How Do the Technology Transfer and Trade Openness Affect Income inequality: A Panel Data Analysis?

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Abstract

This study examines the impact of trade openness on the income inequality in the developing and developed countries. Additionally, we see if technology transfer and changes in the ratio of skilled to unskilled labor and educational attainment have any role in influencing the income inequality. We used panel data for 104 countries from both developed and developing countries during 1980-2014. We estimated the relationship using fixed effects and random effects panel regression analysis as well as system GMM technique for robustness check. We find that trade openness, expenditure on education and ratio of the skilled to unskilled labor significantly reduce inequality in both developed and developing countries. Increase in technology transfer and role of religion in politics significantly reduces inequality in the developing countries only whereas corruption increases income inequality in the developing countries only.

Keywords: Trade openness; transfer of technology; inequality

1. Introduction

Income inequality is a serious global problem and evidence indicates that world income is concentrated in the few rich elite's hands (Dabla-Norris, Kochhar, Suphaphiphat, Ricka, & Tsounta, 2015). According to Fuentes-Nieva and Galasso (2014) almost half of the global wealth is owned by richest one percent and the remaining half is owned by 99 percent population in the world. The rise in inequality is observed in both developing and developed economies in the past two decades (Jaumotte, Lall, & Papageorgiou, 2013).

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In the beginning of 1980s, many developing countries followed the trade openness path and opened their economies to the international market (Meschi & Vivarelli, 2009). The pros and cons of trade openness in terms of its impact on inequality were intensely debated, and this debate still rages on (Ucal, Haug, & Bilgin, 2016).

A number of "studies have discussed the relationship between trade liberalization and income inequality in the developed and developing countries. In developing countries, wages make up the major portion of people's income. The Heckscher-Ohlin (1991) and Stolper and Samuelson (1941) models explained that when developing countries open up their trade, demand for the unskilled labor increases which increases the wages of the unskilled labor relative to skilled labor resulting in decrease in inequality . In the developed countries, wage inequality rises in response to trade liberalization. The developed countries produce final goods, and trade openness shifts production of intermediate inputs towards developing countries (Zhu & Trefler, 2005). The demand for the unskilled labor in the developed world goes down as a response to this outsourcing of intermediate goods to the developing countries. Wages of skilled labor increase in both the developed and developing countries and the gap between skilled and unskilled labor increases and wage inequality rises.

Meschi and Vivarelli (2009) argue that in the period of trade liberalization, adoption of technology can raise the income inequality in the developing countries. Trade liberalization in the developing countries is followed by adoption of new and more efficient technology. To operate this new technology, the increased demand for the skilled labor to operate this new technology will raise the wages of skilled labor and decrease the demand for unskilled labor. This will decrease the wages of unskilled labor and income inequality will rise.

Our study posits that trade openness and income inequality relationship is mediated by the level of education. The increased wages of the skilled labor give a signal to the unskilled labor to improve their education. The unskilled labor tends to increase their education that improves the skills of the workers and future income (Kudasheva, Kunitsa, & Mukhamediyev, 2015). Higher enrollment in education and increase in the expenditure on education can produce more skilled labor that satisfies this extra demand of skilled labor (Pan, 2014). However, it is argued that the differences between the wages of skilled and unskilled labor begin to decrease over time. The wages of the skilled labor decrease and wage rate of unskilled labor increases due to some shortage of unskilled labor supply which in turn reduces the wage gap and income inequality (Pan, 2014).

In this study, we seek to estimate the impact of trade openness on income inequality. We analyze the role of transfer of technology from developed to developing countries, change in the ratio of skilled to unskilled labor caused by changes in the educational endowments in explaining the inequality in the developed and developing economies". A better understanding of the relationship among these variables may help formulate appropriate policies to reduce the income inequality by focusing on increase in trade, transfer of technology, education and skill levels in the country.

2. Literature Review

Inequality has sharply increased in the two previous decades in both developing and developed countries (Jaumotte et al., 2013). "Fuentes-Nieva and Galasso (2014) find that almost half of the wealth is owned by the richest one percent. Trade openness increases economic growth of the country and per capita income but it has the potential to increase inequality and poverty (Anderson, 2005). One obvious result of rising inequality is a sharp increase in poverty and crime. Strain theory states that when unsuccessful people see other people succeeding in life, they feel frustrated are more likely to commit crimes (Kelly, 2000). In the previous years, a number of studies analyzed the relationship between trade liberalization and wage inequality. Greater trade openness may can affect inequality through numerous channels. The relative changes in the wages of skilled and unskilled labor affect inequality (Anderson, 2005).

Effect of trade openness on inequality differs according to the region. Until 1990s, the Stolper-Samuelson (SS) model gave one of the most significant explanations of the relation between income inequality and trade openness. On the basis of Heckscher–Ohlin (HO) two factors and two country model, Stolper and Samuelson (1941) explained that the trade openness in developing countries raises the demand of the unskilled labor due to abundant unskilled labor that increases the wages of unskilled labor relative to the skilled labor resulting in the reduction in income inequality. In the developing countries, the major portion of people's income depends on the wage income. When difference between wages of skilled and unskilled labor decreases, income inequality also goes down.

Some studies have found a negative relationship between trade liberalization and inequality. The theoretical justification for this thesis is provided by the Stolper and Samuelson (1941) model. An increase in trade openness will reduce wage inequality (Bigsten & Durevall, 2006; Chakrabarti, 2000; Chaudry & Imran, 2013; Das, 2007; Gourdon, 2006; Jaumotte et al., 2013; Lin & Fu, 2016). Some studies have identified the

mechanism through which trade liberalization affects inequality. Once a country opens up and increases export, the foreign exchange thus generated significantly reduces unemployment, poverty and inequality (Castilho, Menéndez, & Sztulman, 2012). Trade openness reduces income inequality in a primary education abundant countries (Gourdon, 2006). In the autocratic small developed countries, whose major part of trade depend on primary goods that are produced by low-skilled labor, the increase in trade will decrease the income inequality between skilled and unskilled labor (Lin & Fu, 2016).

There is another stand of literature that cannot confirm the negative relationship between trade openness and inequality. Developed countries produce final goods, and trade openness shifts production of intermediate inputs towards developing countries. The production of intermediate goods in the developing countries increase the demand for skilled labor and their wages relative to the unskilled labor resulting in increasing inequality (Feenstra & Hanson, 2001). Zhu and Trefler (2005) suggest that technological changes in the developed countries increase production of skill-intensive goods and the production of less skill-intensive goods shift in the developing countries, where they are treated as most skill intensive goods so the demand of skilled labor increases in both. Wages of skilled labor increase in both the developed and developing countries, and the gap between skilled and unskilled labor increase and wage inequality increases.

Some studies see the positive relationship between trade openness and wage inequality (Barua & Pant, 2014; Beyer, Rojas, & Vergara, 1999; Galiani & Sanguinetti, 2003; Mehta & Hasan, 2012; Ranjan, 2012; Zhu & Trefler, 2005). Lin and Fu (2016) found that increase in trade increases income inequality in democratic small developing countries due to the inflow of FDI and outsourcing of business from the developed countries. They explained that outsourcing increased the demand for skilled labor, which consequently increased the wages of the skilled labor relative to the wages of the unskilled labor causing an increase in income inequality. In developing countries with large unskilled labor force, the increase in trade will raise wage inequality when export sector requires more skilled labor for the production of goods and wages provided to skilled relative to the wages of unskilled labor (Barua & Pant, 2014). Trade liberalization may increase rapid economic growth, but on the other side industrial sector labor may be adversely affected due to increased competition (Galiani & Sanguinetti, 2003). Greater trade openness can also increase inequality by reducing the ability of government to redistribute income through transfer and taxes (Anderson, 2005).

The trade liberalization and wage inequality relationship is different in developing and developed countries. Galiani and Sanguinetti (2003) found that in some developed countries the small proportion of the rise in wage inequality is due to trade liberalization. Stolper-Samuelson theorem states that after trade, wage rate increases in the labor surplus (developing) countries and decreases in the capital surplus (developed) countries. Liu (2013) found that in United States, wage inequality first increased and then decreased with trade openness, and the shift towards decrease in inequality occurred when export to domestic sales ratio was close to 30%.

There is no clear relationship between trade liberalization and inequality. In the developing countries, trade openness is found to reduce income inequality. It is argued that trade openness reduces the prices of skilled-intensive goods due to foreign competition that relatively reduces skilled labor wages (Jaumotte et al., 2013). Abundant production of unskilled-intensive exportable goods in developing countries increase prices of unskilled-intensive products relative to the wages of unskilled workers resulting in decreased income inequality (Jaumotte et al., 2013). Furthermore, Meschi and Vivarelli (2009) argue that in the period of trade liberalization, adoption of technology can raise the income inequality in the developing countries. Trade liberalization in the developing countries is followed by adoption of new and more efficient technology. To operate this new technology, the increased demand for the skilled labor to operate this new technology will raise the wages of skilled labor and decrease the demand for unskilled labor. This will decrease the wages of unskilled labor and income inequality will rise.

Outsourcing of production plays an important role in explaining the relationship between trade liberalization and wage inequality in developing countries. Outsourcing of production from developed countries to the developing countries increases production of skill-intensive goods in the developed countries, while the production of unskilled-intensive goods shifts in the developing countries. In the developing countries, the unskilled-intensive goods are considered skill-intensive goods, given that the skills levels in the developing countries are generally low. Therefore, the demand for the skilled labor increases in both the developed and developing countries, leading to increased wage inequality (Zhu & Trefler, 2005).

Some other indicators like corruption and religion in politics have been analyzed in the literature because of their perceived impact on inequality. Corruption can significantly increase income inequality (Chêne, 2014;

Gyimah-Brempong, 2002; Li, Xu, & Zou, 2000; Pi & Zhou, 2015). Poor people suffer from the consequences of corruption more seriously than the rich people, which further increases the gap between the rich and the poor (Gyimah-Brempong, 2002). Corruption also increase income inequality if the taxation system is regressive and the economic growth is not healthy (Chêne, 2014). Corruption increases inequality in the wages of skilled and unskilled workers and in the wages of rural-urban migrants (Pi and Zhou (2015).

Although the secular theory predicted that religion would become irrelevant with the level of development and education, vast majority of the people not only profess some type of spiritual affiliation but there is a "resurgence in religious fundamentalism" necessitating the analysis of religion in political life (Gill, 2001). Though the role of religions and inequality is thoroughly analyzed (Cederman, Weidmann, & Bormann, 2015; Novelli, 2016; Vazquez-Gonzalez, 2014), the existing literature does not provide a clear relationship between religion in politics and economic inequality. It is argued that religion in politics puts pressure on government to reduce income inequality through equal distribution of resources through progressive taxation or by pursuing redistributive policies. The transfer of property rights may be strongly influenced by the religious values which may influence inequality. A more equal distribution of property is believed to reduce inequality. The role of religion on inequality is more nuanced and is found to affect distribution of resources through the beliefs of income inequality (Long, 2014).

Again, some studies find that it is the inequality which determines the role of religion in the state institutions. inequality leads to more accommodating attitude towards religion. the poor groups are most likely to support religious in politics (Karakoc & Baskan, 2012). there is a counter narrative that a positive correlation between religiosity and inequality is spurious. in the countries where religiosity is high, the people engage in charitable giving privately. this results in lower taxes and lower public spending. this increases measured income inequality which is higher than actual inequality (Elgin, Goksel, Gurdal, & Orman, 2013)".

3. Model Specification

To estimate the relationship between inequality and role of trade liberalization, we specify a general panel regression model

$$GINI_{it} = \beta_0 + \beta_1 Trade_{it} + \beta_2 TOT_{it} + \beta_3 STU_{it} + \beta_4 EDU_{it} + \beta_X' X_{it} + \epsilon_{it} \quad (1)$$

$$i = 1,2,\dots,N, \quad t = 1,2,\dots,T$$

The dependent variable is Gini coefficient for individual countries *i* in time *t*. X is the vector of control variables which include corruption and religion in politics.

TOT (Transfer of Technology) is proxied by the ratio of information and communication technology (ICT) import and export.[1] Trade (Trade openness) is defined as a percentage of total value of the exports and imports as a ratio of the GDP. STU is the ratio of skilled to unskilled labor force. We have used the share of vulnerable employment as a percentage of total employment as a proxy for the unskilled labor force. ILO defines vulnerable employment as "unpaid family workers and own-account workers as a percentage of total employment."[2] The ratio of skilled to unskilled labor force refers to the variable Labor in the Eq. (1).[3] EDU (Education expenditure) is defined as a total expenditure on education (% of GDP). Education expenditure is expressed in terms of the share of GDP (% of GDP).

The nexus between corruption and inequality is thoroughly analyzed in the literature. Pi and Zhou (2015) show that corruption increases inequality in the wages of skilled and unskilled workers and in the wages of rural-urban migrants.

Although the secular theory predicted that religion would become irrelevant with the level of development and education, vast majority of the people not only profess some type of spiritual affiliation but there is a "resurgence in religious fundamentalism" necessitating the analysis of religion in political life (Gill, 2001).

We take a sample of 104 countries out of which 63 are developed while 41 are developing economies, based on the World Bank's income classification. High income, upper middle income and middle income countries are considered as developed while the rest of the countries are considered developing. The selection of the countries is based on the data availability. Data is taken from 1980 to 2014.

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[1] $Technology\ transfer_{it} = \dfrac{\text{Import of ICT from total imports (\%)}}{\text{Export of ICT from total exports (\%)}}$

[2] http://data.worldbank.org/indicator/SL.EMP.VULN.ZS

[3] $\dfrac{Skilled}{Unskilled} = \dfrac{1-(\text{Share of vulnerable employment from total employment (\%)})}{\text{Share of vulnerable employment from total employment (\%)}}$

The data of all these variables are taken from WDI except the variable related with the unskilled and skilled labor force. The data of share of vulnerable employment from total employment (%) is taken from International labor organization (ILO). Corruption and religion in politics are taken from ICRG and Gini is taken from WIDER. Earlier studies have also used the variables in our model (Kudasheva et al., 2015; Meschi & Vivarelli, 2009; Pan, 2014).

4. Methodology

We report the results of both random effects (RE) and fixed effects (FE) model of Equation (1). In the FE model coefficients of all the individuals are same, but intercept for each individual is different as described (Hill, Griffiths, & Lim, 2008) in this model.

$$GINI_{it} = \beta_{0i} + \beta_1 Trade_{it} + \beta_2 TOT_{it} + \beta_3 STU_{it} + \beta_4 Edu_{it} + \beta_3 X_{it} + e_{it} \ldots (2)$$

In this model intercept β_{0i} captures all the individual heterogeneities. To control the time-invariant individual characteristics, individual intercepts are included. The intercept in this model is called as fixed effect and the model like this is called fixed effect model. In FE model, individual differences are more likely to fix the state or seasonal factor.

In the random effect model, we recognize that individuals are randomly selected in our model and individual difference treated as random rather than fix as we take in FE model. Intercept term divide into two parts in random effect model. β_o is an intercept term, U_{it} is the country specific random effect

Where $\beta_{0i} = \beta_0 + U_{it}$ .... (3)

The RE model is as follows

$$GINI_{it} = (\beta_o + U_{it}) + \beta_1 Trade_{it} + \beta_2 TOT_{it} + \beta_3 STU_{it} + \beta_4 Edu_{it} + \beta_3 X_{it} + e_{it} \ldots (4)$$

$$GINI_{it} = \beta_0 + \beta_1 Trade_{it} + \beta_2 TOT_{it} + \beta_3 STU_{it} + \beta_4 Edu_{it} + \beta_3 X_{it} + (U_{it} + e_{it}) \ldots (5)$$

Where $v_{it} = U_{it} + e_{it}$ .... (6)

By adjusting equation (6) in equation (5)

$$GINI_{it} = \beta_0 + \beta_1 Trade_{it} + \beta_2 TOT_{it} + \beta_3 STU_{it} + \beta_4 Edu_{it} + \beta_3 X_{it} + v_{it} \ldots\ldots\ldots (8)$$

In this equation e_{it} is the regression random error term. The new error term (v_{it}) is the sum of country specific random effect (U_{it}) and the regression random error term (e_{it}). The model in this form is called random effect model.

Both types of models have strengths and limitations. FE models produce robust results for time-variant variables (Andersson, Lawrence, Zavaleta, & Guariguata, 2016). FE models consider only within-individual differences and ignore between-individual differences. However, a major limitation of these models is that they cannot assess the effects of the factors which have little within-group variation. It is a robust estimation technique because it limits the risk of omitted variables bias but has larger standard errors (Allison, 2009).

RE models on the other hand assume zero correlation between unobserved unit heterogeneity and other regressors in the model as well as the error term. Beck and Katz (2004) suggests that in practice this assumption is violated, so FE is used. It eliminates all unobserved time invariant factors such as religion as well as contextual factors that change slowly over time (Baltagi, 2008). Random-effect model is appropriate to estimate the effects of time-invariant factors (Andersson et al., 2016). RE has smaller standard errors but cannot control for possible committed variable bias.

Another "fundamental difference between FE and RE models relates to the assumption of the selection of the sample. FE model assumes that individuals in the sample are not randomly selected from a larger population (Verbeek, 2008) but in RE models, it is assumed that individuals are randomly selected from a larger population and follow a normal distribution. The implication of this difference is that if the assumption of random selection of individuals from a larger population is true, it is possible for us to make an inference to a larger population (Verbeek, 2008). Hausman test is generally applied to decide which of these models is more consistent with the characteristics of the data.

We use FE models because unobserved heterogeneity between countries is expected to be correlated with the regressors included in the model. There might be country specific factors such as democratic norms, role of religion

in the politics and level of education expenditures which may be correlated with trade liberalization (Holt & Hendrickson, 2016).

Hausman tests if the coefficients estimate from the random and fixed effects model are same or not. Under the null, if there is no correlation between the error component and the regressors, then the set of variables common to both estimation methods will give estimates with similar magnitudes". If the null hypothesis that the difference between estimators is zero, we should use fixed effects estimator (Hill et al., 2008).

5. Results

Table 1 reports the "fixed effect and random effect results for both the developed and developing countries as well as the full sample. Increase in trade openness significantly reduces income inequality in both developed and developing countries. This result is consistent with some earlier studies (Bigsten & Durevall, 2006; Chakrabarti, 2000; Chaudry & Imran, 2013; Das, 2007; Gourdon, 2006; Jaumotte et al., 2013). Trade liberalization increases competition in a country which reduces the prices of expensive goods produced by skilled labor which in turn reduces the wages of skilled labor. However, the prices of cheaper goods produced by the unskilled labor go up which in turn push the wages of the unskilled labor (Galiani & Sanguinetti, 2003)".

Table 1: Fixed and Random Effects models

	Developing countries		Developed countries		All countries	
	RE	FE	RE	FE	RE	FE
Trade (% of GDP)	-0.04*	-0.05**	-0.02*	-0.02*	-0.03***	-0.03***
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
ICT import/ICT export	-0.00**	-0.00**	0.00	0.00	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education Expenditure (% of GDP)	-1.62E-06**	-1.51E-06**	1.9E-04	1.7E-04	-8.73E-07***	-9.91E-07***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ratio of	-2.53**	-2.68*	-0.24**	-0.10	-0.24**	-0.06

skilled/unskilled labor force						
	(0.89)	(1.16)	(0.09)	(0.10)	(0.08)	(0.11)
Corruption	1.83***	2.09***	0.02	0.20	0.50**	0.65***
	(0.39)	(0.38)	(0.21)	(0.21)	(0.18)	(0.19)
Religion in politics	-0.92*	-1.86***	-0.29	-0.33	-0.51*	-0.67**
	(0.45)	(0.47)	(0.23)	(0.23)	(0.21)	(0.21)
Constant	49.47***	55.61***	45.72***	43.91***	47.33***	47.16***
	(2.42)	(2.29)	(2.14)	(1.86)	(1.62)	(1.45)
Observations	220	220	563	563	783	783
r2		0.35		0.03		0.11
r2_within	0.34	0.35	0.03	0.03	0.10	0.11
r2_overall	0.00	0.00	0.28	0.19	0.13	0.04
r2_between	0.04	0.01	0.25	0.19	0.12	0.03
F		16.74		2.94		14.17
p	0.00	0.00	0.00	0.00	0.00	0.00

Exponentiated coefficients; Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.00$

Transfer of technology has positive and statistically insignificant impact on income inequality in developed countries. Some earlier studies also see the same relationship (Esquivel & Rodrıguez-López, 2003; Meschi & Vivarelli, 2009; Moore & Ranjan, 2005; Zeira, 2007). Skilled-biased technology adoption increases the demand for skilled labor and reduce the demand of unskilled labor that increase the income gap between skilled and unskilled labor (Meschi & Vivarelli, 2009; Zeira, 2007). Transfer of technology has a negative and statistically significant impact on income inequality in developing countries. Some earlier studies also see the same relationship (Das, 2007; Kudasheva et al., 2015; Scholl, 2015). Technology adoption increases the demand for education and skilled worker and it can reduce income inequality when access to education is easy (Jaumotte et al., 2013).Education Expenditure has negative and statistically significant impact on income inequality in both the developed and developing countries as well as in the total sample. Some earlier studies also see the same relationship (Abdullah, Doucouliagos, & Manning, 2015; Afesorgbor & Mahadevan, 2016; Kudasheva et al., 2015; Pan, 2014; Qazi, Raza, Jawaid, & Karim, 2016).

Skilled to unskilled labor ratio also has a negative and statistically significant impact on income inequality in developed and developing countries. This is consistent with a few earlier studies as well (Pan, 2014). The higher wages of the skilled labor give a signal to the unskilled labor to improve their education. When the supply of the more skilled labor increases in the economy, their wages are pushed downwards but the wages of the unskilled labor goes up, thereby causing a reduction in the income equality (Pan, 2014).

Corruption has positive and statistically significant impact on income inequality in developing countries as well as in the full sample but statistically insignificant impact in developed countries. Some earlier studies also find the significant role of corruption in widening income inequalities show that corruption increases inequality in the wages of skilled and unskilled workers and in the wages of rural-urban migrants (Chêne, 2014; Gyimah-Brempong, 2002; Li et al., 2000; Pi & Zhou, 2015).

Religion in politics has negative and statistically "significant impact on income inequality in developing countries but this impact is insignificant in developed countries. An earlier study also finds the inverse relationship between these two factors (Karakoç & Başkan, 2012). Religion in politics significantly reduces inequality only in the developing countries. Religion in politics can serve to promote inequality as well as reduce inequality. When religion is used to spawn xenophobia and discrimination against minorities, the poorer sections suffer disproportionately and the inequality is further deepened. There are other ways in which religion in politics can lead to increased inequality. When the economic structures of society are such that certain religious denominations are restricted to carry out only a few economic activities that do not ensure a decent living, members of these religious communities are effectively and systematically marginalized from the society and give rise to wider inequality. The difference in the earnings on the basis of religious identity can be explained by the differences in the educational endowments of people of different religions (Bhaumik & Chakrabarty, 2006). However, when religion in politics is used to promote redistributive policies through encouraging progressive taxation (such as Zakat in case of Islamic countries) and encouraging supererogatory donations, the inequality is expected to go down".

We also applied System Generalized Method of Moment (GMM) to check the robustness of the results from FE and RE models to the choice of estimation technique (Table 2).

Table 2: System GMM model

	Developing		Developed		Full Sample	
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Gini lag (1)	0.788***	0.889***	0.529***	0.430***	0.622***	0.543***
	(26.50)	(16.21)	(14.33)	(11.63)	(18.41)	(15.64)
Gini lag (2)		-0.109*		0.220***		0.150***
		(-2.25)		(7.65)		(6.05)
Trade (% of GDP)	-0.0169	-0.0184	-0.0151*	-0.0120	-0.0148	-0.00961
	(-1.87)	(-1.92)	(-1.97)	(-1.66)	(-1.95)	(-1.32)
ICT import/ICT export	-1.62E-06	-1.51E-06	0.000186	0.000166	-8.73E-07	-9.91E-07
	(-1.56)	(-1.38)	(1.64)	(1.55)	(-0.61)	(-0.72)
Expenditure on Education (% of GDP)	-1.62E-06	-1.51E-06	0.000186***	0.000166***	-8.73E-07***	-9.91E-07***
	(-0.42)	(-0.57)	(-3.89)	(-3.62)	(-3.30)	(-3.05)
Ratio of skilled/unskilled labor force	-0.352	-0.313	-0.281***	-0.174**	-0.241***	-0.173*
	(-0.77)	(-0.65)	(-4.53)	(-2.91)	(-3.87)	(-2.88)
Corruption	0.595**	0.395	-0.269	-0.122	0.0294	0.201
	(3.03)	(1.75)	(-1.37)	(-0.66)	(0.17)	(1.23)
Religion in	-0.243	-	-0.0840	-0.264	-	-0.313

politics		0.0881			0.0968	
	(-1.19)	(-0.39)	(-0.32)	(-1.05)	(-0.43)	(-1.44)
Constant	10.35***	10.65***	25.43***	19.79***	19.48***	16.18***
	(6.04)	(5.87)	(9.61)	(7.64)	(8.79)	(7.43)
N	220	220	563	563	783	783

t statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Note: In Models 1, 3 and 5, only one lag of the dependent variable (Gini coefficient) is used, while in Models 2, 4, and 6, two lags of Gini are used.

The results of system Generalized Method of Moment (GMM) show broad similarities with the estimates from FE and RE models in terms of the signs of coefficients. "However, in the FE and RE models, the estimates are more efficient because of smaller standard errors. Using system GMM technique we see that trade openness reduces income inequality in both developed and developing countries though the statistically significant results are found only in the developed countries. Transfer of technology has positive and statistically insignificant impact on income inequality in developed countries. Education Expenditure has negative and statistically insignificant impact on income inequality in developing countries but has statistically significant impact on income inequality in developed countries as well as in the total sample. Skilled to unskilled labor ratio also has a negative and statistically insignificant impact on income inequality in developing countries but has statistically significant impact on income inequality in developed countries as well as in the total sample". Corruption has positive and statistically insignificant impact on income in developing and developed as well as full sample of countries.

6. Discussion

Trade openness reduces inequality in both the developed and developing countries. "Trade openness shifts the production of intermediate goods (which are used in the production of consumption goods) from the developed to the developing countries where there are more skill intensive goods. Consequently the demand for the skilled labor and the wages of the skilled labor go up in the developing countries which increases the

inequality between the skilled and unskilled labor(Feenstra & Hanson, 2001). Meschi and Vivarelli (2009) explains that this transfer of the technology to the developing countries, where demand for more skilled labor which can operate this new technology goes up, and the smaller demand for the unskilled laborers pushes their wages down thus causing increasing inequality. The trade liberalization increases the wage inequality in the newly industrialized and developing countries where more sophisticated products make up a major share of the exports (Zhu & Trefler, 2005).

Trade openness shifts production of intermediate inputs from developed to developing countries where they are more skill-intensive goods. As a response to this shift in the production process, the demand of the skilled labor and their go up in both the developed and developing countries. Consequently the wage gap between skilled and unskilled workers goes up (Feenstra & Hanson, 2001). Trade liberalization increase wage inequality in a newly industrialized and developing countries whose larger export share relates to skilled intensive goods (Zhu & Trefler, 2005). Trade liberalization in the developing countries provides an incentive to adopt new technology that is generally more efficient. Developing countries increase the demand for the skilled labor to operate this new technology that will raise the wages of skilled labor and reduce wages of unskilled labor due to less demand, in the response of this action income inequality rising (Meschi & Vivarelli, 2009).

Trade openness reduces inequality in both developing and developed world, though the reduction of inequality in the developing countries is more pronounced. Trade openness decrease inequality by increasing subsequent growth and initial income (Chakrabarti, 2000). Reduction in the protection of manufacturing sector reduces wages of manufacturing sector (skilled labor) with respect to agriculture sector (unskilled labor) wages that reduce the wage inequality (Bigsten & Durevall, 2006). Some studies have explored the specific mechanism of the inverse relationship between trade liberalization and economic inequality. Gourdon (2006) found that trade liberalization significantly reduces inequality only in those countries with a significantly high enrolment ratios in the higher education. Jaumotte et al. (2013) provide trade and inequality relationship for developing and developed countries in which trade openness in developing countries reduces the prices of skilled-intensive goods due to foreign competition which in turn reduces the wages of the skilled labor.

This relationship is reversed in case of unskilled intensive goods. Abundant production of unskilled-intensive exportable goods in developing countries increase the prices of unskilled-intensive product and also the wages of unskilled workers (Jaumotte et al., 2013). Consequently, the wage differences between the skilled and unskilled labor narrow down. In the developed countries, on the other hand, due to skilled labor abundant country. Trade liberalization in the developed countries increase competition and reduce the prices of expensive goods produced by skilled labor which in turn brings down the the wages of skilled labor. On the other hand, increase in the prices of cheaper goods produced by unskilled labor increase the wages of unskilled labor (Zhu & Trefler, 2005). This explains the negative relationship between the trade openness and inequality in the developed countries.

Transfer of technology as measured by the ratio of the import and export of information and communication technology shows a reduction of inequality in the developing countries only. Though theoretically outsourcing of technology in developed countries increases production of skill-intensive goods and the production of unskilled-intensive goods shift in the developing countries where they are most skill intensive goods, the demand for skilled labor increases in both of the regions that increases the wage inequality (Zhu & Trefler, 2005). Skill-biased technology adoption increases the demand for skilled labor and reduces the demand for unskilled labor that increases the income gap between skilled and unskilled labor (Jaumotte et al., 2013; Meschi & Vivarelli, 2009; Zeira, 2007).

In developing countries, technological change is not mostly skill-biased (Scholl, 2015). Technology adoption provides the opportunity to the people to improve their professional skills and provides opportunity to get higher income that reduces the poverty, improves living standard and reduces inequality (Kudasheva et al., 2015). Technology adoption increases the demand of education and skilled worker and it can reduce income inequality when access to education are easy (Jaumotte et al., 2013). Technological progress increases demand for skilled labor and education (Jaumotte et al., 2013) and provides access to information technology which in turn develops skills (Kudasheva et al., 2015). The extra supply of the skilled labor reduces wages of skilled labor while decreases the supply of unskilled labor but increases the wages of unskilled labor which reduces the wage inequality (Pan, 2014).

Corruption significantly increases inequality in the developing countries, though the relationship between corruption and inequality is not statistically

significant in the developed countries. However previous studies also see a positive relationship between corruption and inequality (Dincer & Gunalp, 2012). Some studies have explored the mechanism through which corruption influences the level of inequality. The impact of corruption on inequality has also found to be a linear function of the size of informal sectors (Dobson & Ramlogan-Dobson, 2012). It is also argued that corruption increases inequality through the channel of increasing tax evasion and unbalanced favors (Franses & de Groot, 2016). corruption increases inequality in the wages of skilled and unskilled workers and in the wages of rural-urban migrants(Pi & Zhou, 2015). Corruption crowds out the returns from financial development and exacerbates inequality (Batabyal & Chowdhury, 2015)".

Some studies have however found a feedback relationship between income inequality and corruption. greater inequality leads to more corruption (Apergis, Dincer, & Payne, 2010; Dutta & Mishra, 2013{You, 2010 #1258; You & Khagram, 2005). Inequality leads to discrimination and prejudice among social groups which makes the control of corruption difficult (Cerqueti & Coppier, 2016). Corruption causes inequality in China and Philippines while this causality is reversed in Indonesia Japan Korea and Thailand (Huang, 2013). Inverse relationship between corruption and inequality may be symptomatic of misguided institutional reform policies (Andres & Ramlogan-Dobson, 2011). In US corruption has positive long and significant impact on inequality and Granger's test suggests bidirectional causality (Apergis et al., 2010).

Religion in politics reduces inequality in the developing world while it has no significant impact on the inequality in the developed world. Some earlier studies have also found that involvement of religion in the state affairs exacerbates inequality. Jordan (2016) found that highly unequal societies are more unequal societies. He argued that religious institutions resist the effort of state institutions to organize the working classes. The state-church conflict in the past in the western democracies curtailed the scope of welfare state institutions and are directly responsible for current levels of inequality. The mode of division of property among the heirs is found to be predictive of inequality among different religious denominations in Christianity (Di Matteo, 2016). Some religious interpretations can lead to gender inequalities and subordinate the women in the labor market with the results that they are discriminated against (Klingorova & Havlicek, 2015).

7. Conclusion

The trade theory predicts that transfer of technology from developed to developing countries in the wake of bilateral trade raises the demand for skilled labor which in turn raises the wages of skilled labor (Meschi & Vivarelli, 2009). The increased demand for skilled labor increases the educational attainment of that country (Kudasheva et al., 2015). With the increased supply of skilled labor, the relative real wages of the skilled labor goes down (Pan, 2014). On the other hand, the unskilled labor supply decreases because of an increase in the relative size of the skilled labor force thus pushing up the wages of unskilled workers. The wage gap between skilled and unskilled workers reduces that leads to decrease in the income inequality (Pan, 2014).

Consistent with economic theory, this study finds that trade openness reduces income inequality in developing and developed countries. Transfer of technology from developed to developing countries significantly reduces income inequality because this technology transfer increases expenditure on education and skilled to unskilled labor ratio increases in the developing countries. However, in the developed countries, transfer of technology increases income inequality because of adoption of skilled biased technology. The impact of technology transfer on income inequality in the developed countries is statistically insignificant though. An important policy implication of our findings is that governments in the developing countries need to promote the import of technology. They also need to increase expenditure on education to convert unskilled workers into skilled workers.

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