \mu_i + \varepsilon_{it} \end{aligned}$$

Differentiating w.r.t to IPR, we get:

$$\frac{\partial\ INCOME\ GINI_{it}}{\partial IPRS_{it-1}} = \beta_3 + \beta_4 \log GDP_{it-1} = 0$$

This yields the following threshold level for log per capita GDP:

$$\log GDP_{it-1} = \frac{-\beta_3}{\beta_4}.$$

As Column (1) – (6) of Table 3.1 reveal, the coefficient of IPRs (β_3) is negative implying that the threshold value of log of per capita GDP is positive. This threshold value of log per capita GDP is reported at the bottom of Table 1 for each regression. Figure 3 in the Appendix plots the value of log of per capita GDP over time for our sample of countries. Figure 3 reveals that the log of per capita GDP for all the countries is above the range of threshold levels reported in Table 3.1.This implies that strengthening of IPRs worsens income distribution as the level of development (GDP) is greater than the range of threshold values calculated for our sample of countries. Stronger patent rights increase wage inequality by increasing the return to R&D and the wages of R&D workers, who are generally employed as skilled labor (Cozzi and Galli 2009). Thus, strengthening of IPRs worsens income distribution in countries with higher level of development having higher ability to innovate.

Also it is clearly evident from Table 3.1, the coefficients of the lagged dependent variable are highly statistically significant implying that the estimates are affected by persistent and path-dependent nature of income inequality.

Table 3.1 IPRs and Income Inequality

Dependent Variable				**Net Income Gini**		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	**OLS**	**Fixed Effects**	**LSDVC**	**LSDVC**	**LSDVC**	**LSDVC**
Income Gini$_{t-1}$	0.911***	0.676***	0.878***	0.866***	0.868***	0.866***
	(0.023)	(0.084)	(0.057)	(0.056)	(0.056)	(0.056)
FDI	-0.010	0.006	0.030	0.034	0.031	0.030
	(0.060)	(0.054)	(0.042)	(0.041)	(0.042)	(0.042)
Trade Openness	0.000	0.006	0.010	0.010	0.010	0.009
	(0.003)	(0.011)	(0.010)	(0.010)	(0.011)	(0.011)
Govt Expenditure	0.292***	0.294*	0.257*	0.317**	0.317**	0.314**
	(0.105)	(0.170)	(0.150)	(0.150)	(0.151)	(0.153)
Schooling	0.312*	0.315	0.284	0.251	0.199	0.203
	(0.179)	(0.325)	(0.358)	(0.363)	(0.360)	(0.360)
Political Rights					0.226	0.229
					(0.246)	(0.248)
Civil Liberties					-0.333	-0.341
					(0.330)	(0.333)
Inflation					-0.000	0.000
					(0.001)	(0.001)
Log GDP	0.080	1.590	1.689			
	(0.237)	(1.058)	(1.086)			
Log GDP$_{t-1}$				3.473***	3.500***	3.509***
				(1.088)	(1.109)	(1.174)
(Log GDP$_{t-1}$)^2						0.509
						(4.046)
IPR$_{t-1}$	-0.489*	-0.965***	-0.982***	-0.783***	-0.762**	-0.757**
	(0.279)	(0.274)	(0.270)	(0.288)	(0.297)	(0.298)
IPR$_{t-1}$ *Log GDP$_{t-1}$				2.658**	2.849**	2.647
				(1.286)	(1.292)	(1.907)
Constant	0.787	-2.899				
	(2.311)	(11.038)				
Log GDP threshold	-	-	-	0.295	0.267	0.285
Observations	293	293	293	293	293	293
Time dummies	YES	YES	YES	YES	YES	YES

Number of countries	55	55	55	55	55	55

Notes: Robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1. In the LSDVC estimate, the bias correction was initialised by the GMM-SYS estimator and bootstrapped standard errors were computed through 200 iterations.

As for the control variables, we find that FDI is associated with higher income inequality (albeit not in a statistically significant way). Our variable for trade openness is found to be positively correlated with income inequality but is statistically insignificant. 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).

The coefficient on government expenditure is statistically significant with magnitude ranging from 0.25 to 0.31 suggesting that an increase in government expenditure leads to an increase in income inequality. This finding is contrary to theory which states that economies with good redistributive policies are able to mitigate income inequality. However, as Anderson et al (2017) discuss, impact of government spending on income inequality depends on the extent to which social transfers are targeted on lower income groups. If social transfers are mostly captured by middle class, then the mitigating effect on income inequality is relatively small. Indirect transfers which constitute a major component of total government spending in developing countries relatively benefit higher income groups (Rhee et al 2014). Also, higher government spending does not necessarily imply higher social welfare. If the government is corrupt or predatory, then government expenditure might not enhance social welfare (Bergh and Nilsson 2010).

The impact of GDP per capita on income inequality is in line with theoretical expectation and is consistently positive across all specifications. This implies a 1% increase in GDP per capita increases income inequality by 0.035 points. However, we do not find evidence for curvilinear relationship between level of development and income inequality as the regression coefficient on squared term of GDP per capita is insignificant (Column 6).

Furthermore, 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 schooling appears to widen income disparities in a statistically insignificant way. The positive association between education and income inequality is in line with the findings of Carter (2007), Berggren (1999) and Bergh and Nilsson (2010). As Dabla-Norris et al (2015) point out the effect of increased educational attainment on income inequality can be positive or negative depending on other factors such as size of education investment by individuals and governments and the rate of return on education investments. Also, the coefficients on political rights and civil liberties are statistically insignificant.

As an additional test of robustness of our baseline findings, we replace net income gini coefficients with their gross income equivalents. Column (1) of Table 3.2 presents results when using gini coefficient of gross income as dependent variable. The variable IPR_{t-1} is no longer significant but the interactive term IPR_{t-1}* Log GDP_{t-1} is still positively significant corroborating the baseline result that the impact of tighter IPRs on income inequality is contingent upon level of development of a country. Also, the magnitude of the coefficient of interactive term IPR_{t-1}* Log GDP_{t-1} is greater when dependent variable is gross income gini coefficient implying that although strengthening of IPR worsens income distribution but this impact is mitigated a bit by redistributive taxes and transfers of the government.

We, next, estimate our specification using an alternative estimator - system GMM developed by Arellano and Bover (1995) and Blundell and Bond (1998).

Table 3.2 IPRs and Income Inequality

Dependent Variable	**Gross Income Gini**	**Net Income Gini**	**Gross Income Gini**
	(1)	**(2)**	**(3)**
VARIABLES	**LSDVC**	**System GMM**	**System GMM**
Gross Income Gini$_{t-1}$	0.804***	-	0.575***
	(0.061)		(0.130)
Income Gini$_{t-1}$	-	0.718***	-
		(0.142)	
FDI	0.015	0.177	0.113
	(0.053)	(0.141)	(0.169)
Trade Openness	0.000	-0.009	-0.010
	(0.013)	(0.008)	(0.010)
Govt Expenditure	-0.099	0.094	-0.477
	(0.193)	(0.394)	(0.420)
Schooling	-0.195	0.568	-0.494
	(0.466)	(0.603)	(0.571)
Political Rights	0.442	0.360	0.761
	(0.313)	(0.497)	(0.659)
Civil Liberties	-0.677	-0.557	-0.940
	(0.420)	(0.727)	(0.956)
Inflation	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)
Log GDP$_{t-1}$	5.540***	-1.594	-3.438
	(1.459)	(1.683)	(2.335)
IPR$_{t-1}$	-0.070	-4.679*	-9.957**
	(0.383)	(2.733)	(4.707)
IPR$_{t-1}$ *Log GDP$_{t-1}$	6.645***	0.378	1.146**
	(1.685)	(0.321)	(0.542)
Constant		25.515	53.176**
		(17.602)	(23.659)
Observations	293	293	293
Number of count	55	55	55
Time dummies	YES	YES	YES
Region dummies	NO	YES	YES
Hansen test (p-level)	-	0.460	0.755
AB test (p-level)	-	0.324	0.762
Number of instruments	-	37	37

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

We choose to treat IPR, FDI, trade openness, lagged Net Income Gini and log of per capita GDP as endogenous variables with lags up to 4^{th} period as instruments. FDI and trade inflows are influenced by level of development of a country. FDI can be endogenous to growth as a growing economy attracts additional FDI due to presence of higher profit opportunities. IPR can be endogenous to growth if country adopts stronger IPR protection due to lobbying by established domestic industries who have accumulated their own IP (Kashcheeva 2013). We treat Schooling, Political Rights and Civil Liberties as pre-determined variables because education and governance cannot have immediate effect on income distribution but they impact only with a time lag. Therefore, these variables can be correlated with error terms in later periods rather than in current period. 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).

As Column (2) of Table II shows, the Arellano Bond (AB) test and Hansen test could not reject the null hypothesis of no serial correlation and instrument validity. Also, Difference-in-Hansen statistics (not reported) show that all groups of instruments for endogenous variables are exogenous. The GMM estimation indicates that the negative direct effect of IPRs on income distribution is still significant whereas the positive indirect effect captured by IPR_{t-1}* Log GDP_{t-1} loses its significance when net income gini is the dependent variable. However, the negative direct effect and positive indirect effect of IPRs remain significant when gross gini coefficients replace net gini coefficients as dependent variable (Column (3) of Table 3.2).

However, as discussed earlier, a weakness of GMM estimators is that their properties hold for N tending to infinity. Therefore, this method is only efficient asymptotically and can provide severely biased and imprecise estimates in panel data with a small number of cross-sectional units. This is the limitation of our dataset as we have data for a cross-section of 55 countries. Therefore, we put our utmost significance on our LSDVC results reported in Table 3.1.

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. However, the impact of tighter IPRs on income distribution of a country may depend on a country's ability to innovate. Generally, more developed countries have higher capacity to innovate than developing countries. This paper empirically investigates the relation between IPRs and income distribution. This paper finds that there exists a negative correlation between IPRs and income inequality irrespective of level of development of a country whereas there exists a positive correlation between tighter IPRs and income distribution which is contingent upon a country's ability to innovate. These two opposite effects imply that there exists a threshold value for level of development beyond which strengthening of IPRs exacerbates income inequality. We find that strengthening of IPRs worsens income distribution for our sample of countries as the level of development (GDP) is greater than the range of threshold values calculated for our sample set.

Appendix

Table A.1: Sample of Countries

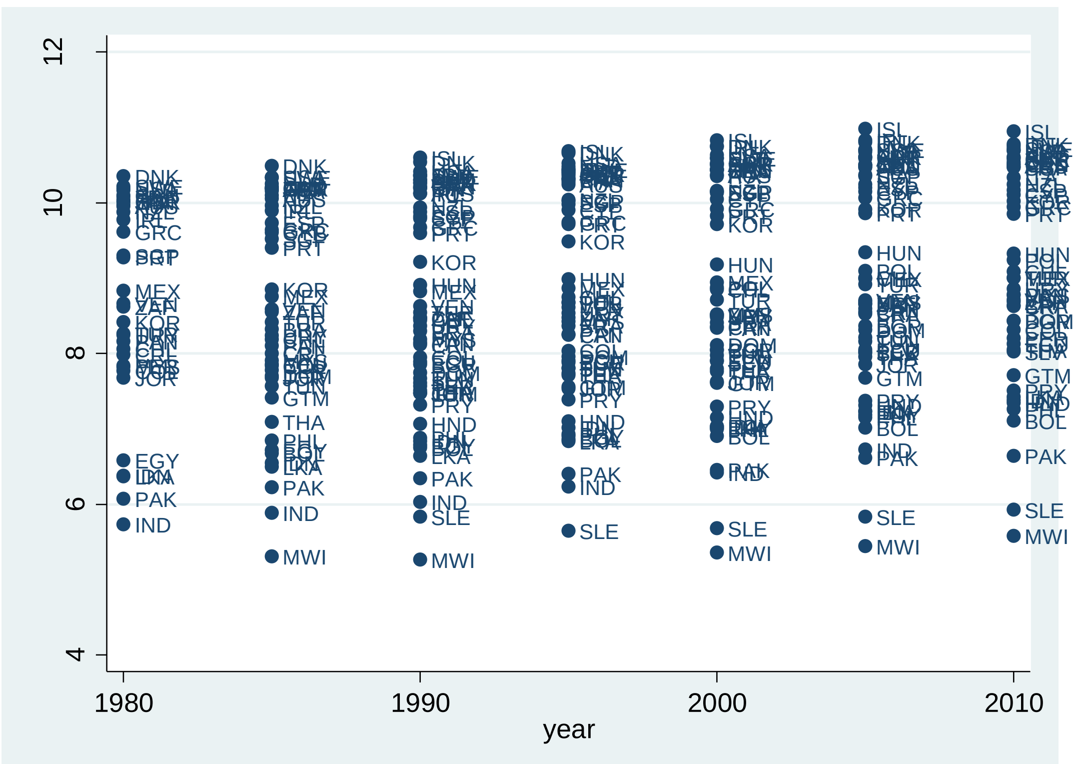
High Income	Upper Middle Income	Lower Middle Income	Low Income
Australia	Brazil	Bolivia	Malawi
Austria	Bulgaria	Egypt	Sierra Leone
Canada	Chile	El Salvador	
Cyprus	Colombia	Guatemala	
Denmark	Costa Rica	Honduras	
Finland	Dominican Republic	India	
France	Ecuador	Indonesia	
Germany	Jordan	Pakistan	
Greece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

Table A.2 Descriptive Statistics

Variables	N	Mean	Standard Deviation	Min	Max
Net Income Gini	349	37.83921	9.597657	19.683	60.4347
Gross Income Gini	349	46.37631	6.7101	27.035	69.0846
FDI	349	2.759806	3.460608	-4.30981	24.1068

Civil Liberties	349	2.58639	1.446436	1	6.8
Inflation	349	29.82123	182.6599	-6.21548	2522.81
Schooling	349	2.738711	1.281455	0.19	6.84
IPR	349	2.977908	1.215421	0.2	4.88
Trade Openness	349	73.45479	53.77766	13.04379	410.2466
Per Capita GDP	349	14235.92	14657.9	192.782	59001.5
Government Expenditure	349	6.363028	1.423436	2	9.74
Political Rights	349	2.310888	1.564154	1	7

Figure 3. Plot of log of per capita GDP over time for the sample of countries



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