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The Impact of Refugees on Income Inequality in Developing Countries by Using Quantile Regression, ANN, Fixed and Random Effect

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Abstract: Refugees affect the hosting countries both politically and economically, but the size of impact differs among these societies. While this effect emerges mostly in the form of cultural cohesion, security, and racist discourses in developed societies, it mostly stands out with its economic dimension such as unemployment, growth, and inflation in developing countries. Although different reflections exist in different societies, the reaction is expected to be higher if it affects social welfare negatively. Accordingly, one of the parameters that should be addressed is the effect of refugees on income distribution since the socio-economic impact is multifaceted. In this study, the effect of refugees on income inequality is analyzed by using quantile regression with fixed effects and Driscoll–Kraay Fixed Effect (FE)/Random Effect (RE) methods for the period of 1991 to 2020 in the 25 largest refugee-hosting developing countries. According to the findings of the study, the functional form of the relationship between refugees and income inequality in the countries is N-shaped. Accordingly, refugees first increase income inequality, decrease it after reaching a certain level, and then start increasing it, albeit at a low level.

Keywords: refugee; migration; income inequality; quantile regression; ANN

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1. Introduction

According to the UNHCR report, as of mid-2020, there are 26.3 million refugees in the world. Today, although refugees are seen as one of the most important problems of European countries, in fact, the burden of refugees is mostly taken by developing countries. For example, in 2018, approximately 4 out of 5 refugees took refuge in neighboring countries. According to the mid-2020 report, Turkey hosts the largest number of refugees, with 3.6 million people, and Colombia follows with 1.8 million, Pakistan with 1.4 million, and Uganda with 1.4 million refugees [1–3].

Immigrants are groups that voluntarily leave their own country and migrate to other countries, mostly for socio-economic reasons or to reach better living conditions. On the other hand, refugees are individuals who migrate due to race, religion, political opinion, war, and security of life. While the prominent factor for refugees is fear and safety of life, for immigrants, this is better living conditions.

Refugees, which are seen as the source of the deterioration in macroeconomic indicators in some countries, may be exposed to social lynching due to various socio-cultural reasons such as racism and language problems [4]. Therefore, the approach towards refugees is closely related to the social structure of the countries as well as their income levels. For example, some studies emphasize the impact of refugees on security [5], social cohesion [6,7], and the environment [8], but others emphasize unemployment [9,10], labor market integration [11], inflation [12–14], growth [15–17], and the effect on foreign dependency [18,19].

Although refugee flows have generally come to the fore with their negative aspects, there are also situations in which they contribute positively to the hosting countries. In this context, refugees, which are an important resource of human capital, entrepreneurship, and increased labor force in some countries [20–22], change the demographic structure in favor of the country with its young population [23]. Therefore, given all this, a single argument on refugees can be misleading.

Even though the prominent institutions and countries, especially non-governmental organizations and donor countries, offer policy suggestions, they cannot prevent refugees from being undesirable sections of the hosting societies. Especially in recent years, the hard measures taken by European countries against refugees are noteworthy. A similar situation is valid for developing countries. Refugees, which are seen as the source of macroeconomic problems such as poverty, public borrowing, and unemployment, are exposed to social pressure in these countries with the effect of socio-cultural and security aspects. In addition to their social exclusion, refugees have a relatively high number of disadvantages among immigrant groups that do not show a homogeneous distribution. Many studies suggest that refugees are more disadvantaged than economic migrants in many parameters, such as employment, wages, and better job conditions, with the impact of problems such as health, language, and traumas in their home country. Moreover, refugees who are mostly exposed to violence, conflict, and persecution, and sometimes forced to undesirable and unplanned migration in their own country, have similar disadvantages in social integration compared to economic migrants [24,25].

In terms of the integration process and economic wellbeing of the hosting country, it is important to systematically address the refugee policy, given the advantages/disadvantages of a refugee policy. Although refugees are seen as a social cost in the first stage, it is possible to contribute to the hosting country if they are integrated quickly. For example, the integration of first-generation refugees into the labor market is different from the refugees who immigrated to countries as children or who are in the second generation. In addition, directing refugees to sectors with labor shortages may contribute to alleviating the pressure on unemployment. Further, policies that can create a complementary relationship between the local workforce and the refugee workforce can be created. In this context, the integration of refugees into socio-economic life, especially in labor markets, has critical importance [26–33].

Lack of integration may cause refugees to be a greater burden on the public and can deepen income inequality, which is the source of social unrest by causing dual employment markets [23]. Rising income inequalities may further increase political polarization [34], and further pressure on refugees, and the process can lead to further social unrest.

Inequalities are sometimes not only limited to the countries that accept refugees but also between emigrant and immigrant countries [35]. Undoubtedly, one of the issues to be emphasized is that the causal relationship between refugees to income inequality is mostly not one-sided. In fact, although economic factors such as poverty and income inequality are among the primary reasons for the migration of economic migrants, poverty and income inequalities added to refugees' concerns, such as war, security, and political pressure, and they are also reasons that accelerate refugee flows.

Income inequality, as well as refugees, are important topics of discussion. Because income inequality, which is one of the important indicators of social welfare, is one of the important parameters in determining the extent of poverty and the living standards

of the poor, rising inequalities seriously damage the social fabric of societies. For this reason, despite the increasing economic growth in the world, the unequal distribution of income is still considered an important problem. For example, GDP per capita in low- and middle-income countries has more than doubled in real terms since 1990. Three out of four households in developing countries live in societies where incomes are more unequally distributed than in the early 1990s. In addition, although the world's economies are getting richer globally, more than 1.2 billion people still continue to live in extreme poverty. Despite the growth momentum, income inequalities have continued to grow on average both between and within countries over the past two decades. Therefore, despite the increasing wealth, the gap between the poor and the rich has begun to deepen. Increases in income inequality have emerged as a more important problem, especially in developing countries with high growth [36–38].

In this study, the effect of refugees on income inequality is analyzed using quantile regression with fixed effects and Driscoll–Kraay FE/RE methods during the period of 1991–2020 in 25 developing countries with the largest refugee hosting. The rest of the paper is organized as follows. In Section 2, the literature is presented. The data and method are included in Section 3, and Section 4 presents the analysis and results.

2. Literature Review

In studies dealing with the relationship between migration and income inequality, refugees or economic migrants are generally not distinguished, while studies with separation often refer to economic migrants. The literature examining the impact of refugees in this relationship is limited. The general trend in studies dealing with the impact of migration on income distribution without the distinction between refugees and economic migrants is that migration increases income inequalities in receiving countries [39–42].

Refugees affect income inequality through many channels. Labor markets are the main ones. Wage disparities between high and low-skilled labor play a decisive role in inequalities. According to this approach, which can be described as a wage effect, the education and skill levels of refugees are determinants of inequalities. Accordingly, if the refugees are made up of a qualified labor force, it causes downward pressure on the wages of individuals with middle-upper income levels. On the other hand, if the refugees are made up of an unqualified workforce, it is expected that the earnings of low-income individuals will decrease. Although these studies, which mainly deal with the labor markets, do not focus directly on income inequality, the findings of the analysis support the argument that immigration is determinant of income inequality. One of the theoretical approaches focusing on the labor channel in the migration–income inequality relationship is the substitution and complementarity hypothesis. Accordingly, if foreign-born workers are substitutes for local labor, refugees are preferred because they are cheaper labor. This leads to an increase in unemployment among the local population, especially in low-skilled jobs. However, if the foreign-born workers are oriented towards jobs that the local people do not want or if they indirectly increase the employment of the local people with the sectoral growth they create, a complementarity relationship emerges [43,44].

In this context, many studies in the literature reveal the impact of the labor channel and education on inequality in the migration axis without making an economic immigration-refugee distinction [39,45–48]. Addressing the issue with a different approach, Aburok [49] evaluated the relationship in the context of gender inequality and reached the finding that the inequality of income increased as refugees entered the labor markets in Jordan. In this finding, he argued that inequalities caused by refugees between sexes were determinative. Guzi et al. [50], discussed the refugee–income inequality relationship by focusing on the education factor through labor markets. According to the study, refugees reduce income inequality in 25 EU countries. The EU accepts relatively highly qualified refugees. Therefore, as suggested in theory, skilled migration has a corrective effect on inequality.

Another transfer channel is the costs. Accordingly, refugees, which provide a cost advantage due to their relatively low labor force for the owners of middle-high income

companies, increase the welfare level of the owners of these firms. Moreover, this situation increases the profit margin of not only the companies that the refugees work at but also all sectors through the externalities, so this welfare effect is reflected in many employers. Moreover, refugees can deepen the poverty of low-income households with the effect of unemployment and wages in the host country by decreasing wages.

Therefore, refugees have different effects on both employers and workers at the same time. Especially in studies dealing with the impact of refugees on the labor market in terms of worker-employer distinction, this effect is seen more clearly. For example, in their study discussing that the impact of migration flows on agricultural workers and producers varies, Ruiz and Vargas-Silva [51] suggested that forced migration increased competition in the labor market, agricultural workers were negatively affected by this, but employers were positively affected from this because of the increased labor supply and cost advantage. From this perspective, it can be said that refugees, which negatively affect the income distribution between the poorest and the middle-upper income level of society, are determinants in income inequality.

Another channel for influencing refugees' income inequality is the real estate industry. There are many studies in the literature suggesting that refugees increase housing prices. Refugees, which lead to price increases, especially in low-segment housing, indirectly affect income inequality by raising the living costs for the poor. The work of Schmeidl [52] is one of the studies supporting this argument. Accordingly, with the arrival of refugees or immigrant-aid staff in Peshawar, Pakistan, local property owners' income increased, but rising home prices have led to even more difficulties for the poor people. According to Al-Hawarin et al. [53], which have reached similar findings, poor households are more affected by the Syrian refugees who have increased their rents in Jordan. However, Balkan et al. [54] reached a different finding. With the increase in refugees in Turkey, there has been an increased demand for houses in the regions where wealthy households live, then luxury residential prices increased, while there was a drop in prices in relatively cheap houses. Although the findings of the studies dealing with the refugee-housing relationship differ, it can be said that, ultimately, refugees are influential in the distribution of income by affecting the income level of either the poor or middle-upper income groups. However, since this study was conducted in the early stages of the refugee influx and with limited data (2010–2013), it is controversial whether it reflects the current situation.

Inflation is one of the channels through which refugees indirectly affect income inequality. In some studies, it is emphasized that refugees especially increase food prices [55,56]. The share of food is relatively high in the consumption basket of the poor. Thus, increases in food prices are expected to increase the cost of living for the poor and deepen inequalities. However, in some studies, it is argued that inflation shows a downward trend with refugees [57], and this, which affects the living standards of poor individuals more, is especially negligible in the welfare of the households at the upper-income level. Therefore, regardless of its direction, the impact of refugees on inflation affects the income level of the poor more and thus plays an indirect role in income inequality.

Public spending is another transfer channel on this issue. Especially in the least developed or developing countries with a limited budget, budget expenditures that are not limited to the local population can lead to the division of social aid provided to the poor with refugees, and this can negatively affect the living conditions of low-income households and increase income inequalities.

In addition to the channels of transmission, the share of refugees in the population, their integration with society and the duration of their accommodation are also important inequalities. Refugees are faced with the struggle to survive in the first stage, and they have to do dirty, dangerous, and demeaning jobs, and this causes low-income individuals to be more affected by society. However, with the decrease in cultural adaptation, experience, and language problems in time, some refugees can get the opportunity to work in more qualified jobs. This is expected to partially reduce income inequalities. However, in the long run, especially with the clustering of the increasing refugee population, it is expected that

the refugees, who started to exist as entrepreneurs in low-value-added sectors, especially in textiles, will reduce the income of middle-low-income local craftsmen. This may cause income inequalities to tend to increase again. In fact, it is the most important example of Turkey, which is one of the most refugee-hosting countries in the world. In Turkey, which hosted mass migrations after the conflict in Syria, refugees started to work in low-skilled jobs such as textiles and construction for low salaries. This has affected the living conditions of low-income households the most. However, it affected the lives of middle-income households of the refugees who started working in other sectors over time. According to the Republic of Turkey's Ministry of Commerce data, as of 26 February 2019, the number of companies with at least one Syrian partner reached 15,159. These companies consist of SMEs such as wholesale trade, textiles, and construction. These companies, which employ more Syrians, affected the living conditions of the poor, especially in construction and textiles.

3. Data and Methodology

In this study, the impact of refugees on income inequality is analyzed using the Quantile regression with fixed effects method and Driscoll–Kraay FE/RE in 25 developing countries (in Appendix A) countries which host the most refugees. There are important differences among the income inequalities of the countries included in the study. Therefore, the quantile regression method was used to see how refugees affect inequality in countries with low or high-income inequality. The Gini index was taken as the dependent variable, and besides refugees, unemployment and growth data were used as determining factors of income inequality as independent variables. The model used in the analysis is as in Equation (1):

$$LGINI_{it} = \beta_0 + \beta_1 LREF_{it} + \beta_2 LREF^2{}_{it} + \beta_3 LREF^3{}_{it} + \beta_4 LUNEMP_{it} + \beta_5 LGDP_{it} + u_{it} \quad (1)$$

LGINI data are provided from the UTIP, and missing years are obtained using the ANN simulation method and other variables provided from the World Bank. All variables are presented in Table 1.

Table 1. Data Description.

Variables	Description
LGINI	Gini Coefficient
LREF	Refugee population by country or territory of asylum
LGDP	GDP per capita (constant 2010 USD)
LUNEMP	Unemployment, total (% of total labor force)

Note: L indicates the logarithmic transformation of the variables.

In this study, the Gini index data, which are missing in different years of the countries, were obtained primarily using the artificial neural networks (ANN) simulation method. The simplest variant of an artificial neural network is a perceptron introduced in the 1950s [58] to model the information processing of the brain. Artificial neural networks are artificial intelligence applications that have been applied by engineering to implement specialized design tasks since the 1970s [59,60]. The idea of a neural network was seen as a theoretical basis for building a machine learning system. Recent neural network research has overcome some early restrictions from the early 1970s [61]. Artificial neural networks (ANN) is a widely used method for estimating complex processes and pattern classification of multivariate datasets, such as engineering, physics, and social studies [62–66]. ANNs consist of two or more layers of nodes that include an input layer, a hidden layer, and an output layer, and it is connected by links of different weights. Node data are multiplied by weights to calculate signal strength and then transferred to the next node in the network; input layer nodes accept input vectors and transmit signals to the next layer based on connection. This process keeps going until the signals reach the output layer [67–69].

The present study uses objective methodologies to design better simulations and predictions for the Gini index. For 25 developing countries, the Gini index data, which are missing in different years of these countries, were estimated using the ANN method to see the effect of refugees on income inequality and also generally, starting from the 1960s until the year 2020. All of the simulated and predicted data are given in Appendix A in order to show the real and estimated data; the data of a few countries are given in Figure 1. There were fluctuations and similarities of more than 99% for all countries. Unlike other countries, the Gini data of Malaysia are decreased by peaking in certain years.

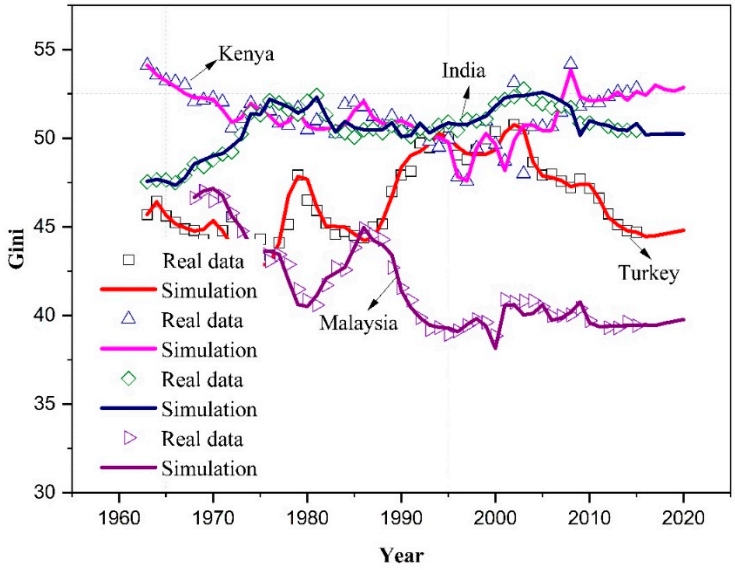

Figure 1. Real and predicted data of Gini versus year for Kenya, Malaysia, India, and Turkey.

After the ANN method, the quantile regression fixed effects via the method of moments method, developed by Machado and Santos Silva [70], was used for analysis. When data are not normally distributed, the quantile regression method can give more effective results. On the other hand, quantile regression is more sensitive to extreme values in the dependent variable. In this context, it can give more reliable results, especially on issues such as income and wage inequality [71–73].

Quantile regression fixed effects estimator via the method of moments, which was brought to the literature by Machado and Santos Silva [70], was used in this study. In general, quantile regression is frequently preferred in different disciplines and interdisciplinary studies [74–76]. Although the quantile regression estimator is robust against the extreme values in the series, it does not take into account the unobserved individual heterogeneity. However, the MMQR method is a suitable method for regression quantile estimations that include individual effects since it allows individual effects to affect the entire distribution. In the MMQR approach, the $Q_Y(\tau|X)$ location-scale estimation model of conditional quantiles is defined as follows [70]:

$$Y_{it} = \alpha_i + X'_{it}\beta + (\delta_i + Z'_{it}\gamma)U_{it} \quad (2)$$

here the probability is $P\{\delta_i + Z'_{it}\gamma > 0\} = 1$ and $(\alpha,\ \beta',\ \delta,\ \gamma')'$ are unknown parameters; that is, they refer to the estimated parameters. (α_i, δ_i); $i = 1, \ldots, n$, individual (i) indicate fixed effects. Y_{it} shows the dependent variable. Z is a k-vector of defined components of X with distinguishable transformations with the I element [70].

$$Z_I = z_I(X),\ I = 1, \ldots, k \quad (3)$$

X_{it} is strictly external. U_{it} represents the unobservable random variable and is independent from X_{it}. It is normalized as follows to satisfy the moment conditions [70].

$$E(U) = 0\ E(|U|) = 1$$

In this case, if the model defined in Equation (2) is rearranged for different quantile (τ) levels, it can be expressed as follows [70]:

$$Q_Y(\tau|X_{it}) = (\alpha_i + \delta_i q(\tau)) + X'_{it}\beta + Z'_{it}\gamma q(\tau) \quad (4)$$

$\alpha_i(\tau) \equiv \alpha_i + \delta_i q(\tau)$ shows the distributional effects at quantile τ. That is, the dispersion effect represents the effect of time-invariant individual characteristics such as other variables. It is allowed to have different effects on different regions of the conditional distribution of the dependent variable. The MMQR approach is very useful for panel data models with individual effects [70].

4. Results

Before analyzing the cointegration relationship between the series, the bias-adjusted test (LM_{Adj}), developed by Pesaran, Ullah, and Yamagata [77], was used to determine cross-section dependence. In this context, Pesaran's [78] cross-sectionally augmented IPS (CIPS), and Hadri and Kurozumi's [79] panel unit root tests were used to test the stationarity. The unit root and cross-section dependence test findings are presented in Table 2.

Table 2. Unit Root and Cross-Section Dependence Test.

Variables	CIPS Cons.	CIPS Cons. + Trends	Z_A^{SPC} Cons.	Z_A^{SPC} Cons.+Trends	Z_A^{LA} Cons.	Z_A^{LA} Cons. +Trends	LM_{Adj} Cons.	LM_{Adj} Cons. + Trends
LGINI	−1.946	−2.773 **	19.824	7.007	110.703	12.594	244.201 ***	229.199 ***
LREF	−2.512 ***	−2.845 ***	5.481	−2.432 [a]	3.091	−4.626 [a]	202.983 ***	204.992 ***
$LREF^2$	−2.688 ***	−2.897 ***	4.223	−2.438 [a]	3.213	−4.524 [a]	201.796 ***	204.469 ***
$LREF^3$	−2.869 ***	−2.952 ***	2.971	−2.533 [a]	3.861	−4.478 [a]	201.355 ***	204.714 ***
LUNEMP	−1.666	−1.872	0.793 [a]	−1.193 [a]	18.991	13.853	268.720 ***	259.868 ***
LGDP	−2.073 *	−2.138	−2.999 [a]	−0.816 [a]	4.339	5.781	220.875 ***	230.128 ***
ΔLGINI	−3.867 ***		19.738		140.466		215.950 ***	
ΔLREF	−3.787 ***		4.702		2.486		231.563 ***	
$\Delta LREF^2$	−3.698 ***		3.958		2.630		231.067 ***	
$\Delta LREF^3$	−3.723 ***		2.752		3.370		230.591 ***	
ΔLUNEMP	−2.606 ***		1.839		4.830		268.371 ***	
ΔLGDP	−3.079 ***		−3.091 [a]		5.623		299.500 ***	

Notes: [a] indicates that the panels are stationary in Z_A^{SPC} ve Z_A^{LA}. ***, **, and * indicate the significance levels at 1%, 5%, and 10%, respectively. Maximum lag length is taken as 3, *p*-values are in parentheses. The critical values for the CIPS tests were used from Pesaran [61].

In Table 1, according to the LM_{Adj} test, H_0 hypotheses are strongly rejected because the probability values are less than 0.05. Therefore, it is concluded that the cross-sectional dependence exists. For the stability of the series, while most of the series are stationary at the levels, some are stationary at first differences. After unit root tests, for slope homogeneity, Swamy's S. test [80] and Pesaran and Yamagata's [81] Delta ($\tilde{\Delta}$, $\hat{\Delta}$) homogeneity tests were used. The findings are presented in Table 3.

Table 3. Homogeneity Test.

Tests	Coefficients
Swamy Shat	121.65 (0.0396) **
$\tilde{\Delta}$	15.90 (0.0000) ***
$\tilde{\Delta}_{Adj}$	18.08 (0.0000) ***
$\hat{\Delta}$	−0.2114 (0.5837)
$\hat{\Delta}_{Adj}$	−0.0367 (0.5146)

*** and ** indicate the significance levels at 1% and 5%, respectively. Prob. values are given in parentheses.

In Table 3, according to the Swamy Shat $\widetilde{\Delta}$ and $\widetilde{\Delta}_{Adj}$ test result, the H_0 hypothesis is rejected; therefore, the slope coefficient is heterogeneous across groups. In the next stage, for cointegration, the Durbin–Hausman test of Westerlund [82] is used, and the findings are presented in Table 4.

Table 4. Westerlund Cointegration Test.

Tests	Coefficients
DH-g	2.810 (0.002) ***
DH-p	0.773 (0.220)

*** ndicate the significance levels at 1%. Prob. values are given in parentheses.

The Westerlund cointegration analysis findings revealed that there is a cointegration relationship for some cross-section units. After the cointegration relationship was revealed, the regression coefficients were estimated using quantile regression. When the data are not normally distributed, the quantile regression method can give more effective results [71]. Descriptive statistics were used to determine how the series are distributed in the study, and the findings are presented in Table 5.

Table 5. Descriptive Statistics.

Variebles	Mean	Median	Max.	Min.	Std. Err.	Skew	Kurtos.	Jarque-Bera (Prob)
LGINI	3.8659	3.8792	4.0821	3.5475	0.1065	−0.4937	2.7973	31.5076 * (0.0000)
LREF	11.0027	10.9462	15.2982	4.9767	2.0151	0.0424	2.2959	15.7134 * (0.0003)
LUNEMP	1.5561	1.6412	3.1286	−1.3862	0.7977	−0.5575	3.5055	46.84974 * (0.0000)
LGDP	7.5546	7.3517	9.5610	5.4729	1.0787	0.0851	1.9890	32.8467 * (0.000)

* Indicates the rejection of the null hypothesis that the normal distribution according to 1%.

According to the descriptive statistics in Table 5, all variables are not normally distributed at the 1% significance level. This is one of the reasons for the preference of the quantile regression method in the coefficient estimation; the analysis findings are presented in Table 6.

Table 6. Test Results.

Variables	25th	50th	75th	Driscoll–Kraay FE	Driscoll–Kraay RE
LREF	0.2360 *** (0.003)	0.2137 *** (0.000)	0.1927 ** (0.011)	0.2151 ** (0.014)	0.2190 ** (0.013)
$LREF^2$	−0.0225 *** (0.004)	−0.0200 *** (0.001)	−0.0176 ** (0.018)	−0.0202 *** (0.008)	−0.0208 ** (0.023)
$LREF^3$	0.0006 *** (0.007)	0.0005 *** (0.001)	0.0005 ** (0.034)	0.0005 ** (0.043)	0.0006 ** (0.040)
LUNEMP	0.0180 * (0.061)	0.0171 ** (0.016)	0.0162 * (0.077)	0.0171 (0.282)	0.0159 (0.176)
LGDP	−0.0177 * (0.070)	−0.0274 *** (0.000)	−0.0365 *** (0.000)	−0.0268 ** (0.034)	−0.032 *** (0.004)
Observation	750				

***, **, and * indicate the significance levels at 1%, 5% and 10%, respectively. Prob. values are given in parentheses.

When the analysis findings are examined, it can be seen that the refugee population and its square-cubic form have a statistically significant effect on income inequality for quantile and Driscoll–Kraay methods. The coefficient signs of the refugee population were found to be positive, negative, and positive, respectively. In cases where the quantile level is low (25th quantile), the increase in the number of refugees has a higher effect on income inequality. As the quantile levels increase, the effect of the number of refugees on income inequality decreases.

The income per capita and income inequality are negatively correlated in all quantile values. Per capita GDP elasticity of income inequality is estimated as 0.017, 0.027, and 0.036 in the 25th, 50th, and 75th quantiles, respectively. At the low quantile value (25th), a 1% increase in per capita GDP reduces income inequality by 0.017%. This effect is stronger

at higher quantile values. For example, at the 75th quantile, a 1% increase in per capita GDP reduces income inequality by 0.03%. Similarly, per capita income has a statistically significant effect on income inequality, according to the Driscoll–Kraay estimator. In addition, unemployment increases income inequality in all quantiles. The unemployment elasticity of income inequality was estimated at 0.018, 0.017, and 0.016 at the 25th, 50th, and 75th quantiles. In the case of low-income inequality (25th quantile), a 1% increase in unemployment increases income inequality by 0.018%. This effect weakens as the quantile values increase. Findings from the Driscoll–Kraay estimator show that there is no statistically significant relationship between unemployment and income inequality.

There is an N-type functional relationship between refugees and income inequality at all quantile values and the Driscoll–Kraay estimator. Accordingly, the turning points calculated according to the quantities are as follows:

In Table 7, two turning points were calculated for each quantile value. The first turning point for the 25th quantile is 8.2894. This value is logarithmic. In other words, it corresponds to approximately 3981 refugees. The function is increasing as far as this turning point. The second turning point was calculated as 14.1759. While the function decreases between 8.28 and 14.17, the function follows an increasing course after 14.17. Therefore, it is confirmed that there is an N-type functional relationship between the refugee and inequality at the 25th quantile. At the quantile level (25th quantile), where income inequality is low, the increase in the number of refugees increases the income inequality until the number of refugees reaches 3981. After the number of refugees exceeds 3981, income inequality decreases as the number of refugees increases, and after the number of refugees reaches 1,433,960, the increase in refugees begins to increase income inequality again. In the 50th quantile, the increase in refugees increases income inequality until the number of refugees reaches 4635. After the number of refugees exceeds 4635, income inequality decreases as the number of refugees increases, and after the number of refugees reaches 1,891,847, the increase in the number of refugees begins to increase income inequality again. Findings from the Driscoll–Kraay FE estimator are very close to the 50th quantile estimates of the quantile regression estimator. In the 75th quantile, the increase in the number of refugees increases income inequality until the number of refugees reaches 5492. After the number of refugees exceeds 5492, income inequality decreases as the number of refugees increases, and after the number of refugees reaches 2,742,147, the increase in the number of refugees begins to increase income inequality again.

Table 7. Turning Point for Quantiles and Driscoll–Kraay FE/RE.

Turning Points	25th	50th	75th	Driscoll–Kraay FE	Driscoll–Kray RE
1st Turning point	8.2894 (3981.57)	8.4414 (4635.29)	8.6112 (5492.98)	8.4299 (4582.07)	8.3862 (4386.38)
2nd Turning point	14.1759 (1,433,960.4)	14.453 (1,891,847.7)	14.8242 (2,742,147.7)	14.4356 (1,859,105.42)	14.0825 (1,306,093.60)

Note: Turning values are given in parentheses.

When we look at the countries that have crossed the second turning point, where income inequality tends to increase again, these countries are Turkey, Iran, Pakistan, and Jordan, although in different periods in all models. All of these countries host large numbers of refugees. The concentration of refugees in these countries has put pressure on many macroeconomic indicators, especially inflation and unemployment. In fact, for fairer distribution, countries in the world need to undertake a more balanced refugee burden. Because when refugees exceed a certain threshold in number or population ratio, they can create a burden, not a benefit, for the country's economy.

Our study findings partially support the theoretical approach emphasizing the complementarity/substitution role of refugees in the labor market in the literature. Accordingly, foreign-origin workers are mostly in the lower and upper segments of the labor market (the upper segment is for developed countries). Accordingly, refugees reduce the wages of low-income households more when foreign workers are substitutes for the local workforce. Therefore, increasing labor supply with migration increases inequalities. In the complemen-

tarity relationship, refugees can lead to the emergence of job opportunities for local workers by creating alternative sectors or establishing their own companies [83,84]. In this study, the fact that refugees increase wage inequalities in the first phase supports the substitution effect. However, with the increase in the sectors in which refugees work, wage pressure spreads to a wider segment, so inequalities tend to decrease partially. However, the fact that refugees mostly employ refugees in the companies they have established may cause the opposite effect of the complementarity relationship. The third phase, which shows that inequalities in the study increase again, is a good example of the opposite effect of the complementarity relationship. Because when we look at the current situation today, for example, in Turkey, it is seen that Syrians employ more Syrians in the companies they have established in recent years, and this leads to an increase in inequalities.

5. Conclusions

As a result of the selective and strict policies of developed countries on refugees, mostly qualified refugees can migrate to these countries. Low-educated or unqualified refugees are mostly clustered in developing countries. Low-skilled refugees concentrated in developing countries mostly affect the working conditions of the low-income workforce. Therefore, this can lead to an increase in income inequalities in these countries. At this point, as Kahanec and Zimmermann [47] emphasized, one of the measures to be taken is social integration. This process may offer refugees the opportunity to access more different job opportunities. As a result, it can be prevented that especially educated refugees accumulate in unskilled jobs.

In this study, the effect of refugees on income inequality is analyzed using quantile regression with fixed effects and Driscoll–Kraay FE/RE methods during the period of 1991–2020 in 25 developing countries with the largest refugee hosting. According to the findings of the study, there is an N-type functional relationship between refugees and income inequality in all estimated results. In addition, the turning points where the impact of refugees started to decrease and then the increase was calculated. Accordingly, using quantile regression with fixed effects, the first turning point for the 25th quantile is 8.28 (approximately 3981 refugees). The function is increasing as far as this turning point. The second turning point was calculated as 14.17 (approximately 1,433,960 refugees). While the function decreases between 8.28 and 14.17, the function follows an increasing course after 14.17. The first turning point for the 50th quantile is 8.4414 (approximately 4635 refugees). The function is increasing as far as this turning point. The second turning point was calculated as 14.453 (approximately 1,891,847 refugees). While the function decreases between 8.44 and 14.53, the function follows an increasing course after 14.53. The first turning point for the 75th quantile is 8.6112 (approximately 5492 refugees). The function is increasing as far as this turning point. The second turning point was calculated as 14.842 (approximately 2,742,147 refugees). While the function decreases between 8.61 and 14.82, the function follows an increasing course after 14.82. The turning points for the Driscoll–Kraay FE estimator is similar to the results for the 50th quantile. However, the results for the Driscoll–Kraay RE estimator differ slightly from the quantile regression results. The first turning point for the Driscoll–Kraay RE estimator was 8.38 (approximately 4386 people), while the second milestone was 14.08 (approximately 1,306,093 people).

As seen from the turning points, once the number of refugees exceeds a certain threshold, income inequality increases. For example, after the number of refugees exceeds 1,433,960 in the 25th quantile, after they exceed 1,891,847 in the 50th quantile, and after they exceed 2,742,147 in the 75th quantile, income inequality increases again. Therefore, as we emphasized, when the number of refugees reaches a certain level, it leads to the colonization of refugees in these countries, and inequalities may deepen with their inclusion in the labor market as an employer.

When the control variables in the model are analyzed, unemployment increases income inequality in all quantiles and per capita GDP reduces income inequality in all quantiles.

The N-relationship, which states that refugees first increase income inequality but decreases it after reaching a certain level and ultimately increase it again, can be rationalized as follows:

(i). Low-skilled immigrants are clustered mostly in developing countries, while refugees with the highest education level are mostly clustered in developed countries. Refugees do not have the luxury of setting wages or choosing jobs for reasons such as social integration, anti-refugee, and language problems in both developed and developing countries. Therefore, refugees are concentrated in sectors where unskilled indigenous people are employed, thereby disrupting the income distribution against the poor. This situation causes refugees to increase income inequality by affecting the income of low-income households in the first stage, especially in developing countries.

(ii). Refugees, which have reached a certain density in the hosting countries, gradually adapt to society with their entrepreneurial identities and start their commercial activities mostly with small enterprises. Both these businesses run by refugees and foreign aid provided to refugees can provide employment opportunities for local people in some countries [9,85]. These initiatives, which mostly benefit households with low incomes, may result in a partial reduction of income inequality. Another factor is that refugees, whose skill levels are increasing, have the opportunity to improve themselves in different fields of work and partially solve the language problem. This group competes against the local middle-upper wage labor force over time. All of these stand out as factors that lead to inequality tending to decline.

(iii). In the third stage, refugees re-increase income inequalities through colonization in hosting countries. For example, a significant population of Syrian refugees lives in Turkey, and at the first stage, they were working in labor-intensive jobs, such as textiles, agriculture, and construction. However, over time, ghettoization has become a reality, and they established their districts, their small-scale initiatives, and offered jobs only to individuals from their nation. We can call this *"The Colonization Effect on Migration"*.

In Turkey, which hosts the most refugees in the world, Syrian refugees, who have established small-scale businesses, especially in the textile sector, mostly offer jobs to Syrian refugees. The increase in refugees in this sector, where people with low-income levels are concentrated, mostly affects the poor local people. Moreover, although establishing a one-person company does not create additional labor employment, refugees cause low-income local small business owners in an economically difficult situation by crowding out effects through smaller businesses (grocery stores, haberdashery, delicatessen, greengrocer, etc.). Again, these businesses cause middle–low-income households to lose their income. However, this effect is low, as seen in the analysis findings.

Here, the first and second stages are the usual process of migration. However, in the third stage, governments need to intervene in this process. The policy recommendations on this issue are as follows: (i) Refugees can be prevented from clustering in certain regions/provinces. (ii) Conditions for setting up new companies for refugees can be aggravated, especially if it adversely affects the welfare of poor local people or companies opened by refugees may be obliged to employ local people. (iii) Refugees may settle in rural areas with intense migration through land acquisition. The result can be multifaceted. First, in some countries, the need for labor in agriculture can be met in this way. Secondly, the employment of refugees in agriculture can support self-sufficiency policies in agriculture. Third, in this way, the pressure of refugees on the poor workforce in big cities can be alleviated.

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Appendix A

The countries in the model are as follows. Argentina, Bangladesh, Burundi, Cameroon, Central African Republic, China, Congo Rep., Costa Rica, Egypt, Ghana, India, Iran, Jordan, Kenya, Malawi, Malaysia, Mexico, Nepal, Nigeria, Pakistan, Senegal, Thailand, Turkey, Uganda, Zimbabwe.

Table A1. Diagnostic Tests for FE and RE Methods.

Test	Problem	Result (FE)	Result (RE)
Modified Wald test	Heteroscedast.	5366.38 ***	-
Levene, Brown and Forsythe	Heteroscedast.		W0 = 10.5367832 *** W50 = 6.7754434 *** W10 = 9.4714734 ***
M. Bhargava et al. D.W	Autocorrelation	0.32339412	0.32339412
Baltagi-Wu LBI	Autocorrelation	0.4004718	0.4004718
Pesaran	CSD	0.652	1.041
Friedman	CSD	34.371 *	37.330 **
Frees	CSD	2.777 ***	2.789 ***

***, **, and * indicate the significance levels at 1%, 5% and 10%, respectively.

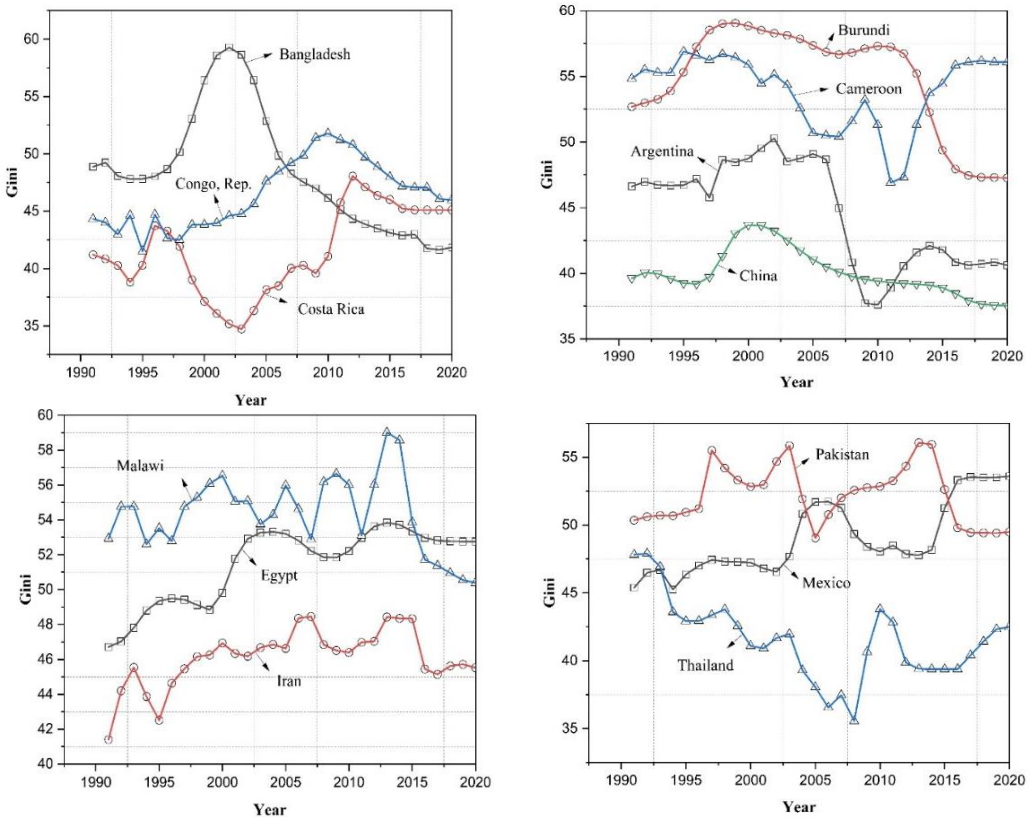

Figure A1. *Cont.*

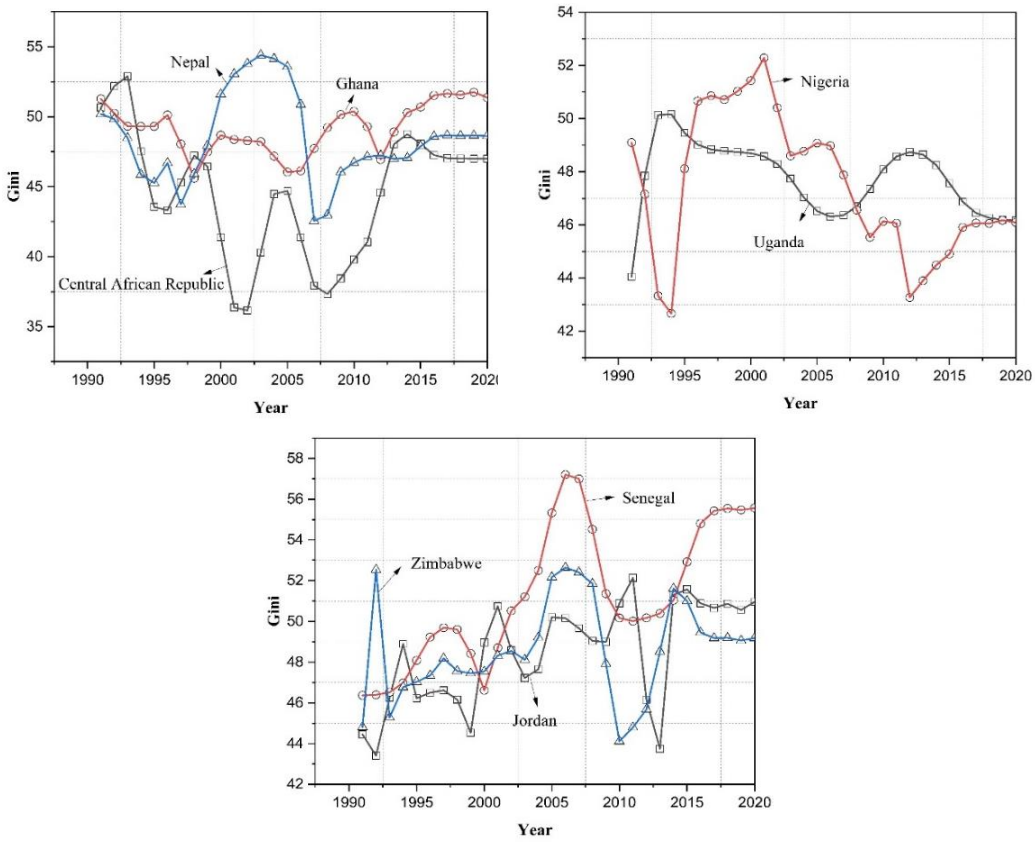

Figure A1. Real and predicted data of Gini versus year for 25 developing countries.

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