ERASMUS UNIVERSITEIT ROTTERDAM

Erasmus School of Economics

Trade as the great equalizer?

The effect of trade on the income distribution within a country

Abstract

This paper studies the relationship between economic openness and income inequality within countries, and how this effect differs between countries with high and low levels of intra-industry trade. A Panel Fixed Effects regression analysis is performed on a data sample of 40 countries in a period between 2007 and 2017. Using three different proxies for income inequality, a negative relationship between economic openness and income inequality is found. The model incorporates two control variables: the level of democracy and the level of education in a country. Contrary to what theoretical literature would say, a higher proportion of intra-industry trade for a country makes this effect stronger.

Bachelor's Thesis Economics and Business Economics

Track Policy Economics

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Table of content

1. Introduction

'Trade policy cannot fix America's inequality problem' (Financial Times, 11 May 2022). In the last decade, the world has seen more and more debates about the effect of trade on inequality. Politicians have had fierce debates over potential trade agreements such as the Transatlantic Trade and Investment Partnership (TTIP) between the United States and the European Union, the Comprehensive Economic and Trade Agreement (CETA) between Canada and the European Union and the Trans-Pacific Partnership (TPP) with countries on both sides of the Pacific Ocean, like the United States, Mexico, and Chile on one side, and countries like Japan and Australia on the other side of the ocean.

Although there were additional reasons to criticize these trade agreements, for example with regards to climate change and sustainability (Ortiz et al. 2021; Friel et al. 2020 and Gehring et al. 2013), the impact of trade on the inequality within a country was also an argument for politicians and policymakers to think twice before signing these agreements. CETA received criticism related to inequality by economists (Kohler & Storm, 2016), Felbermayr (2016) concluded TTIP could increase inequality and Capaldo and Izurieta (2018) analyse the potential consequences of TPP and conclude that TPP can lead to more unemployment and an increase in inequality.

There are different types of inequality. In this study, inequality focusses on income inequality within countries. The impact of economic openness and more trade on the income inequality within a country is analysed using three different proxies of income inequality, with a focus on the effect on the lowest earning population. The Gini-coefficient is widely used and known as a measurement of income inequality. In addition to that, the income share of the lowest earning quintile and the percentage of the population with an income lower than 50% of the median income in a country are used as proxies for income inequality. Economic openness can be measured by calculating total imports plus total exports and dividing that by the GDP of a country. These calculations will lead to the Impex rate of a country.

The empirical literature is divided on the effect of trade openness on income inequality within a country. Some studies did not find a relationship at all (Lundberg & Squire 2003; Birdsall and Londono 1998), some studies find an effect that is equal for low, middle, and high incomes within a country (Dollar & Kraay 2002), others find a negative relationship between trade openness and income inequality (Reuveny & Li 2003; Jaumotte et al. 2013). Contrary to this, other papers suggest that increasing trade openness may lead to more income inequality,

especially in poorer countries (Savvides 1998; Barro 2000; Ravellion 2001; Milanovic 2005; Bensidoun et al. 2011).

The theoretical literature suggests that intra-industry trade should have no effect of the income distribution within a country. The empirical literature has little attention for this hypothesis. In this paper, it will be tested whether the effect of trade openness on income inequality differs between countries with relatively high proportions of intra-industry trade and low proportions of intra-industry trade. To study this topic, an interaction term with the Grubel-Lloyd index will be added to the model.

Data of 40 countries over an 11-year-period (2007-2017) is used to perform the analysis. A Panel Fixed Effects regression analyses is performed to gain insight in the relationship between economic openness and income inequality. Two control variables are added to the model: the level of democracy and the level of education in a country. Five different models are constructed to analyse the consequences of adding control variables and the interaction term.

This paper is structured as follows. Section 2 reviews the existing theories and knowledge about the effect of trade on income inequality within a country. Section 2.1 focusses on theoretical literature and in section 2.2 the empirical papers are discussed. Section 3 describes the data used for this research and explains the variables in detail. Section 4 presents the models and the methodology that is used to get results from the data. Section 5 shows these results and interprets the results. In section 6, a robustness test is performed. Section 7 is the conclusion and ends this study.

2. Relevant literature

2.1 Theoretical literature

Relevant theoretical economic models related to trade and income distribution are the Hecksher-Ohlin model (Hecksher 1919; Ohlin 1933), and the Stolper-Samuelson theorem (Stolper & Samuelson 1941). In addition to these models, the Specific Factors model by Jones (1971) will be discussed. These models differ in assumptions and therefore differ in their implications for this research. The theoretical framework for measuring the level of intra-industry trade between countries was introduced by Grubel and Lloyd (1971; 1975).

The Hecksher-Ohlin model (Hecksher 1919; Ohlin 1933) predicts that countries specialize in producing goods in which they have a comparative advantage. In which goods countries have a relative advantage is determined by the resource endowments a country has. If we assess the case of two countries (Home and Foreign), two products (cars and food) and two factors of production (capital and labor), the H-O model predicts that the capital abundant country will have a comparative advantage in producing the capital-intensive cars, whereas the labor abundant country will have a comparative advantage in producing food, which is relatively labor-intensive. The H-O model assumes that factors of production can freely move within countries but not between countries. That means trade in the H-O model does not affect the income distribution within countries. The H-O model cannot explain intra-industry trade, in the sense that the two countries in the model will not trade within one product category, since this is not beneficial for the two countries.

The Stolper-Samuelson theorem (Stolper & Samuelson 1941) is an addition to the H-O model. It states that if a relative price of a good increases, the returns on the factor used intensively in the production of that increases, relative to the return of the other production factor. That means that any change in the relative price of goods could change the distribution of income within a country. Opening up to trade usually changes the relative price of a good, which leads to the conclusion that trade can have an impact on the income distribution within a country (Suranovic 2012). Kanbur (2000) explains that in a H-O-model with skilled and unskilled workers, unskilled workers in developed countries will have to deal with lower wages when trade openness increases. On the contrary, low skilled workers in less developed countries will get higher wages as a result of more trade openness. Trade openness thus increases income inequality in developed countries and decreases income inequality in less developed countries in a H-O model including both high-skilled and low-skilled workers. Intra-industry trade in the

H-O model with the addition of the Stolper-Samuelson does not have an effect of the income distribution within countries.

The Specific Factors model (Jones 1971) shows that trade within that model creates winners and losers. The owners of the production factor that is used in producing the good that is exported by a country gain an advantage on the owners of the production factor used in producing the good that is imported. This difference exists since production factors are immobile. For mobile production factors, the effect of opening up to trade is ambiguous.

All models lead to the conclusion that trade is beneficial for a country as a whole, but within a country there can be winners and losers from opening up to trade. In theory, the winners could compensate the losers such that everyone is better off, or at least not worse off. Beekman and Kench (2008) studied the willingness of winners of international trade to compensate losers. Around two third of the subjects chose to share a part of their gains with losers, making a potential Pareto improving policy more feasible Walter (2010) shows that winning or losing from international trade can depend on the level of education an individual has, and concludes that winning or losing from international trade can directly affect an individual's policy preferences. Recent research of Kolben (2021) shows that compensating losers from international trade is easier said than done. The problems with compensating the losers from international trade and globalization has led to the populist backlash to free trade we have seen in recent years.

2.2 Empirical literature

The estimate of the effect of trade on the income distribution within a country is a debated topic in the academic literature. Savvides (1998) analyses the relationship between income inequality and trade protection and concludes that less developed countries with more economic openness experienced higher income inequality. Among developed countries, trade policy did not affect the income distribution within the given country. Savvides comes to these conclusions using measurements of trade protection developed by Lee and Swagel (1997). They aggregate measures of trade protection at industry level by assigning weights to different industries for all of the 41 countries in their sample. Lee and Swagel compute two overall measures of trade protection; one including tariffs and other monetary taxes on trade, and one consisting of non-tariff barriers.

Barro (2000) and Ravallion (2001) both find that more trade openness is associated with higher inequality in poorer countries. Milanovic (2005) uses household survey data to look at the effect of economic openness on relative income shares. The paper concludes that for poorer countries with more economic openness relative to poorer countries with less economic openness, the share of income for the poor is smaller.
Bergh and Nilsson (2010) examine whether globalization and economic freedom affect the within-country income inequality. They find that policy changes towards more economic freedom are likely to increase inequality in richer countries, while social globalization has more influence on poorer countries.
Bensidoun et al. (2011) find that an increase in the labor content of trade, relative to the capital content of trade, increases income inequality in poorer countries, but reduces the income inequality in richer countries. The findings in this paper are in line with what Milanovic (2005) wrote earlier.

Contrary to the papers discussed above, Birdsall and Londono (1998) cannot conclude that trade variables have a statistically effect on the income distribution within a country. Dollar and Kraay (2002) show that a country opening up to trade will benefit the poor in that country as much as the middle class and the rich. All groups experience the same relative growth, stimulated by trade openness. Lundberg and Squire (2003) find no real relationship between trade openness and inequality. They find a slightly negative coefficient which is not statistically significant. The result between economic growth and trade openness is also not statistically significant, contrary to Dollar and Kraay (2002) who use similar data. Reuveny and Li (2003) find that trade reduces income inequality, in a paper in which they study the effect of both economic openness and democracy on income inequality. Consistent with this, Jaumotte et al. (2013) conclude that a negative relationship exists between trade openness and income inequality.

There is not a lot of common ground when it comes to the effect of trade on the income distribution within a country. Theoretical models predict different outcomes, and empirical papers give contradictory results. It is probable that the effect of trade differs between developed countries and developing countries, given the large number of papers stating that the effect differs between rich and poorer countries. However, there are also papers which

had results contrary to this. Therefore, this research contributes to the existing literature by adding additional empirical results, which helps to better understand the relationship between trade and income inequality. The biggest contribution to the existing literature is that this research takes a look at how the effect of trade openness interacts with the amount of intra-industry trade for a given country. According to the theory, intra-industry trade should have no effect on the income distribution within countries, whereas Hecksher-Ohlin trade, including the Stolper-Samuelson theorem, could affect the income distribution of a country. This topic has not been explored thoroughly by the existing empirical literature and the results of this paper give a first indication how the effect differs between countries with differing levels of intra-industry trade.

3. Data and variables

Most of the data needed for this research can be found in the World Development Indicators database of the Worldbank. The data needed for the main analysis in this paper consist of five variables: (i) Impex rate (imports + exports as a % of GDP), (ii) Gini-coefficient, (iii) percentage of people living under 50% of the median income, (iv) the share of income earned by the lowest earning 20% and (v) the Grubel Lloyd Index per country.

For the first four variables, we use data from the World Development Indicators database of the Worldbank. The Gini-coefficient and the share of income earned by the poorest 20% are variables that are also used by (among others) Savvides (1998) as a way of comparing income inequality across countries.

For the fifth variable, the Grubel-Lloyd Index per country, we use calculations by Brülhart (2008) for the GL-Index per country. He calculated a GL-Index using the UN's Standard International Trade Classification (SITC) for different industries and used both the 3-digit and 5-digit classification to calculate two different GL-Indices for countries. Since the number of calculations to be done is quite large, he only uses the year 2006. Repeating his calculations for different years would be impossible within the scope of this thesis, and there seems to be no data available for yearly GL-Indices per country. Therefore, his calculations will be used. Using a GL-Index per year per country would contribute to a better thesis, but this is unfortunately not possible.

3.1 Control variables

One of the control variables we use is an index for democracy, using data from the Economics Intelligence Unit (EIU). The democracy index expresses the quality of a democracy as a number between 0 and 10. The index is based on 60 different aspects which are relevant to democracy, such as voting rights, participation in election and human rights protection. The 60 different aspects are categorized in 5 sub-indices: (i) electoral pluralism, (ii) government, (iii) political participation, (iv) political culture and (v) civil liberty. Each category covers roughly 12 indicators. The data of the EIU is used by Gapminder to compose a dataset with all the data between 2007 and 2020. Data from 2007 and 2009 are not available from EIU, so Gapminder generated numbers for these two years by drawing lines between the years 2006 and 2008, and 2008 and 2010. Gapminder also changed the scale from 0 to 10 to 0 to 100 to make better comparison (with percentages for example). Bensidoun et al. (2011) and Milanovic (2005) also

use an indicator for democracy as a control variable in their papers. Both papers refer to Barro (2000) who suggests that the level of democracy might affect the sensitivity of redistribution to the degree of inequality. The median voter hypothesis plays a role in explaining this potential effect. This variable might change within 11 years. Therefore, we control for the level of democracy. We expect that an increasing democracy index weakly affects income inequality negatively (or positively affects income equality), in line with Gradstein, Milanovic & Ying (2001). This effect can be explained as follows. On average, the better the democracy, the better the human rights protection and the better the voting rights. Through democracy, the poor can increase their prospects by voting, and their rights will be protected better by a better democracy. In addition to that, Rodrik (1999) shows that an enhancement of democratic institutions might lead to a wage increase within the range of 6 to 38 percent (if Mexico would increase their democracy to the level of that of the United States).

A second control variable controls for time-variant differences in schooling within a country. Schooling might affect income inequality within a country and might change over a period of eleven years (Jeng et al., 2019). To control for this, we use data from the United Nations Development Programme (UNDP), which uses calculations by the Human Development Report Office (HDRO) on expected years of schooling and mean years of schooling from the Unesco Institute for Statistics. They compose an education index, which is an average of mean years of schooling (of adults) and expected years of schooling (of children), both expressed as an index obtained by scaling with the corresponding maxima. This results in numbers ranging between zero and one, with close to one representing a better education then close to zero. Education can play an important role in changing the income distribution within a country (Gregorio & Lee 2002). This paper shows that investing in preventing education inequality helps reducing income inequality. The findings by Coady and Dizioli (2017) confirm these conclusions, and that this holds for especially emerging and developing economies. Although we have more developed economies in our research, we expect that the effect of education on income inequality will be negative, meaning that better education will lead to less inequality.

3.2 Data availability and countries

For reasons of data availability, this paper will look at 40 countries over an eleven-year period (2007-2017). The 40 countries are mainly European countries, but also countries like Peru, Thailand and Honduras are included. For a list of all countries included, see the Appendix. It would have been better to include more countries or study a longer period than 11 years, but due to data availability of the variables we could not study more countries or a longer period (or both). The two variables that mainly caused dropping countries from the selection were the percentage of the population with an income less than 50% of median income and the income share of the lowest earning quintile. When values were missing of variables, the countries or years were dropped from the selection. Extrapolation was not used to fill gaps in the data. We selected the maximum number of countries over a period as long as the data enables us to study. That resulted in studying 40 countries over a 11-year period, which gives us 440 observations per variable.

3.3 Descriptive statistics

Table 3.1 shows descriptive statistics for all variables. We do not show the variables country and year in this table since these variables cannot be described in this table. All variables have 440 observations since we observe 40 countries over a period of eleven years.

Table 3.1: Descriptive statistics for all variables used

Variable	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Impex rate	440	108.5	60.7	24.8	353.8
Gini-coefficient	440	34.6	6.9	23.2	55.8
<50% median income	440	12.8	4.73	4.2	26.1
Inc. share 20%	440	7.1	1.7	2.7	10.2
Education	440	79.8	10.2	46.1	94.0
Democracy	440	76.9	11.6	45.9	99.3
GL-5-digit	440	0.233	0.127	0.020	0.424
GL-3 digit	440	0.372	0.172	0.052	0.622

The Impex rate expresses how much a country trades relative to its GDP. The average Impex rate of the countries studies is 108.5, but this variable has a high standard deviation due to a low minimum of 24.8 (United States 2009) and a really high maximum of 353.8 (Luxembourg

2017). Figure 3.1 shows the average Impex rate between 2007 and 2017. From this graph, it can be concluded that the trend is slightly upwards, meaning that trade openness is increasing in the countries within this dataset. The decrease in 2009 can probably be explained by the financial crisis which started in the fall of 2008. Figure 3.2 shows that the trend for countries with a high or low Impex rate do not differ greatly.

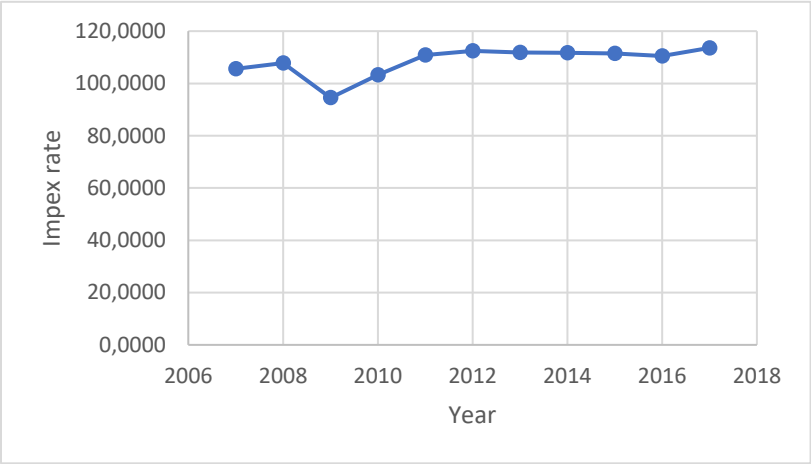

Figure 3.1: Average Impex rate between 2007 and 2017.

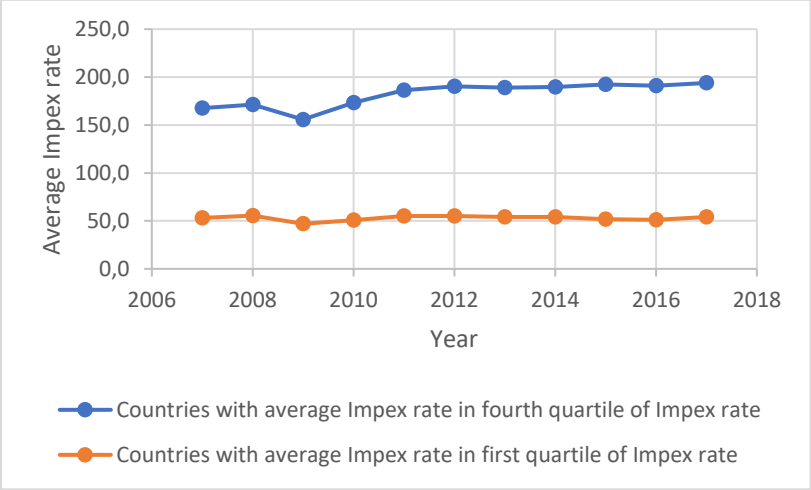

Figure 3.2: Average Impex rate between 2007 and 2017 for countries in the first quartile (blue) and the fourth quartile (orange) of the distribution of the Impex rate.

The Gini coefficient shows income inequality within a country. A Gini coefficient of 0 equals perfect equality, a Gini coefficient of 100 equal perfect inequality with one person gaining all the income within a country. The Gini coefficient of the 40 countries is on average 34.6, and varies between 23.2 (Slovakia 2017) and 55.8 (Honduras 2007).

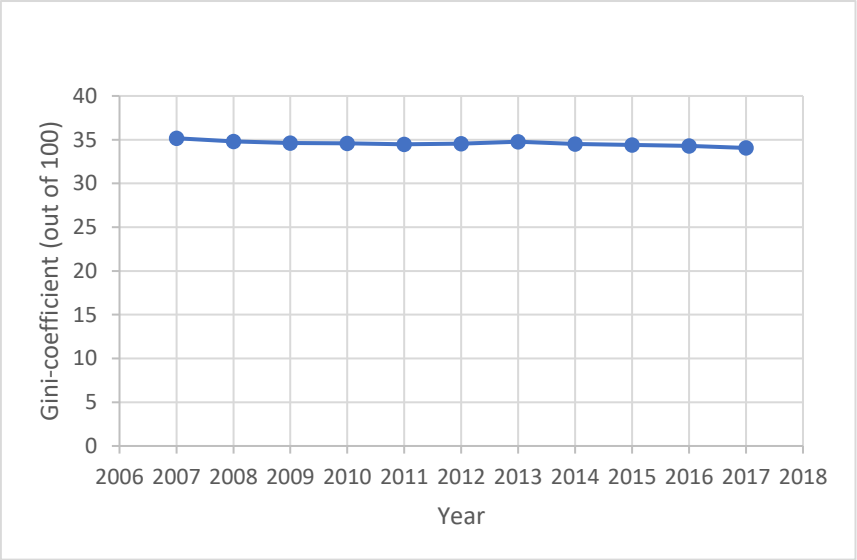

Figure 3.3: Average Gini-coefficient between 2007 and 2017.

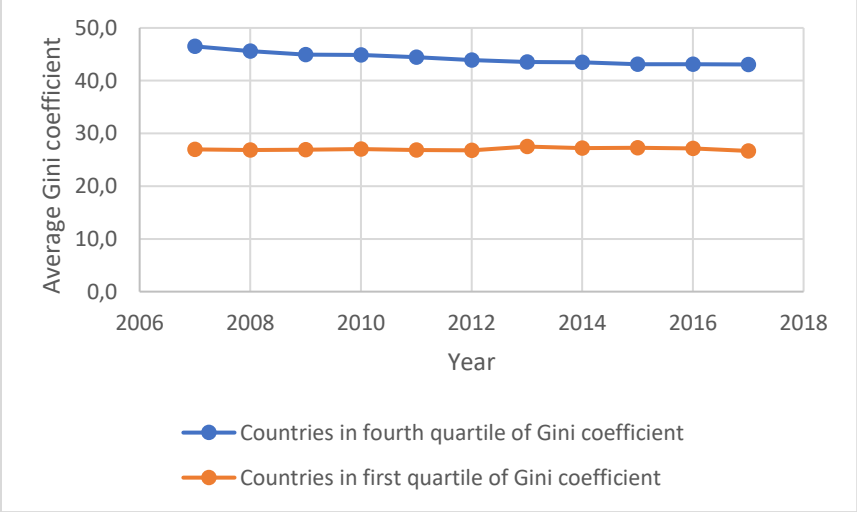

Figure 3.4: Average Gini-coefficient between 2007 and 2017 for countries in the first quartile (orange) and the fourth quartile (blue) of the distribution of the Gini-coefficient.

Figures 3.3 and 3.4 show that the Gini-coefficient is quite stable, but is decreasing slowly, mainly in the higher segments of the Gini-coefficient. In 2007 the average Gini-coefficient was 35.2 for this dataset. This decreased to an average Gini-coefficient of 34.1 in 2017. A decreasing Gini-coefficient means that income inequality within countries is, on average, decreasing.

The variable '<50% median income' represents the percentage of people in the population within countries who live in households whose per capita income or consumption is below half of the median income or consumption per capita. The average is 12.8, with a minimum of 4.2 (Moldova 2016 and a maximum of 26.1 (Honduras 2008).

The variable named 'Inc. share 20%' shows the share of income (in percentages) that accrues to the first (poorest) quintile of the population within a country. The average equals 7.1 which means that on average, in these 40 countries over eleven years, the poorest 20% of the population gain 7.1 percent of the income within a country. The lowest observation is 2.7 (Honduras 2008), the highest 10.2 (Slovenia 2008).

The education variable is an index which could in potential vary between 0 and 100, but the minimum of these countries is 46.1 (Honduras 2008) and the maximum is 94.0 (Germany 2017). The average is 79.8.

Democracy is also an index variable which could in potential vary between 0 and 100. Like education, this is not the case in the data we use. The average is 76.9, with 45.9 (Georgia 2010) as the lowest observation and 99.3 (Norway 2012-2016) the highest.

GL-5-digit is a variable which shows the Grubel-Lloyd index per country calculated for the year 2006 by Brülhart (2008) using the 5-digit level of the SITC classification. Using 5 digits to categorize trade results in 1161 different industries. The GL-Index measures intra-industry trade for a country. The average is 0.233, but the variation is considerable given the minimum of 0.02 (Georgia) and the maximum of 0.424 (France).

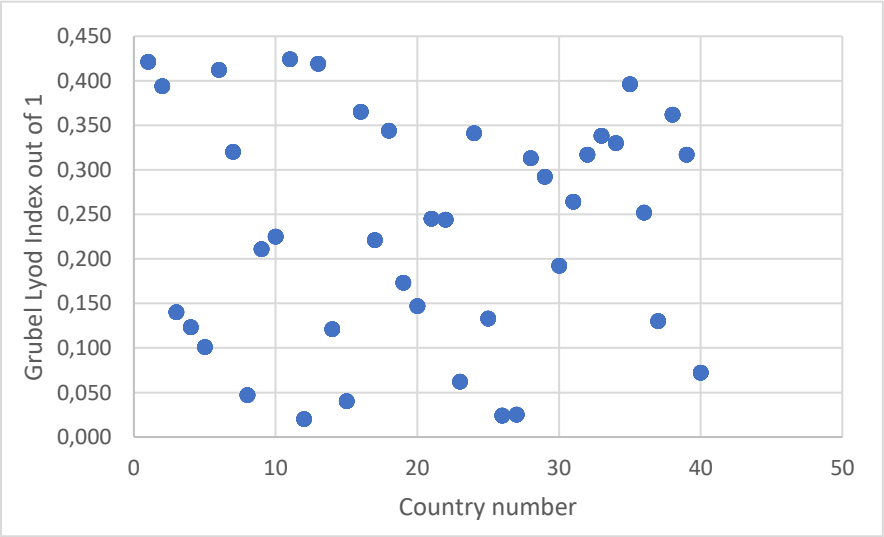

Figure 3.5: Distribution of the Grubel Lloyd Index. Every dot represents one country, with its corresponding country number (manually assigned, alphabetically ordered). See Appendix for which country belongs to which number.

Figure 3.5 shows the distribution of the Grubel Lloyd Index calculated using 5-digit industry levels. Every dot represents a country with a corresponding number (see Appendix) and the corresponding GL-Index, calculated by Brülhart (2008) with data from 2006. The graph shows that countries are distributed quite evenly along the Y-axis, with numbers ranging from 0.02 to 0.424, meaning that the country with the lowest amount of intra-industry trade in this dataset has 2% of intra-industry trade and the country with the highest amount has more than 42% of intra-industry trade. 100% equals all trade a country has.

GL-3-digit is the same variable as GL-5-digit, but then calculated by using a 3-digit definition of industries, which results in a total of 177 industries. Because there are less industries, there is per definition more intra-industry trade and thus the GL-3-digit variable is higher than the GL-5-digit variable. The average of these countries is 0.372. The minimum equals 0.052 (Honduras), the maximum observation is 0.622 (Czech Republic).

3.4 Hypotheses

Figure 3.6 and Figure 3.7 show that there may be a difference in the effect of trade openness on income inequality between countries with high and low percentages of intra-industry trade. Both figures have the same X-axis and Y-axis, which makes comparing the figures easier. Figure 3.6 shows a scatterplot with observations which have an GL-index below average, indicating a relatively low amount of intra-industry trade. The variety of the Impex-rate is relatively small, while the variety in income inequality (Gini-coefficient) is relatively big. For Figure 3.7, showing observations with relatively high amount of intra-industry trade, this holds vice versa. Looking at Figure 3.6 and Figure 3.7, it is expected that the impact from trade openness on income inequality differs between countries with high and low amounts of intra-industry trade.

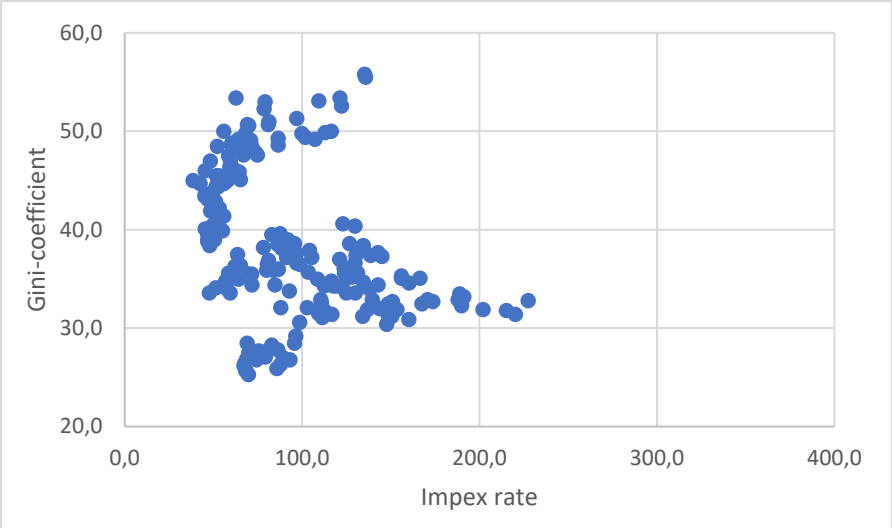

Figure 3.6: Scatterplot with income inequality measured as Gini coefficient on Y-axis and trade openness measured as the Impex rate on X-axis for observations with a GL5digit lower than the average GL5digit of this dataset. 209 observations out of a total of 440.

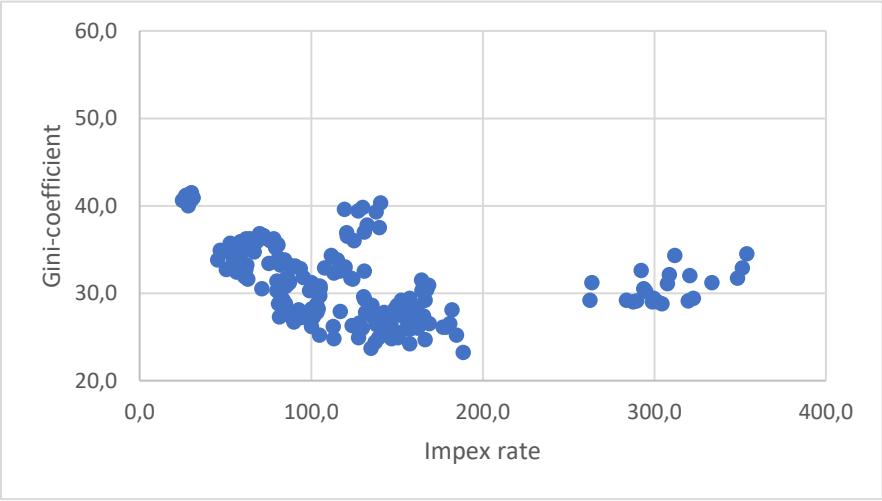

Figure 3.7: Scatterplot with income inequality measured as Gini coefficient on Y-axis and trade openness measured as the Impex rate on X-axis for observations with a GL5digit higher than the average GL5digit of this dataset. 231 observations out of a total of 440.

4. Methodology

This thesis will rely on a Panel Fixed Effects regression to estimate results. This method gives the opportunity to assess the relationship between the trade openness and the income inequality of a given country while controlling for unobserved country characteristics that do not vary over time.

The following equation will used to estimate the effect of trade openness on income inequality in a given country:

$$Inequality_{it} = \beta_0 + \beta_1 Impex_{it} + \beta_2 X_{it} + \beta_3 GL_i + \beta_4 Impex_{it} * GL_i + \epsilon_{it} ,$$

with X_{it} as a vector of country- and time-specific control variables, and with ε_{it} as the error term. β_1 measures the direct effect of the Impex rate on income inequality and β_3 indicates what the direct effect of the Grubel-Lloyd index on income inequality is. β_4 is an interaction term that captures how the effect differs between countries with high and low levels of intra-industry trade. X_{it} represents the two control variables, the education index, and the democracy index.

Each table with regression analysis results shows five different versions of the model, which will be briefly explained. The first model is a simple regression analysis model with no control variables. That means Omitted Variable Bias may lead to an over- or underestimation of the result. The formula for Model 1 is as follows:

$$Inequality_{it} = \beta_0 + \beta_1 Impex_{it} + \epsilon_{it} \quad (1)$$

The second and third model add relevant control variables to account for a potential Omitted Variable Bias. Model 2 incorporates a control variable for the level of democracy in a given country and Model 3 adds another control variable, namely the level of education in a given country. The formulas for Model 2 and Model 3 are given below:

$$Inequality_{it} = \beta_0 + \beta_1 Impex_{it} + \beta_2 democracy_{it} + \epsilon_{it} \quad (2)$$

$$Inequality_{it} = \beta_0 + \beta_1 Impex_{it} + \beta_2 democracy_{it} + \beta_3 education_{it} \epsilon_{it} \quad (3)$$

In the fourth and fifth model the Grubel-Lloyd Index enters the equation. In Model 4, we add the GL-Index based on 5-digit-industries as a control variable to Model 3. In Model 5 we subsequently add an interaction term between the Impex rate and the GL-Index to Model 4. Model 5 allows to analyse how the GL-Index might affect the effect economic openness of a country has on the income distribution within that country. Model 5 is the most complete model and gives the opportunity to analyse in detail what the effect of economic openness on income inequality is and how this effect differs between countries with high and low proportions of intra-industry trade. The formulas of Model 4 and Model 5 are given below:

$$Inequality_{it} = \beta_0 + \beta_1 Impex_{it} + \beta_2\, democracy_{it} + \beta_3 education_{it} + \beta_4 GL5_i + \epsilon_{it} \quad (4)$$

$$Inequality_{it} = \beta_0 + \beta_1 Impex_{it} + \beta_2\, democracy_{it} + \beta_3 education_{it} + \beta_4 GL5_i + \beta_5 Impex_{it} * GL5_i + \epsilon_{it} \quad (5)$$

In this paper, three different measurements of income inequality are used. The Gini-coefficient is the most important and most known measurement for income inequality. The other two variables used as a measurement for income inequality are more focused on the people with lower incomes. The percentage of the population living in households who have less income than 50% of the median income in their country is the second measurement for income inequality within a country. The third and last variable measuring income inequality within a country is the percentage of total income that is earned by the 20% lowest earners. These three specifications of inequality lead to a total of fifteen regression formulas.

5. Results

This section presents the results of the Panel Fixed Effects regression analysis. Additionally, this section interprets the results, discusses outcomes, and will provide information about the intuition behind the results.

5.1 Gini-coefficient

Table 5.1 shows the regression analysis results of the five models as explained in section 4 with the Gini-coefficient as the measurement for income inequality within a country. Column 1 shows results for Model 1, column 2 for Model 2, and so on.

Table 5.1: Regression analysis results of the effect of trade openness (Impex rate) on the income inequality (Gini-coefficient) within a country, and the difference of this effect between countries with higher or lower intra-industry trade (Impex*GL5).

Variable	(1)	(2)	(3)	(4)	(5)
Impex rate	-0.041***	-0.031***	-0.031***	-0.028***	-0.002
	(0.0044)	(0.0046)	(0.0033)	(0.0038)	(0.1001)
Impex*GL5					-0.108**
					(0.0488)
GL-5-digit				Yes	Yes
Education			Yes	Yes	Yes
Democracy		Yes	Yes	Yes	Yes
Constant	39.06	61.33	63.10	57.25	55.19
R^2	0.13	0.39	0.39	0.51	0.51

*Note: Standard errors are in parentheses; * p < 0.010, ** p < 0.05, *** p < 0.01.*

Column 1 of Table 5.1 shows that the outcome of the regression analysis of Model 1 of the effect of the economic openness, measured by the Impex rate, on the income inequality, measured by the Gini-coefficient is negative and statistically significant. The coefficient of -0.041 can be interpreted that a one percentage point increase in the Impex rate, decreases the Gini-coefficient with 0.041 (on a scale of 0 to 100). The constant is 39.06, which can be interpreted that an isolated, self-sufficient country with no trade at all would have a Gini-coefficient of 39.06. If this fictional country would open up to trade until it would have an average Impex rate of 108.5, the Gini-coefficient of this country would decrease to a level of 34.6.

Column 2 and 3 of Table 5.1 show that Model 1 has the issue of Omitted Variables Bias. When we add two control variables that are relevant according to the existing literature, we see that the effect of the Impex rate on the Gini-coefficient decreases. The estimated effect of both models is -0.031 and statistically significant, meaning that an increase of the Impex rate with one percentage point will lead to a decrease of the Gini-coefficient with 0.031, when controlling for the level of democracy and the level of education in a specific country.

Column 4 of Table 5.1 shows results for Model 4, with the Grubel-Lloyd Index calculated at a 5-digit-industry level as additional control variable, does not differ significantly from Model 3. The estimated coefficient for the effect of the Impex rate on the Gini-coefficient is -0.031. This estimation is statistically significant.

Column 5 of Table 5.1 shows results for the full model, with the interaction term between the Impex rate and the amount of intra-industry trade added to Model 4. An interaction term is somewhat harder to interpret, but it can expand the understanding of the relationships between the variables in the model greatly. The interaction term gives the opportunity to analyse the effect of the economic openness on the income inequality within a country for different levels of intra-industry trade. Adding the interaction term leads to a statistically insignificant estimated effect of the Impex rate in row 1. However, for a correct interpretation of the effect of the Impex rate on the Gini-coefficient, the estimated coefficient for the interaction term in row 2 should be incorporated as well. An example will probably help to understand the total effect.

Example interpretation total effect of Impex rate

The Impex rate for Lithuania in 2011 and Cyprus in 2017 are exactly the same, namely 148.4. The amount of intra-industry trade differs between those two countries, which allows us to analyse the total effect of the Impex rate and the Gini-coefficient. The Grubel-Lloyd index for Lithuania based on a 5-digit-industry level is 0.147, and for Cyprus 0.101.

The total effect of the Impex rate on the Gini-coefficient for Lithuania can be calculated as follows: 148.4 * -0.002 + 148.4*0.147*-0.108 = -2.653.

The total effect of the Impex rate on the Gini-coefficient for Cyprus can be calculated as follows: 148.4*-0.002 + 148.4*0.101*-0.108 = -1.916

The outcomes of these calculations can be interpreted as the total effect of the Impex rate of 148.4 on the Gini-coefficient for different levels of intra-industry trade.

The estimated coefficient of the interaction term is negative and statistically significant at 5%, which means that the effect of the Impex rate on the Gini-coefficient is more negative for countries with a higher amount of intra-industry trade at a given level of the Impex rate. The example is helpful to see the difference.

The results considering the effect of economic openness on income inequality within a country are hard to interpret. The regression analysis results indicate that a negative relationship exists between economic openness and income inequality. This effect is small but significant. From the empirical literature, it is known that the effect of economic openness on income inequality can differ between rich and poor countries. Since this dataset is heavily dominated by richer countries, it is in line with the existing literature that we find a negative relationship.

The results of the interaction term are contrary to what is expected given the theoretical literature. As discussed in the section on theoretical literature, the models predict that intra-industry trade does not have an effect on the income distribution within a country. Hence, it is expected that the effect of the Impex rate on the Gini-coefficient is lower for countries with a lot of intra-industry trade and thus a high Grubel-Lloyd index. The results in column 5 of Table 5.1 suggest that the effect of economic openness on income inequality increases when a country has more intra-industry trade.

5.2 Income share lowest earning quintile

Table 5.2 shows regression analysis results for the effect of the Impex rate on the income share of the lowest earning quintile of the population within a country. All five models as discussed in the methodology section are incorporated in Table 5.2. Column 1 shows results for Model 1, etc.

Column 1 of Table 5.2 estimates a negative relationship between economic openness and income inequality. The estimated coefficient is positive, but since this indicates that the income share of the lowest earning quintile of the population increases when economic openness increases, this suggests a negative relationship between economic openness and income inequality. The correct interpretation is that when the Impex rate increases with one percentage point, the income share of the lowest earning quintile increases with 0.011 percentage point. This effect is small but significant. However, as with all simple regression

models with only two variables, the risk of overestimating or underestimating this effect due to Omitted Variable Bias is realistic.

Table 5.2: Regression analysis results of the effect of trade openness (Impex rate) on the income inequality (income share <20) within a country, and how this effect differs between countries with higher or lower intra-industry trade (Impex*GL5)

Variable	(1)	(2)	(3)	(4)	(5)
Impex rate	0.011***	0.008***	0.008***	0.008***	-0.001
	(0.0011)	(0.0012)	(0.0012)	(0.0010)	(0.0033)
Impex*GL5					0.036**
					(0.0121)
GL-5-digit				Yes	Yes
Education			Yes	Yes	Yes
Democracy		Yes	Yes	Yes	Yes
Constant	5.95	0.45	0.27	1.51	2.21
R^2	0.14	0.39	0.39	0.49	0.49

*Note: Standard errors are in parentheses; * p < 0.010, ** p < 0.05, *** p < 0.01.*

Columns 2, 3 and 4 of Table 5.2 shows that adding one, two or three control variables decreases the effect of the economic openness on income inequality with 0.003. This emphasizes that the estimated effect in column 1 may be influenced by Omitted Variable Bias. The effect is smaller, but still statistically significant.

Column 5 of Table 5.2 shows results for the regression analysis including the interaction term. The interaction term is positive and statistically significant, which means that for countries with more intra-industry trade, the effect of economic openness on income inequality is bigger.

5.3 Percentage of population with an income lower than 50% of the median income

Table 5.3 shows regression analysis results for the effect of economic openness on the income inequality within countries. Income inequality in Table 5.3 is measured as the percentage of the population which has an income lower than half of the median income in the country. The columns in Table 5.3 correspond with the different versions of the model, as discussed in the methodology section.

Table 5.3: Regression analysis results of the effect of trade openness (Impex rate) on the income inequality (income <50% median income) within a country, and how this effect differs between countries with higher or lower intra-industry trade (Impex*GL5)

Variable	(1)	(2)	(3)	(4)	(5)
Impex rate	-0.028***	-0.021***	-0.021***	-0.020***	-0.013
	(0.0030)	(0.0033)	(0.0032)	(0.0028)	(0.0100)
Impex*GL5					-0.029
					(0.0376)
GL-5-digit				Yes	Yes
Education			Yes	Yes	Yes
Democracy		Yes	Yes	Yes	Yes
Constant	15.84	31.05	31.01	27.81	27.25
R^2	0.13	0.38	0.38	0.46	0.46

*Note: Standard errors are in parentheses; * p < 0.010, ** p < 0.05, *** p < 0.01.*

Column 1 shows, as with the Gini-coefficient and the income share of the lowest earning quintile, a negative relationship between economic openness and income inequality. In Table 5.3, income inequality is measured as the percentage of the population with an income lower than 50% of the median income in that country. The estimated coefficient in column 1 mean that a one percentage point increase of the Impex rate would lead to a decrease of the percentage of people with an income lower than 50% of the median income with 0.028 percentage point. This estimation is statistically significant at 1%. However, Omitted Variable Bias may cause an underestimation or overestimation of this estimated coefficient.

Columns 2, 3 and 4 shows that this is indeed a potential problem. Adding control variables leads to a smaller effect. The effect is still statistically significant. With all control variables added, column 4 shows that the estimated coefficient is -0.020.

So far, Tables 5.1, 5.2 and 5.3 looked quite similar. The estimated effect was significant in all cases, decreased a little bit when control variables were added, and the interaction term was significant. However, column 5 of shows that the interaction term is not significant, with the standard deviation bigger than the estimated effect. The estimated effect of the direct effect in row 1 is still significant, but only at 10%.

The results of this paper are contrary to what could be expected based on the Heckscher-Ohlin model of international trade. Kanbur (2000) describes that in a H-O-model with skilled and unskilled workers, unskilled workers in developed countries will have to deal with lower wages when trade openness increases. The results indicate that an increase in trade openness will lead to lower income inequality in developed countries. In addition to that, the results show that increasing trade openness increases income inequality in poorer countries, in line with Savvides (1998), Barro (2000), Ravallion (2001) and Milanovic (2005), all of whom found that increasing trade openness increases income inequality in poorer and developing countries.

6. Robustness checks

In this section, a robustness check is performed for the results obtained in the previous chapter. We will use the Grubel-Lloyd index calculated by Brülhart (2008) using three-digit-industries, instead of the five-digit-industries.

Tables 6.1, 6.2 and 6.3 show regression analysis results for the effect of economic openness on income inequality within a country, measured by the Gini-coefficient (Table 6.1), the income share of the lowest earning quintile (Table 6.2) and the percentage of the population with a wage lower than 50% of the median income (Table 6.3). Columns 1-3 of each table are exactly the same as in Tables 5.1, 5.2 and 5.3. In columns 4 and 5, a robustness check is performed for the results obtained in the results section.

Table 6.1: Regression analysis results of the effect of trade openness (Impex rate) on the income inequality (Gini-coefficient) within a country, and the difference of this effect between countries with higher or lower intra-industry trade (Impex*GL3).

Variable	(1)	(2)	(3)	(4)	(5)
Impex rate	-0.041***	-0.031***	-0.031***	-0.028***	-0.002
	(0.0044)	(0.0046)	(0.0033)	(0.0037)	(0.0136)
Impex*GL3					-0.065*
					(0.0339)
GL-3-digit				Yes	Yes
Education			Yes	Yes	Yes
Democracy		Yes	Yes	Yes	Yes
Constant	39.06	61.33	63.10	56.49	54.71
R^2	0.13	0.39	0.39	0.57	0.57

*Note: Standard errors are in parentheses; * p < 0.010, ** p < 0.05, *** p < 0.01.*

Table 6.2: Regression analysis results of the effect of trade openness (Impex rate) on the income inequality (income share <20) within a country, and how this effect differs between countries with higher or lower intra-industry trade (Impex*GL3)

Variable	(1)	(2)	(3)	(4)	(5)
Impex rate	0.011***	0.008***	0.008***	0.008***	-0.001
	(0.0011)	(0.0012)	(0.0012)	(0.0010)	(0.0033)
Impex*GL3					0.022***
					(0.0081)
GL-3-digit				Yes	Yes
Education			Yes	Yes	Yes
Democracy		Yes	Yes	Yes	Yes
Constant	5.95	0.45	0.27	1.71	2.31
R^2	0.14	0.39	0.39	0.53	0.54

*Note: Standard errors are in parentheses; * p < 0.010, ** p < 0.05, *** p < 0.01.*

Table 6.3: Regression analysis results of the effect of trade openness (Impex rate) on the income inequality (income <50% median income) within a country, and how this effect differs between countries with higher or lower intra-industry trade (Impex*GL3)

Variable	(1)	(2)	(3)	(4)	(5)
Impex rate	-0.028***	-0.021***	-0.021***	-0.020***	-0.016
	(0.0030)	(0.0033)	(0.0032)	(0.0028)	(0.0102)
Impex*GL3					-0.009
					(0.0253)
GL-3-digit				Yes	Yes
Education			Yes	Yes	Yes
Democracy		Yes	Yes	Yes	Yes
Constant	15.84	31.05	31.01	27.27	27.03
R^2	0.13	0.38	0.38	0.50	0.50

*Note: Standard errors are in parentheses; * p < 0.010, ** p < 0.05, *** p < 0.01.*

Tables 6.1, 6.2 and 6.3 show regression analysis results for the effect of economic openness on income inequality within a country, measured by the Gini-coefficient (Table 6.1), the income share of the lowest earning quintile (Table 6.2) and the percentage of the population

with a wage lower than 50% of the median income (Table 6.3). Columns 1-3 of each table are exactly the same as in Tables 5.1, 5.2 and 5.3. In columns 4 and 5, a robustness check is performed for the results obtained in the results section.

The estimated effect in column 4 row 1 of each table does not change in any of the three cases. This result is quite robust. The constant and R^2 in column 4 differ between using the Grubel-Lloyd index calculated with industries at 3-digit-level and 5-digit-level.

Column 5 of the tables in this section shows other results than column 5 of the tables in the previous section. Table 5.1 and Table 5.2 suggested a statistically significant coefficient of the interaction term at the 5% level. Table 6.1 shows an estimated effect of -0.065, which is only significant at 10%. Table 6.2 however shows an estimated effect of 0.022, which is significant at 1%. Table 6.3, like Table 5.3, does not show a statistically significant effect of economic openness on income inequality or of the interaction term. With the robustness check, the results deviate a little bit from the original results, but in conclusion, the results are quite similar.

7. Conclusion and discussion

This study focusses on the relationship between economic openness and income inequality within a country. In addition, a test is performed to see how high amounts and low amounts of intra-industry trade affect this relationship. The data sample covers 40 countries over the time period between 2007 and 2017. Two control variables are used: the level of democracy and the level of education of a country. Three different proxies of income inequality are used: the Gini-coefficient, the income share of the lowest earning quintile of the population, and the percentage of the population with an income lower than 50% of the median income of a country. Economic openness is measured as total imports and exports divided by the GDP of a country, also known as the Impex rate. To measure intra-industry trade, the Grubel-Lloyd index is used, both with five-digit-industries and three-digit-industries.

This study concludes that economic openness and income inequality have a negative relationship, which means that more economic openness will lead to less income inequality. With all three proxies for income inequality a statistically significant result is found for the estimated effect of economic openness on income inequality. The estimated effect is found to be statistically significant at 1% in Models 1-4. However, although control variables are added to the model, there is still a potential risk of Omitted Variable Bias. In other empirical papers, more control variables are added to be able to control better for this risk.

This paper also studied the effect of the amount of intra-industry trade a country has on the effect of economic openness on income inequality. The results were surprising. Where theory would predict that intra-industry trade would not have an effect on the income distribution, it was expected that the higher the proportion of intra-industry trade, the lower the effect of economic openness on the income inequality in a country. Contrary to this expectation, the results suggest the exact opposite. A high Grubel-Lloyd index, indicating a lot of intra-industry trade, suggested a bigger effect of economic openness on income inequality. A potential causing factor of this is that countries with a lot of intra-industry trade are often richer, developed countries. Existing empirical literature suggests that the relationship between economic openness and income inequality itself can be negative for rich countries (meaning more trade causes less inequality) and can be positive for poorer countries (meaning more

trade causes more inequality). This may drive the interaction effect. Therefore, it is unsure whether this effect is true. Further research is necessary to find out whether this effect remains true when controlling for the differences between countries, like GDP per capita or an index whether a country is developed or developing.

The robustness check indicated that the results found with regards to the direct effect of economic openness on income inequality are robust when controlling for the Grubel-Lloyd index calculated using three-digit-industries instead of five-digit-industries. The estimated effect of the interaction term is less robust. Differences are observed between the three proxies of income inequality. However, there are still two statistically significant results, at 10% and at 1%.

A factor that could influence the results found in this paper is the limited data availability, which is why the data sample consisted of only 40 countries between 2007 and 2017. Most countries are located in Europe, and many countries could be regarded as richer or developed. To be able to analyse the differences in more detail, one would need data of a balanced set of countries from all continents over many years. Additionally, further research could study the effect of intra-industry trade on income inequality while controlling for different levels of development and richness of countries. Moreover, using different measurements of economic openness might be useful to be able to understand the relationship between economic openness and income inequality better.

This paper contributes to the literature by providing additional empirical evidence for the relationship between economic openness and income inequality within a country. In addition, it provides a first empirical analysis of the differences of this effect between countries with high and low intra-industry trade. Further research is necessary to better understand this relationship, since the results in this paper are contrary to what is expected based on theoretical frameworks.

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Appendix: List of countries included in paper, including country number

Country name	Country number	Country name	Country number
Austria	1	Luxembourg	21
Belgium	2	Malta	22
Bulgaria	3	Moldova (Republic of)	23
Costa Rica	4	Netherlands	24
Cyprus	5	Norway	25
Czech Republic	6	Paraguay	26
Denmark	7	Peru	27
Ecuador	8	Poland	28
Estonia	9	Portugal	29
Finland	10	Romania	30
France	11	Slovakia	31
Georgia	12	Slovenia	32
Germany	13	Spain	33
Greece	14	Sweden	34
Honduras	15	Switzerland	35
Hungary	16	Thailand	36
Ireland	17	Turkey	37
Italy	18	United Kingdom	38
Latvia	19	United States	39
Lithuania	20	Uruguay	40