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The effect of trade on inequality: analysis of the effect of trade openness on within-country income inequality in developed and developing countries

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Abstract

Never-before-seen levels of globalization has increased the academic relevance on how trade affects within-country income inequality. This thesis investigates historic and recent academic literature on the effect of trade on within-country income inequality. It also performs an individual fixed effects analysis with both an inequality measure, and three separate income shares to research how inequality changes in imports and exports. This is done for both developed as developing countries. The results seem to suggest a relationship between trade and within-country income inequality but due to limited data availability, these results cannot be seen as a causal relationship between trade and inequality.

1. Introduction

Worldwide levels of trade have been increasing over the last decade resulting in higher globalization than ever before. This globalization can lead to multiple changes in production and consumption patterns in countries, resulting in losers and winners from trade. This paper focusses on the effect increasing trade openness has on within-country income inequality. Income inequality is related to perceived individual happiness (Ferrer-i-Carbonell & Ramos, 2013). Other research describes how inequality can affect economic growth both positively and negatively depending on where income inequality exists in the income distribution (Voitchovsky, 2005). As trade is possibly affecting this income inequality and considering the large effects income-inequality can have on a society, it is academically and socially relevant to research the effects increasing trade has on within-country income inequality.

The following main research question will be discussed and answered:

What is the effect of trade openness on within-country income inequality in both developed and developing countries?

Besides a main effect of trade openness on within-country income inequality, it is also important to understand who gains and who loses and how a possibly changing inequality is determined. Inequality can for example arise from the top earners growing in income earned or from the bottom earners decreasing their income being earned. This insight can be used for better policy measures against income inequality. For this reason, three subquestions will be discussed:

How does the share of the top 10 percentile of income shares move with increasing trade openness in both developed and developing countries?
How does the share of the middle 40 percentile of income shares move with increasing trade openness in both developed and developing countries?
How does the share of the bottom 50 percentile of income shares move with increasing trade openness in both developed and developing countries?

To answer the research questions, relevant literature is reviewed, and an own empirical analysis is performed. The literature review discusses both empirical evidence on within-country income inequality that is collected over the years as different theories and trade models explaining how trade affects within-country income inequality. The own empirical analysis is done by an individual fixed effects method. The sample is divided in two main groups: developed and developing countries. The sample consists of nine developed countries and six developing countries. The data ranges from 1982 to 2018 for developed countries and 2001 until 2018 for developing countries. Where the literature suggests that trade increases inequality in both developed and developing countries, the own empirical analysis only finds strong evidence for increasing inequality in developed countries. The results for developing countries only find a small negative effect of imports on within-country inequality. The literature is reviewed in section 2. Section 3 discusses the used data in the empirical analysis, and section 4 follows with the used methodology. Section 5 presents the results of the analysis; section 6 discusses the limitations of the method, and the thesis is concluded in section 7.

2. Literature review

2.1 Heckscher-Ohlin model

To analyze how international trade can influence within-country inequality, it is important to understand different trade theories and their predictions on inequality. The Heckscher-Ohlin theory states that a country's comparative advantage is based on production factor endowment instead of labor productivity like the Ricardian model. The goods a country trades are based on these comparative advantages. A country would export the good where its factor of production is abundant and import the good which factor of production is scarce. The simple HO model with 2 countries, 2 production factors, and 2 goods predicts that prices converge. This is known as the factor price equalization theorem. The Stolper-Samuelson theorem states that when prices of a certain good increase, the return of the factor used intensively in the production of this

good increases and the return of the other factor decreases. This would mean, that in a skilled-labor abundant country the returns to skilled labor would increase, and the return to unskilled labor would decrease due to price increases in skilled labor-intensive goods caused by increasing trade openness. Advanced economies often characterized as skilled-labor or capital abundant would therefore be expected to see an increase in within-country inequality whereas a decrease would be expected for developing countries which are characterized as (unskilled) labor abundant (Harrison et al., 2011; Meschi & Vivarelli, 2009).

Dornbusch et al (1980) extend the simple Heckscher-Ohlin model by allowing for a continuum of goods. This extension has implications for the Factor Price Equalization prediction. FPE now only holds if the elasticity of substitutions for production are low, meaning factor endowments are not similar between the countries. This in turn also affects the capital labor ratios used for production in the countries and so affects the income distribution.

In summary, the simple Heckscher-Ohlin model, and the Stolper-Samuelson theorem state that when a country opens for trade or increases its trade activity within-country inequality increases for capital abundant countries (or skill-intensive labor abundant countries) and decreases for (non-skill intensive) labor countries. This prediction has been used for political reasons and is an important model in explaining who gains and who loses from trade (Harrison et al., 2011; Meschi & Vivarelli, 2009).

2.2 Empirical findings of trade and inequality

Goldberg and Pavcnik (2007) provide empirical evidence for the evolution of wage inequality in several developing countries during the 1980's and 1990's. During this period, these countries underwent large reduction in trade barriers, for example by lower tariffs and less non-trade barriers due to the signing of trade agreements. The authors compile previous empirical evidence on income inequality. This is measured by a skill premium which is defined as the wage gap between skilled and unskilled workers, by comparisons between blue- and white-collar workers, or manufacturing and non-manufacturing workers. It finds that over the entire 1980's and 1990's period the skill premium of the countries is increasing. The skill premium increase often coincides with trade reforms in several countries. However, this relationship might be affected by, for example labor market reforms happening at the same moment. The effect of trade openness, defined by the ratio of imports and exports to GDP on inequality is mentioned by Barro (2000). It finds that larger trade openness has a positive effect on inequality. By defining an interaction variable between trade openness and log of per capita GDP, Barro concludes that the effect is mostly related to poor countries as this interaction

variable has a negative sign. This means that the positive effect of trade openness is reduced by increasing GDP per capita (even resulting in a total negative effect for most OECD countries). The result of trade having a "positive" effect on inequality is partially supported by Meschi and Viverelli (2009). However, they argue that not aggregate trade is of importance but only trade with more technical advanced countries leads to increasing income inequality. Milanovic and Squire (2005) critically review previous empirical research and based on these findings perform an own empirical analysis. They find a weak relationship between trade liberalization and increasing within country wage inequality (both inter-occupational and between industries wage inequality).

2.3 Theories for increasing within-country inequality

The literature in the previous section shows that trade openness increases the inequality in developing countries (Barro, 2000; Goldberg & Pavcnik, 2007; Meschi & Viverelli, 2009; Milanovic & Squire, 2005). These findings are against the prediction made by the Heckscher-Ohlin model and the Stolper-Samuelson theorem as they predict a decrease in within-country inequality in developing countries. With this in mind, we must take a look at other theories that can explain the phenomenon of rising inequality in both developing and developed countries.

2.3.1 Offshoring

An important theory for the increasing inequality in developing countries is the offshoring theory. With offshoring, a firm in a developed country produces certain (intermediate) goods in a developing country and the focus of trade should be on intermediate tasks instead of final goods (Grossman and Rossi-Hansberg, 2008). Goods are ranked on a scale based on skill-intensity with the skill intensive goods produced by the developed country. When the developed country offshores their least skill intensive goods to the developing country, the demand for skilled labor rises. For the developing country this means that this newly produced good is relatively skill intensive compared to their earlier produced goods, and therefore also increasing the demand for skilled labor. As labor demand becomes more skill-intensive in both developed countries and developing countries, offshoring predicts increasing within-country inequality in both developed and developing counties. Offshoring can occur due to capital flowing from a developed country to a developing country (Feenstra & Hanson (1995). Feenstra and Hanson (1996) find that the change in offshoring and the import share increases the nonproduction wage share, and so increases the wage inequality within a country.

Trefler and Zhu (2005) moves the focus to technological catch-up by southern countries (northern countries being developed and southern developing). A general equilibrium model is created where technological catch up causes the product mix produced in the south to change and become more skill intensive. The predictions are similar as in Feenstra and Hanson (1995). They find empirical evidence for the shift of goods produced by the countries due to southern catch-up. The increase in export shares of skill-intensive goods causes the increases in wage inequality and that this effect is not directly due to the southern catch up but only indirect through the rise in export shares in skill-intensive goods.

Xu (2003) hypothesizes that trade liberalization on its own can cause wage inequality to increase in developing countries due to an increase in the number of goods being traded, without the influence of accompanied foreign investment and technical change as discussed in other empirical work (Feenstra and Hanson, 1995; Trefler and Zhu, 2005). It does so by applying a 2 country (developed North and developing South), 2 factor, 4 goods (ranked on skill intensity) Heckscher-Ohlin model where due to an existing tariff the 2 middle goods are not traded. The tariff prevents the 3rd most skill intensive good to be imported by South as it increases the price, while it prevents the 2nd most skill intensive good to be exported due to Terms of Trade effects. The first direct effect of a decrease in tariffs in South is the increasing import range of goods, resulting in lower skilled labor demand, and so a decreasing wage inequality. An indirect effect of this is that the demand for skilled labor in North increases, increasing their wages and therefore also increasing the export range from South, which raises Souths wage inequality. Both effects can dominate each other but the model by Xu does show it is possible that trade liberalization increases wage inequality in a developing country by shifting the goods that are traded. The likelihood that this occurs is even higher when the developed country also liberalizes its trade. Offshoring due to trade liberalization is therefore a possible explanation for rising wage inequality in developing countries by affecting the mix of goods being traded.

Ebenstein et al. (2014) find that offshoring in the United States results in several different wage decreases. First, they find that a 10% increase in occupational exposure to imports leads to a 3 to 4.5% decrease in real wages, secondly that a 10% increase in occupation specific exposure to low-wage countries employment results in a 0.7 to 2% decrease in real wages between 1984 and 2002. They also find a decrease on wages of other workers facing more competition from reallocating workers from import competing manufacturing jobs. This evidence is in line with the above-described theories that offshoring leads to increasing inequality in developed countries. Not all literature agrees upon the statement that offshoring always increases inequality. For example, Grossman and Rossi-Hansberg (2008) model that

unskilled labor wages can increase due to productivity increases for unskilled labor. This effect can however be overturned by terms of trade effects.

Summarizing, most empirical evidence proves the importance of offshoring on explaining the rising inequality in both developed and developing countries. The change in product-mix can be caused by capital flows moving from Northern to Southern countries (Feenstra and Hanson, 1995), technological catch-up by Southern countries (Trefler and Zhu, 2005) or trade liberalization moving nontraded goods to being traded (Xu, 2003).

2.3.2 Skill Biased Technological Change

One possible explanation for the increase in inequality in developed and developing countries is that of skill-biased technological change (SBTC). This theory argues that due to technological change being skill-biased, technological change increases the skilled-labor demand in both developed and developing countries (Goldberg and Pavcnik, 2007; Chusseau et al., 2008; Berman et al., 1998). SBTC was seen as a large reason for increasing inequality directly, but recent literature has highlighted the importance of the effect trade can have on SBTC (Chussea et al., 2008). Trade can effect technological change in several ways, and so influence the inequality within a country.

A first mechanism on how trade can cause SBTC is "defensive innovation" as hypothesized by Wood (1995). Here, firms engage in R&D due to increasing competition due to trade. A critique for this theory raised in Chussea et al. (2008) is however that firms should already engage in R&D without trade if this would increase their profits. Thoenig and Verdier (2003) developed a further model of trade and innovation and found that in both North-North and North-South trade, when firms are facing more foreign competition, they increase their skilled-labor intensive innovations. This ultimately leads to an increase in skill premium in both regions. Another way how trade and SBTC can work together is based on endogenous technological change and the increased import of capital and equipment that are complimentary to skilled labor. According to Chussea et al. (2008) trade increases the market size, and this makes R&D more attractive for firms. Due to the comparative advantage of skilled labor in the U.S. (and other developed countries) innovation is also skill-biased to complement its abundant factor (Acemoglu, 2003). These skill-biased innovations increase the inequality in developed countries but also the inequality in developing countries as firms here import these skill-intensive innovations. Burstein et al. (2013) support this claim by analyzing the role of capital and equipment imports. They find that when countries move to autarky, or lower their trade volumes, that this decreases the skill premium. This result varies and is larger for countries

relying on capital and equipment imports that are complementary to skilled labor. Lee and Wie (2015) find that SBTC in Indonesia through increasing technology imports is responsible for increasing wage inequality as it increased the demand for skilled labor. R&D activities are also seen as skill-intensive, which would directly affect the skill premium in a country (Dinopoulos & Segerstrom, 1999, as cited by Chussea et al, 2008).

More recent developments in the literature describe the effects of automation and so-called Routine-Biased Technological Change (RBTC). When technological change is biased in routine tasks, the labor of these tasks gets replaced by capital. This labor is often of middle to low skill, causing the observed job polarization in Western European countries (Goos et al, 2014). Autor and Dorn (2013) find similar job polarization in the U.S. labor market. Technology replaces low to middle skilled labor, but it complements high skilled labor raising its productivity and the demand for high skilled (or college educated) labor (Autor et al., 2003). The middle skilled labor often moves towards low skilled service sectors. As the high skilled labor employment grows the fastest, the middle skilled labor group the slowest, and the low skilled (service) sector grows modestly, job polarization increases (Autor & Dorn, 2013; Autor et al., 2006).

Automation is defined by Acemoglu and Restrepo (2018c) as the increase in tasks where capital replaces labor as factor of production. Automation has several effects, mainly the displacement and reinstatement effects (Acemoglu & Restrepo, 2018c, Acemoglu & Restrepo, 2019). For the displacement effect, capital replaces labor in the production with the income share of labor decreasing. The reinstatement effect describes how automation creates new tasks with a comparative advantage of labor, increasing the income share of labor. Problems here are however that these tasks require new skills and the transition from old, automated tasks towards these newer tasks can take a while as these new tasks are usually high skilled labor intense. Other effects that can increase the income share of labor are the productivity effect, the capital accumulation effect, and the deepening of automation (no displacement of labor takes place). Acemoglu and Restrepo (2018b) model how automation reduced the type of labor it replaces and how low skilled labor automation increases inequality, and high skilled labor automation decreases this. Hémous and Olsen (2022) similarly model how automation causes a larger increase in high skilled labor wage than in low skilled labor resulting in increasing inequality. This is in line with the results of Prettner and Strulik (2020) who also find an increase in inequality caused by automation.

An important note on SBTC is that it can be both factor as sector biased. When it is sector biased, it is not that the technologies affect skilled labor as a factor, but the technologies

affect skill-intensive industries (Chussea et al, 2008). Most literature focus on the factor-bias of SBTC (Krugman, 2000). Haskel and Slaughter (2002) however aim their focus on sector bias and that this is responsible for the pattern found in the skill premium. In their multi-sector framework, they find that sector bias of SBTC determines the effect on relative wages, which is supported by their empirical analysis of ten OECD countries during the 1970's and 1980's. Xu (2001) mediates the debate and concludes that in a world with global, but different technological change across countries both the factor as the sector bias play a role.

The literature suggests that SBTC can cause within-country inequality in both developed as developing countries (Chussea et al., 2008, Berman et al., 1998) and that SBTC is both factor as sector biased (Xu, 2001). International trade can affect SBTC by mechanisms like 'defensive innovation' as described in Wood (1995) and Thoenig & Verdier (2003) or by the innovations occurring in developed countries being complementary to their abundant factor (skilled labor), also affecting developing countries (Acemoglu, 2003; Burstein et al., 2013).

2.3.3 Firm heterogeneity

A more recent development in the literature involves the effect trade has on firm heterogeneity and how this results in increasing inequality. This inequality is however not as usual, between certain industries but concentrated within industries (or even occupations). Firm heterogeneity can occur when firms in the same industry have different demand for skilled and unskilled labor, possibly creating a larger skill premium. Firm heterogeneity can occur due to trade liberalization which in result is increasing the demand for more productive, or higher quality firms (Goldberg and Pavcnik, 2007). It is also argued that exporting firms demand more skilled labor than non-exporting firms (Goldberg and Pavcnik, 2007) and that trade, by lowering the costs to export, is a mechanism that causes skilled workers to reallocate to these large firms. This would increase the wage inequality within industries.

Trade exposure can also affect allocation of profitability between heterogenous firms and affect within industry wage inequality. Trade causes firms to self-select them into exporters and non-exporters. Firms that export are usually larger, more productive and pay on average higher wages than non-export firms and therefore can force smaller non-export firms out of business (Bernard et al., 2012; Greenaway & Keller, 2007; Yeaple, 2005). This is also one of the main results of the model developed in Melitz (2003). Melitz developed a dynamic industry model with heterogeneous firms to explain productivity differences between firms in the same industry and its relationship to trade. Firms that enter draw upon a certain productivity level, only firms with a productivity level higher than the cut-off level will produce. The zero cutoff profit and

the free entry conditions determine the equilibrium cutoff productivity and average profit. These outcomes can change due to various shocks that can induce changes in allocation between firms, with trade being one of those shocks. When countries open, firms can decide to export. Exporting comes with increasing variable costs due to tariffs and other transport costs and fixed costs increase due to for example creating new business networks, learning about foreign markets and these, often sunk costs are essential for the export decision (Bernard & Jensen, 2004; Das et al., 2007). Melitz (2003) assumes that the decision to export is made after the productivity level is discovered and therefore sees these costs as an additional investment, which some firms are not willing to pay. An important result is that due to the possibilities of trade, the new zero cutoff productivity level increases. The least efficient firms will exit, and the most productive firms will start to export. Only the most productive firms gain from trade, while less productive exporters increase their market share but lose profits. Firms that do stay in the domestic markets but do not enter the export market lose both market share and profitability, the least productive firms exit the market. The new export demand for the productive firms increases their labor demand, and so wages. This causes the least productive firms to exit. Melitz (2003) also analyses the case of more realistic trade liberalizations. When the number of trade partners increases, a similar reallocation of market share and profits to more productive firms can be expected. When variable trade costs decrease, the cutoff productivity level will also increase, forcing low productive firms outside the market. It also lowers the export cutoff productivity level, increasing the number of exporting firms. The reallocation movements of market shares and profits remain the same. When fixed export costs decrease the same shifts in the cutoff levels will take place but reallocation movements will differ. Firms that already export will not see any increase, but this increase will flow to new exporting firms.

Now that it is modelled, and empirically proven that trade and trade liberalization causes firm heterogeneity in terms of productivity and profitability, Egger and Kreickemeier (2009) expand the Melitz model by analyzing effects of trade on income inequality. They do this by incorporating so called "workers' fair wage preferences" in the model. Workers' care about the productivity of firms and so it can lead to higher performing firms to pay higher wages to workers with similar skill levels than less performing firms. When variable and fixed transport costs exit, the move to an open economy increases profits, welfare, unemployment, the average wage and increases the inequality between similarly skilled labor groups. When fixed costs are the same between countries, increasing the amount of trade partners increases welfare, unemployment, and wage inequality. Lowering the variable trade costs increases unemployment and wage inequality if the initial variable trade costs are relatively large and

decreases these if initial variable trade costs are relatively small already. Helpman et al. (2010) develop a model with additional roles of search and matching frictions between firms and workers. More productive firms benefit more from better matching workers and screen these workers more intensively. When a worker is hired by a more productive firm, they know they have a certain value and have more bargaining power. This causes more productive firms to pay higher wages than less productive firms. When a country opens to trade, this effect increases, and within-industry wage inequality increases further as exporting firms become more profitable and pay even higher wages. When a country is already open to trade, further trade liberalization first increases the inequality and later decreases the inequality which is similar to the results of Egger and Kreickemeier (2009). The results of the model are empirically tested with Brazilian and Swedish data (Helpman et al., 2016; Akerman et al., 2013). The model estimates are close to the actual data and the relationship between trade and inequality through firm heterogeneity is empirically found.

2.3.4 Foreign Direct Investment

Increasing globalization in the previous decades made it easier for firms to engage in foreign direct investments (FDI). As the barriers for these types of investments decreased, the effect it has on within country inequality also becomes more important. FDI is defined as the net inflow of investments that are needed to obtain management interest in a foreign country (The World Bank, 2022).

The effect of FDI on income inequality has been subject to debate for the last decades. Bornschier et al. (1978) is one of the earlier papers that reviews empirical research in the field. It finds that five previously performed empirical studies concluded that FDI increased within-country inequality and no previous empirical studies found a negative relationship between FDI and inequality. This result is also found in Chen et al. (2011) and Han et al. (2012) where FDI increased the skilled labor demand and so the wage inequality in China. FDI also had negative effects on domestic firm wages. Basu and Guariglia (2007) find that in developing countries inequality is increased by FDI, Feenstra and Hansson (1997) find that FDI increases inequality in Mexico, Jaumotte et al. (2013) find that the total effect of globalization on inequality is offset by a negative effect of trade globalization on inequality and a positive effect of financial globalization (FDI) on inequality and it is found that FDI has an increasing effect on inequality in the U.K (Taylor & Driffield, 2005). Other empirical evidence however seems to suggest that FDI has a decreasing effect on within-country inequality. Chintrakarn (2012) finds a negative effect of FDI on income inequality in the United States, but it is noted that there is substantial

heterogeneity across states. Huang et al. (2020) performs a meta-analysis of over 500 empirical papers. They conclude that in low-income countries, FDI increases inequality while for middle-income countries there is no effect, and FDI reduces inequality in higher-income countries. It is also possible that when a country grows from low- to high-income the effects of FDI change. Therefore, it is possible for empirical research to find different effects of FDI, even in the same countries but at different moments.

A possible theory of how FDI causes a larger skill premium and wage inequality is the theory of offshoring. Here inward FDI in developing countries causes increasing skilled labor demand. This theory is extensively discussed in the next section.

2.3.5 Labor market institutions and market policies

Trade can affect inequality in countries differently based on their surroundings. Therefore, it is important to look what causes these effects to differ and how certain institutions or labor market policies affect the impact that trade can have on within-country inequality.

An important factor that impacts inequality is whether a country is a democracy or not. Reuveny and Li (2003) perform an OLS regression on the Gini-coefficient to find the effect of the level of democracy, while also using variables for trade openness, FDI and portfolio inflow. It finds that democracy reduces the within-country level of inequality. It is important to understand that democracy affects inequality, as it also affects trade levels itself and therefore needs to be controlled for in a regression analyzing the effect of trade and inequality. A more extensive analysis is performed by Lin and Fu (2016). They examine how within-country inequality is affected by trade in developing countries and note the importance of institutions. When a country is democratic, trade increases the income inequality. While for autocracies trade decreases income inequality. The difference between the two types of developing countries is in the goods they trade. Democracies are more likely to attract FDI and trade in intermediate and manufactured goods, and according to the Feenstra and Hanson (1996) predictions mentioned in section 2.3.1. which results in increasing inequality. Autocracies are more likely to trade in primary goods and follow the Stolper-Samuelson prediction as described in section 2.1 which results in the reduction in income inequality. This reasoning shows how democracy levels both influence trade patterns and inequality.

Certain policies can affect the inequality after this is caused by one of the other trade mechanisms. An example of this is mentioned by Akerman et al. (2013) that find that the wage inequality caused by firm heterogeneity (section 2.3.3) is larger in Brazil than Sweden. A possible explanation for this is that Sweden has a larger safety net for the losers from trade or

distributes the gains from trade more equally than Brazil does resulting in a lower increase in inequality. Lyon and Waugh (2018) model that with an increase in trade openness, there should be an accompanying increase in progressivity of tax systems as these increases total welfare. Increasing openness causes higher labor risks and due to a more progressive tax system these risks can be offset.

Unionization is another way how wage inequality can be increased. Cortez (2001) analyzes the case of Mexico and finds that the decline in unionization can explain the increasing wage inequality during the 1990's. Decreasing unionization rates also lower the bargaining power for low-skilled workers, which in turn causes the minimum wage to become more effective in decreasing the inequality. Cortez also finds that educational levels decrease the inequality. Fortin and Lemieux (1997) find similar results for the United States during this period as decreasing unionization increased inequality for men (not women) and decreasing real levels of minimum wage increases inequality for both men and women. These mechanisms are related to trade as trade is potentially a cause of decreasing effectiveness of institutions as it increases labor demand elasticities (Spector, 2001). This may also be a reason why unions have become less prevalent during this period.

2.4 Overview and own analysis

The effect of trade on inequality is a heavily discussed subject in the academic world. Early trade models like the Hekcscher-Ohlin model and its Stolper-Samuelson theorem are historically one of the main explanations of rising trade inequality in developed countries and predicts how developing countries should see a decreasing inequality. However, the empirical evidence of more recent research has shown that also developing countries face increasing inequality as an effect of trade. The literature provides several mechanisms how trade affects inequality in both developed and developing countries. The first hypothesis is based on several of these mechanisms. The theory of offshoring predicts how changing trade patterns cause increases in skill-premium and income-inequality in both developed and developing countries due to capital flowing from developed to developing countries, Southern catch-up and trade liberalization (Feenstra and Hanson, 1995; Trefler and Zhu, 2005; Xu, 2003). Skill Biased Technological Change predicts how inequality can be increased by defensive innovation (Wood, 1995) or skill-complementary innovations (Acemoglu, 2003; Burnstein et al., 2013). Trade can also increase the inequality by firm heterogeneity. Skilled-labor demand is often higher in exporting firms (Goldberg and Pavcnik, 2007) and even how similarly skilled workers are paid more on exporting firms (Egger and Kreickemeir, 2009).

Hypothesis 1: Trade openness will positively impact within-country income inequality in both developed and developing countries resulting in larger income inequality.

Separating different income groups shows how income inequality is changing and how policy makers can best react to changing inequality. For this reason, the analysis will not just be limited to overall inequality but also three income shares of the total population will be analyzed. When skill-premia rise (as is predicted by the theories of offshoring, SBTC, automation, firm heterogeneity and FDI) the most skilled workers gain, and the least skilled workers lose. Assuming that the most skilled workers are also the top earners, these theories would predict an increasing income share for top earners and a decreasing for bottom earners. RBTC theory predicts how the middle class is hollowed out (Autor & Dorn, 2013; Autor et al., 2006). These different theories result in the following hypothesis:

Hypothesis 2: The increasing within-country income inequality will be caused by an increasing top income share percentile and decreasing middle- and lower-income share percentiles.

As it is important to look at the effects on developed and developing countries separately data is separated into two groups. One group investigates the effects on developed European OECD countries, the other group investigates the effects on lesser developed Latin America countries. The used data and methodology are described in chapter 3 and 4 respectively.

3. Data

For the sample, similar countries in terms of region and development are grouped. The division is made between developed and developing countries as the effects of trade can differ between these types of countries. The developed countries that are used are Austria, Belgium, Denmark, France, Germany, The Netherlands, Norway, Sweden, and Switzerland. Data is available from 1982 until 2018. The developing countries that are used Argentina, Brazil, Costa Rica, Ecuador, Mexico, and Peru. As there are only three OECD members from the same region that are not classified as a high-income country by the World Bank, the control variable for the effect of the unionization rate is dropped as this is not available for most developing countries. The available data is limited per country and a timeframe of 1999 until 2018 is used for the effect

on the Gini-coefficient and data ranging from 2001-2018 for the three other dependent variables.

To answer the research question, it is important to define our dependent variable "within-country income inequality". The dependent variable is the variable that is affected by the variable of interests. Most literature measures inequality with the Gini-index (De Maio, 2007). The Gini-index uses the Lorenz curve to measure inequality. Gastwirth (1971) defines the Lorenz curve as the share of all income earned by a specific income group. This share gets aggregated as more income groups are considered. The surface between a 45-degree line of perfect equality and the Lorenz curve is the degree of inequality in a country, also known as the Gini-index (Gastwirth, 1972). The upsides of this measure are that data of it is widely available for our sample and the coefficient is easy to interpretate. For our analysis however, only using the Gini-index falls short as it does not show how the income inequality within a country moves. If for example, the inequality grows it is unclear whether this is caused by the high income gaining, or the low income losing. This is also pointed out by Dagum (1980), here it is argued that the Gini-coefficient can only provide an inequality measure for within a population and not between certain populations or income groups. Another problem with the Gini-coefficient arises from the fact that it is no decomposable within several subgroups of a population (Bourguigon, 1980). To address these problems, not just the Gini-index of each country is used but also the respective top 10%, middle 40% and bottom 50% income shares of the selected countries are used as dependent variables. The data for the Gini-coefficients and all the different income shares are retrieved from the World Inequality Database.

The main independent variable of interest is trade. The independent variable affects the dependent variable. Trade openness can be measured in several ways. The two main ways are explained by Spilimbergo et al. (1999). Trade openness can be measured based on incidence which are direct measures, for example tariff rates. The second measurement is outcome based and focusses on total levels of trade. Where incidence-based measures are more specific, data here is are also less available. Therefore, for this analysis an outcome-based measure is used. A common problem is however that there are many different outcome-based measures. Different measures can provide different results, and it is unclear which measure is the "right" one. The World Bank defines trade as the share of the sum of exports and imports of a country its GDP. This ratio is also referred to as the openness ratio of a country. As the data that is used in our analysis is provided by the World Bank, we will use a similar ratio as the openness ratio. However, the literature has stated that exports and imports can have separate effects on inequality. For example, how imports can be complementary to skilled labor (Dinopoulos &

Segerstrom, 1999, as cited by Chussea et al, 2008) or how exporting firms differ from non-exporting firms as they are larger, more productive and pay higher wages (Bernard et al., 2012; Greenaway & Keller, 2007; Yeaple, 2005). For this reason, both the import and the export share in goods and services of the GDP level is used to account for trade openness of a country. As mentioned, data that is used in this analysis is retrieved from the World Bank database.

Besides the dependent variable inequality and the independent variables of interest, there are also other variables that can both affect trade and inequality. These variables need to be controlled for. These so-called control variables are selected based on the discussed theories in the literature review. For the institutions and labor market policies section of the literature review several variables are used. An index is used to control for the level of democracy of the countries used in our sample. This democracy index is retrieved from the Our World in Data database. The democracy matrix is used to determine whether the used countries are democracies or autocracies as this could change the effects of trade on inequality (Lin and Fu, 2016). OECD data is used to analyze the effect of unionization rates of the sampled countries. The role of FDI is described in section 2.3.4, data from the World Bank is used. FDI can affect inequality through offshoring as capital moves from Northern developed countries to Southern developing countries. Therefore, both the net outflows as net inflows as a percentage of GDP are used. The World Bank also provides data for R&D expenditures as a percentage of GDP. This is to account for a share of skill biased technological change. Further control variables that are used are the total GDP and GDP growth, total population and population growth and the GDP per capita. World Bank data is used for these variables. The last two variables that are controlled for is the education level and income taxes. For education the total government expenditure going to education as a share of the GDP is used, also being extracted from the World Bank database. The OECD database provides data for the total collected income tax shares of the countries as a share of the country its GDP for the developed countries. A note here is that for the developing countries this variable is not available. Here, data from Our World in Data is used. The value of this however differs as also taxes on profits and capital gains are used.

The descriptive statistics of the variables that are used in the regressions are given in the two columns in Appendix A. Table 5 presents the descriptive statistics for the developed countries, Table 6 for the developing countries. Besides all descriptive statistics, it is of importance to look at the change of the most important variables. These are given in Table 1 and Table 2.

Table 1. *Averages for developed countries*

Year	Gini	Top10	Middle40	Bottom50	Exports	Imports
1982	0.391	0.288	0.469	0.243	37.585	37.134
2000	0.423	0.320	0.452	0.228	47.390	42.249
2018	0.431	0.324	0.454	0.222	56.505	51.515

Note: This table provides the averages for the most important variables of the analysis, namely the Gini-coefficient, the top 10, the middle 40 and the bottom 50 income share percentiles, the export and import shares over GDP. The averages are taken of the nine developed countries that are used in the analysis: Austria, Belgium, Denmark, France, Germany, the Netherlands, Norway, Sweden, and Switzerland.

Table 2. *Averages for developing countries*

Year	Gini	Top10	Middle40	Bottom50	Exports	Imports
2002	0.657	0.558	0.341	0.101	23.860	22.992
2018	0.637	0.535	0.349	0.116	24.978	25.379

Note: This table provides the averages for the most important variables of the analysis, namely the Gini-coefficient, the top 10, the middle 40 and the bottom 50 income share percentiles, the export and import shares over GDP. The averages are taken of the six developing countries that are used in the analysis: Argentina, Brazil, Costa Rica, Ecuador, Mexico, and Peru.

Table 1 presents the averages of the developed countries in 1982, 2000 and 2018. The Gini-coefficient is increasing in both the 1982-2000 as in the 2000-2018 period. This means inequality has increased in both periods and in general during the 1982-2018 period, as measured by the Gini-coefficient. Similarly, the top 10 income share percentile has also increased with 12.5% in the 1982-2018 period. The middle 40 percentile showed a decrease in the 1982-2000 period followed by a small increase between 2000 and 2018, but over the 1982-2018 there is still a 3.3% decrease visible. The bottom 50 income percentile is decreasing in both periods, with an 8.6% decrease over 1982-2018. It seems to be the case that inequality is increasing due to a growing top income share and a decreasing middle- and bottom-income share. During the same period of 1982 until 2018, the export and income shares are increasing. The export share increases with 50.3% and the import share with 38.7%.

In Table 2 the averages of developing countries are provided for the period 2002-2018. The Gini-coefficient is slightly decreasing, just as the top 10 income percentile. The middle 40 income percentile is slightly increasing, similarly to the bottom 50 income percentile. This suggests that the income inequality is decreasing in the six developing countries over the 2002-2018 period. The export and income shares are however on average increasing, with 4.7% and 10.4%.

4. Methodology

4.1 General estimation method

To analyze the effect trade has on inequality, data is used of different countries over a longer period. With this panel data the most appropriate method to use is the individual fixed effects method. This method ensures that all time invariant characteristics are accounted for and only time varying variables need to be controlled for. A general form of an individual fixed effects model is given as follows:

Formula 1. *General estimation regression*

$$Y_{it} = \alpha_i + \rho T_{it} + \beta X_{it} + \gamma_i + \tau_t + \varepsilon_{it}$$

Note: General estimation form of an individual and time fixed effects model. The regression consists of a constant, an independent variable, dependent variables of interest, control variables, country and year fixed effects and a clustered standard error.

In this regression, Y_{it} is the dependent variable of country i=1,…,7 in year t=1981,…,2020. T_{it} are the variables of interest. And X_{it} takes on the value of the control variables. γ_i is the country fixed effect, τ_t is the year fixed effect and ε_{it} is the standard error. Clustered standard errors are used and there is clustered on a country level. Several variations of this general form will be used, with the exact regressions in section 4.2.

4.2 Regressions

For the developed countries, four regressions are run for the period between 1982 and 2018. The four regressions differ in the used dependent variable as described in the section 3.2. The estimated regressions for the developed countries are:

Formula 2. *Regression developed countries*

$$\begin{aligned} &InequalityMeasure \\ &= \beta_0 + \beta_1 Imports + \beta_2 Exports + \beta_3 Democracy + \beta_4 Unionization \\ &+ \beta_5 FDI\ Inflow + \beta_6 FDi\ Outflow + \beta_7 R\&D + \beta_8 Total\ GDP \\ &+ \beta_9 GDP\ Growth + \beta_{10} Total\ Population + \beta_{11} Population\ growth \\ &+ \beta_{12}\, GDP\ per\ Capita + \beta_{13}\, Education + \beta_{14} Income\ Tax + \gamma_i + \tau_t + \varepsilon_{it} \end{aligned}$$

Note: Regression formula that is ran for the developed countries group. The specific inequality measures that are used are the Gini-coefficient, top 10 income percentile, middle 40 income percentile and the bottom 50 income percentile. The dependent variables that are used are described in the data section and descriptive statistics are presented in table 5 in Appendix A. Country and a year fixed effects are added to the regression.

Developing countries have less data available, including missing data for the unionization rate of countries. Therefore, this variable is dropped and the regression for developing countries looks as follows:

Formula 3. *Regression developing countries*

$$InequalityMeasure = \beta_0 + \beta_1 Imports + \beta_2 Exports + \beta_3 Democracy + \beta_4 FDI\ Inflow + \beta_5 FDi\ Outflow + \beta_6 R\&D + \beta_7 Total\ GDP + \beta_8 GDP\ Growth + \beta_9 Total\ Population + \beta_{10} Population\ growth + \beta_{11}\ GDP\ per\ Capita + \beta_{12}\ Education + \beta_{13} Income\ Tax + \gamma_i + \tau_t + \varepsilon_{it}$$

Note: Regression formula that is ran for the developing countries group. The specific inequality measures that are used are the Gini-coefficient, top 10 income percentile, middle 40 income percentile and the bottom 50 income percentile. The dependent variables that are used are described in the data section and descriptive statistics are presented in table 6 in Appendix A. Country and a year fixed effects are added to the regression.

5. Results

5.1 Results developed countries

The results for the developed countries are shown in Table 3. Each column presents the regression coefficients and standard errors of the individual and year fixed regressions of the 9 developed countries on the respective dependent variable. The values of the control variables are presented in Table 7 in Appendix B.

Table 3. *Effects trade openness on income inequality developed countries from an individual fixed effects estimation*

	Gini (1)	**Top10 (2)**	**Middle40 (3)**	**Bottom50 (4)**
Exports	0.002	0.002	-0.001	-0.001
	(0.0007)**	(0.0006)***	(0.0003)***	(0.0004)**
Imports	-0.003	-0.003	0.002	0.001
	(0.0009)**	(0.0008)***	(0.0004)***	(0.0005)*

Note: The table provides the fixed effects regression results of the effect of trade on within-country income inequality in developed countries. The treatment variables are the export and import share to total GDP of 9 developed European countries. Control variables are used for the democracy rating of a country, the unionization rate, inflow and outflow of Foreign Direct Investments, R&D expenditures as percentage of total GDP, the levels of total GDP, the GDP growth, total population, population growth the GDP per capita of a country, the governmental expenditures on education as a percentage of GDP and total received income taxes of the respective country. The values of the control variables can be found in Table 7 in Appendix B. In column 1 the dependent variable that is used is the Gini-coefficient that measures the within country inequality, The second column estimates the effect on the top 10% income shares of a country, the third column the middle 40% and the fourth column the bottom 50%. Clustered standard errors are used on a 10%, 5% and 1% and reported by *,**,*** respectively.

5.1.1 Results Gini coefficient developed countries

The effect trade, in terms of the share of exports and imports has on the Gini-coefficient is given in the first column of Table 3. The export share has a positive and a 5% significant effect on the Gini-coefficient. This means that when the export share rises, inequality also rises in developed countries. When the export share rises with 1 percentage point (this is the case as the

variable is an export share over GDP and therefore presented in a percentage) the Gini-coefficient increases with 0.002. These results are in line with some of the discussed literature, as it resembles the pattern that is predicted by the Heckscher-Ohlin model and the Stolper-Samuelson theorem. Developed countries export the goods they have a comparative advantage in, which use skilled labor intensively and therefore the inequality rises. The found result on the export shares is also in line with the firm heterogeneity theory that is discussed. Here it is highlighted how exporting firms are more productive and pay higher wages, resulting in an increase of inequality (shown by Bernard et al., 2012; Greenaway & Keller, 2007; Yeaple, 2006 and modelled by Egger and Kreickemeier, 2009 and Helpman et al.,2010). As the exports share rises, this theory would then suggest an increase in inequality, this result is represented by the positive sign of the coefficient in Table 3 for exports.

The import share has a negative and 5% significant effect on the Gini-coefficient. This means that when the import share rises, inequality decreases in developed countries. When the import share rises with 1 percentage point, the Gini-coefficient decreases with -0.003. This result is not supported by the literature. The theories offshoring and skill-biased technological change both predict that increasing imports and import competition would lead to a higher demand for skilled labor. It is however possible that low-skilled workers benefit more as consumers from lower import prices than they are hurt by a higher demand for high-skilled labor. In this case, the theories do correctly predict a change in income levels, but not in real income levels which are changed by lower prices for goods due to trade.

5.1.2 Results income percentiles developed countries

The second column of Table 3 provides the regression results for the top 10% of income shares. The export share of total GDP has a positive and a 1% significant effect on the income share of the highest 10% earners in developed countries. When the export share rises with 1 percentage point, the income share of the top 10 highest earner rises with 0.002 (if total income is equal to 1). This result can be explained by the Heckscher-Ohlin model and the Stolper-Samuelson theorem. An increase in exports increases the return of the factor that is used intensively, which is skilled labor in the case of developed countries. Therefore, there is an increase visible in the income share of the top 10% biggest earners. An important assumption here is that the top earners also are the most skilled workers. The import share has a negative and 1% significant effect on the income share of the highest 10% earners in developed countries. When the import share rises with 1 percentage point, the income share of the top 10 highest earners will decrease with 0.003. This result is similar to the effect on the Gini-coefficient as in section 5.1.1. It can

be argued that imports are often of relative low skilled labor in developed countries (as is done by the theory of offshoring) and the caused price decrease in these goods is more beneficial for lower incomes. This would be the case as the total share of these expenses on low skilled intensive imports account for more of their spendings compared to higher incomes (as these spend relatively more on luxury goods), and therefore benefiting these top earners less and decreasing their income share.

The third column of Table 3 provides the regression results for the middle 40% of income shares. The export share of total GDP has a negative and a 1% significant effect on the income share of the middle 40% earners in developed countries. When the export share rises with 1 percentage point, the share of the middle 40% earners will decrease with 0.001. This decrease can be caused by automation and RBTC as explained in section 2.3.2. Here, the middle class is hollowed out due to increasing technical change that replaces routine tasks often performed by this middle-income group (Autor & Dorn, 2013; Autor et al., 2006). The import share of total GDP has a positive and a 1% significant effect on the income share of the middle 40% earners in developed countries. When the import share rises with 1 percentage point, the income share of the middle 40% earners will increase with 0.002. This result goes against the prediction of automation theories. This result could however be explained by similar logic as the negative effect imports have on the top 10 percentile earners. But here, the decreasing prices for import goods have a beneficial effect.

The fourth column of Table 3 provides the regression results for the bottom 50% of income shares. Here the export share has a negative and 5% significant effect on the total income share of the bottom 50% earners. When the export share rises with 1 percentage point, the income share of the bottom 50% earners will decrease with 0.001. The import share has a positive and 10% significant effect. When the import share rises with 1 percentage point, the income share of the bottom 50% earners will increase with 0.001. The results can be explained similarly to those of the middle 40 percentile.

5.1.3 Overview income percentiles and effects on inequality

As discussed above, the export share increases the income shares of the top earners and lowers those of the middle and bottom earners. This means that the export share has an increasing effect on within-country inequality in developed countries. This result comes forward by both the Gini-coefficient as the separate income shares. The discussed literature complements this result by explaining how comparative advantages, firm heterogeneity and automation affect this inequality. It is however important to note that imports have a decreasing effect on inequality.

It is possible that this is due to decreasing prices resulting from import competition. This is however not put forward by the literature.

5.2 Results developing countries

The results for the developing countries are shown in Table 4. Each column presents the regression coefficients and standard errors of the individual and year fixed regressions of the 6 developing countries on the respective dependent variable. The values for the used control variables are presented in Table 8 in Appendix B.

Table 4. *Effect trade openness on income inequality developing countries from an individual effects estimation*

	Gini (1)	**Top10 (2)**	**Middle40 (3)**	**Bottom50 (4)**
Exports	-0.0003	-0.0004	0.0008	-0.0005
	(0.0008)	(0.0009)	(0.001)	(0.0006)
Imports	-0.002	-0.002	0.0001	0.002
	(0.001)**	(0.001)	(0.001)	(0.0005)**

Note: The table provides the fixed effects regression results of the effect of trade on within-country income inequality in developing countries. The treatment variables are the export and import share to total GDP of 6 developing countries. Control variables are used for the democracy rating of a country, inflow and outflow of Foreign Direct Investments, R&D expenditures as percentage of total GDP, the levels of total GDP, the GDP growth, total population, population growth the GDP per capita of a country, the governmental expenditures on education as a percentage of GDP and total received income and profit taxes of the respective country. The values of the control variables can be found in Table 8 in Appendix B. In column 1 the dependent variable that is used is the Gini-coefficient that measures the within country inequality, The second column estimates the effect on the top 10% income shares of a country, the third column the middle 40% and the fourth column the bottom 50%. Clustered standard errors are used on a 10%, 5% and 1% and reported by *,**,*** respectively.

5.2.1 Results Gini coefficient developing countries

The effect of the import and export shares on the Gini coefficient are presented in the first column of Table 4. The export share has a negative effect on the Gini coefficient. This would mean that it has a decreasing effect on inequality. However, this result is not significant on a 10% significance level. This means there is no evidence for a relationship between the export share and the Gini-coefficient. The import share has a negative and 5% significant effect on the Gini coefficient. This result suggests that when the import to GDP share increases, the inequality measured by the Gini-coefficient decreases. When the import share rises with 1 percentage point, the Gini-coefficient will decrease with 0.002. This result is in in line with the Heckscher-Ohlin model and its Stolper-Samuelson theorem, which predicts that trade decreases inequality in developing countries as these countries have a comparative advantage in goods that use unskilled labor intensively. It is however not in line with the other discussed literature

that suggests that inequality increases in developing countries, for example the offshoring and SBTC theories.

5.2.2 Results income percentiles developing countries

The second column of Table 4 provides the regression results for the top 10% of income shares. The export share of total GDP has a negative but unsignificant effect on the top 10 percentile of earners. The import share of total GDP also has a negative but unsignificant effect on the top 10 percentile of earners. These results suggest that increasing trade does not affect the top earners in developing countries.

The third column of Table 4 provides the regression results for the middle 40% of income shares. The export share has a positive but insignificant effect on the middle 40 percentile of earners. The same effect is found for the import share. Similar to the top 10%, these results suggest that increasing trade does not affect the middle 50% earners in developing countries.

The fourth column of Table 4 provides the regression results for the bottom 50% of income shares. The export share has a negative but insignificant result. The import share however has a positive and 5% significant effect. An increasing import share seems to increase the income share of the lowest income group. When the import share rises with 1 percentage point, the income share of the bottom 40% earners will increase with 0.002. This result is explained similarly as the decreasing Gini-coefficient in section 5.2.1.

5.2.3 Overview income percentiles and effects on inequality

The result on the Gini-coefficient seems to be driven by the increasing share of the bottom 50 income percentile due to a positive and significant effect of the import share. All other income shares have insignificant results and have no effect on the income inequality. Therefore, it seems that for developing countries the within-country income inequality is decreased with increased trade (import) levels. This result is in line with the Heckscher-Ohlin framework that predicts that trade causes decreasing income inequality. It is not in line with the other, and more recent theories like offshoring and SBTC that suggest that developing countries also experience increasing inequality just like developed countries do.

6. Discussion

The discussed theories in the literature review would suggest a decreasing within-country inequality in both developed and developing countries. As presented in the results, the performed analysis shows that this is only the case for developed countries and, for developing countries only a small decreasing effect of the import share on inequality is found. There can be several reasons why the result for developing countries does not match the theory.

The first reason that the results do not match the hypothesis is the limited data availability for the developing countries. The data for developing countries that is used is less extensive than that of developed countries. So is the period used shorter and is the control variable unionization rate dropped. This can lead to a biased effect. With more available data over a longer period and more control variables a better analysis could be performed.

The second reason why the results do not match the literature is the country selection for the developing countries. The selected developing countries are, even though not fully developed yet, not the least developed countries in the world. The World Bank (2022) describes the countries that are used in this analysis as "upper middle-income countries". This could result in different effects of trade on income inequality. These countries are however the best option for as low-income countries have even less, or even no data available. For future research it would be better to find and collect data of the countries who are classified as low-income or lower-middle income countries.

The third reason why the results might differ from the hypothesis is the used method. Even though the method controls for country and year fixed effects, it does not present causal effects. For this, more control variables are needed but also issues like reverse causality and selection bias are still present. An ideal method controls for all variables that affect both why countries trade in general and income inequality, and then find the effect of different trade volumes on within-country inequality. It is however not possible to control for all variables that affect these two variables. As it is not clear where the variation in trade volumes or inequality originates from, it is hard to find causal effects of the effect of trade on income inequality. Other methods can also be used to estimate the causal effect of trade on inequality. Examples of this is the use of an instrumental variable approach, for example how Pascali (2017) uses the introduction of steamships and wind patterns to find the effect trade has on economic growth. A similar approach can be used in the future to find the effect of trade on inequality.

7. Conclusion

To answer the research question on how trade affects within-country income inequality literature has been reviewed and an own empirical analysis has been performed. Historically, the effect of trade on inequality is explained by the Heckscher-Ohlin model and its Stolper-Samuelson theorem. The prediction is that developed countries experience increasing inequality and developing countries experience decreasing income inequality with increasing trade openness. More recent empirical evidence however find that income inequality is also increasing in developing countries. Several more recent theories try to explain this phenomenon. It argues how offshoring, skill-biased technological change and automation, firm heterogeneity, FDI, institutions and labor market policies can result in increasing inequality in both developed and developing countries. With this literature in mind and individual and year fixed effects method is used to empirically test how trade influences within-country income inequality and data is used from 9 developed and 6 developing countries. The results from this analysis suggest that for the developed countries the export share has a positive effect and imports a negative effect on income inequality. For developing countries, only a significant result is obtained for imports, which shows a decreasing effect on inequality. Three income shares variables show which income groups gain and lose from trade and how the observed inequality is caused. For developed countries this is caused by an increasing top income share and a decreasing middle and bottom income share in case for rising exports and a decreasing top income share and increasing middle- and bottom-income shares in case for increasing imports. For developing countries, the observed decreasing inequality is caused by an increasing bottom income percentile as imports rise. This relationship is not as expected by the literature. This could be due limited data availability and a limited effectiveness of the used research method. Due to these, and other issues raised in the discussion, it is not possible to find a causal relationship between trade and inequality. Suggestions for future research are therefore to collect and create more data for a larger group of countries and to use more advanced empirical methods.

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Appendix A:

Table 5. *Descriptive statistics developed countries*

	Mean	Standard Deviation	Minimum	Maximum
Gini	0.416	0.032	0.319	0.499
Top 10	0.311	0.028	0.229	0.383
Middle 40	0.458	0.016	0.421	0.497
Bottom 50	0.230	0.020	0.181	0.288
Exports	45.127	15.799	18.621	84.683
Imports	41.294	14.407	19.113	83.277
Democracy	0.837	0.035	0.76	0.896
Unionization	43.013	22.456	10	86.6
FDI Inflow	3.699	9.679	-37.712	86.479
FDI Outflow	4.964	9.753	-29.936	71.348
R&D	2.200	0.607	1.014	3.874
Total GDP	$7.22*10^{11}$	$8.92*10^{11}$	$5.91*10^{10}$	$3.98*10^{12}$
GDP Growth	1.827	1.948	-7.855	6.052
Total Population	$2.26*10^{7}$	$2.66*10^{7}$	4085620	$8.32*10^{7}$
Population Growth	0.476	0.342	-1.854	1.347
GDP per Capita	36665.820	19892.61	8457.269	102913.500
Education	5.768	1.144	2.989	8.660
Income Tax	11.135	5.249	4.313	26.196

Note: The table provides the descriptive statistics of the nine developed countries in our sample. In the first column, the mean is presented. In the second column the standard deviation is presented and in the third and fourth column the minimum and maximum values of the respective variable is given. All values are reported with maximal three decimals. All the independent, dependent and control variables that are used in the estimation method are listed.

Table 6. Descriptive statistics developing countries

	Mean	Standard Deviation	Minimum	Maximum
Gini	0.647	0.056	0.505	0.739
Top 10	0.541	0.070	0.385	0.641
Middle 40	0.349	0.043	0.284	0.441

Bottom 50	0.110	0.031	0.065	0.187
Exports	20.679	9.420	5.062	45.084
Imports	21.210	10.236	4.631	48.176
Democracy	0.527	0.215	0.048	0.865
FDI Inflow	2.412	1.751	-0.506	8.461
FDI Outflow	0.355	0.524	-0.642	3.293
R&D	0.426	0.310	0.052	1.343
Total GDP	$3.23*10^{11}$	$4.88*10^{11}$	$1.71*10^{9}$	$2.62*10^{12}$
GDP Growth	2.646	4.061	-12.312	12.308
Total Population	$5.55*10^{7}$	$5.69*10^{7}$	2389973	$2.13*10^{8}$
Population Growth	1.629	0.531	0.713	2.723
GDP per Capita	4325.361	3257.914	511.550	14613.04
Education	4.308	1.315	1.046	7.347
Income Tax	3.988	1.815	0.550	7.808

Note: The table provides the descriptive statistics of the six developing countries in our sample. In the first column, the mean is presented. In the second column the standard deviation is presented and in the third and fourth column the minimum and maximum values of the respective variable is given. All values are reported with maximal three decimals. All the independent, dependent and control variables that are used in the estimation method are listed.

Appendix B:

Table 7. *Complete individuals effect estimation* of *trade openness on income inequality developed countries*

	Gini (1)	**Top10 (2)**	**Middle40 (3)**	**Bottom50 (4)**
Exports	0.002	0.002	-0.001	-0.001
	(0.0007)**	(0.0006)***	(0.0003)***	(0.0004)**
Imports	-0.003	-0.003	0.002	0.001
	(0.0009)**	(0.0008)***	(0.0004)***	(0.0005)*
Democracy	-0.345	-0.374	0.217	0.156
	(0.224)	(0.197)*	(0.090)**	(0.128)
Unionization	0.00005	0.0008	-0.001	0.0003
	(0.0006)	(0.0006)	(0.0003)**	(0.0003)
FDI Inflow	-0.0001	-0.0003	0.0002	0.00002
	(0.0003)	(0.0004)	(0.0003)	(0.0001)

FDI Outflow	0.0001	0.0002	-0.0001	-0.00005
	(0.0003)	(0.0004)	(0.0003)	0.0001
R&D	-0.004	0.004	-0.010	0.006
	(0.008)	(0.007)	(0.003)**	(0.004)
Total GDP	$2.54*10^{-14}$	$2.89*10^{-14}$	$-1.75*10^{-14}$	$-1.14*10^{-14}$
	$(1.19*10^{-14})$*	$(1.11*10^{-14})$**	$(4.85*10^{-15})$***	$(6.44*10^{-15})$
GDP Growth	0.0008	0.0008	-0.0004	-0.0004
	(0.0007)	(0.0008)	(0.0005)	(0.0003)
Total Population	$-6.96*10^{-9}$	$-7.00*10^{-9}$	$3.12*10^{-9}$	$3.88*10^{-9}$
	$(2.53*10^{-9})$**	$(2.40*10^{-9})$**	$(1.36*10^{-9})$**	$(1.50*10^{-9})$**
Population	-0.004	-0.003	0.002	0.002
Growth	(0.004)	(0.003)	(0.002)	(0.002)
GDP per Capita	$4.83*10^{-7}$	$6.58*10^{-7}$	$5.16*10^{-7}$	$-1.43*10^{-7}$
	$(3.94*10^{-7})$	$(3.88*10^{-7})$	$(1.98*10^{-7})$**	$(2.12*10^{-7})$
Education	-0.001	0.0008	-0.002	0.001
	(0.002)	(0.002)	(0.001)*	(0.001)
Income Tax	-0.0001	-0.0004	0.0005	-0.0001
	(0.0008)	(0.0009)	(0.0006)	(0.0004)
Constant	0.801	0.678	0.295	0.028
	(0.178)***	(0.157)***	(0.070)***	(0.101)

Note: The table provides the fixed effects regression results of the effect of trade on within-country income inequality in developed countries. The treatment variables are the export and import share to total GDP of 9 developed European countries. Control variables are used for the democracy rating of a country, the unionization rate, inflow and outflow of Foreign Direct Investments, R&D expenditures as percentage of total GDP, the levels of total GDP, the GDP growth, total population, population growth the GDP per capita of a country, the governmental expenditures on education as a percentage of GDP and total received income taxes of the respective country. In column 1 the dependent variable that is used is the Gini-coefficient that measures the within country inequality, The second column estimates the effect on the top 10% income shares of a country, the third column the middle 40% and the fourth column the bottom 50%. Clustered standard errors are used on a 10%, 5% and 1% and reported by *,**,*** respectively.

Table 8 . *Complete individuals effect estimation* of *trade openness on income inequality developing countries*

	Gini (1)	**Top10 (2)**	**Middle40 (3)**	**Bottom50 (4)**
Exports	-0.0003	-0.0004	0.0008	-0.0005
	(0.0008)	(0.0009)	(0.001)	(0.0006)
Imports	-0.002	-0.002	0.0001	0.002

	(0.001)**	(0.001)	(0.001)	(0.0005)**
Democracy	0.1305	0.189	-0.132	-0.057
	(0.045**	(0.055)**	(0.040)**	(0.017)**
FDI Inflow	-0.002	-0.005	0.004	0.0004
	(0.001)	(0.001)**	(0.001)***	(0.0007)
FDI Outflow	0.002	0.005	-0.004	-0.0006
	(0.003)	(0.003)	(0.002)	0.002
R&D	-0.070	-0.050	0.023	0.027
	(0.054)	(0.076)	(0.057)	(0.022)
Total GDP	$-1.12*10^{-14}$	$-1.59*10^{-14}$	$8.08*10^{-15}$	$7.75*10^{-15}$
	$(1.76*10^{-14})$	$(2.07*10^{-14})$	$(1.57*10^{-14})$	$(7.22*10^{-15})$
GDP Growth	-0.00008	0.0004	-0.0004	$7.01*10^{-6}$
	(0.0007)	(0.0009)	(0.0006)	(0.0004)
Total Population	$2.91*10^{-9}$	$3.18*10^{-9}$	$-1.54*10^{-9}$	$-1.64*10^{-9}$
	$(1.53*10^{-9})$**	$(1.70*10^{-9})$**	$(1.25*10^{-9})$	$(5.62*10^{-9})$**
Population	-0.007	-0.013	0.014	-0.001
Growth	(0.013)	(0.017)	(0.012)	(0.007)
GDP per Capita	$3.69*10^{-6}$	$-5.88*10^{-7}$	$-1.44*10^{-6}$	$2.04*10^{-6}$
	$(1.48*10^{-6})$*	$(2.77*10^{-6})$	$(2.57*10^{-6})$	$(1.38*10^{-6})$
Education	-0.013	-0.031	0.029	0.002
	(0.011)	(0.009)**	(0.006)***	(0.005)
Income Tax	-0.014	-0.021	0.017	0.004
	(0.005)**	(0.007)**	(0.005)**	(0.002)
Constant	0.575	0.529	0.293	0.178
	(0.130)***	(0.124)***	(0.070)***	(0.067)

Note: The table provides the fixed effects regression results of the effect of trade on within-country income inequality in developing countries. The treatment variables are the export and import share to total GDP of 9 developed European countries. Control variables are used for the democracy rating of a country, inflow and outflow of Foreign Direct Investments, R&D expenditures as percentage of total GDP, the levels of total GDP, the GDP growth, total population, population growth the GDP per capita of a country, the governmental expenditures on education as a percentage of GDP and total received income and profit taxes of the respective country. In column 1 the dependent variable that is used is the Gini-coefficient that measures the within country inequality, The second column estimates the effect on the top 10% income shares of a country, the third column the middle 40% and the fourth column the bottom 50%. Clustered standard errors are used on a 10%, 5% and 1% and reported by *,**,*** respectively.