Globalisation and Income Inequality Revisited

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DG ECFIN's Fellowship Initiative 2016-2017 "Challenges to integrated markets" culminates and comes to a successful conclusion with the publication of the fellows' contributed papers in our Discussion paper series. Against the background of increasing strains to economic integration at both the global and the European level, the Initiative has brought together a group of outstanding scholars to re-examine integration challenges at the current juncture and to explore the policy options to address these challenges in a discursive interaction process between the group of fellows and Commission services. The research themes of the fellows have spanned a broad area including topics in the political economy of globalisation and integration, issues of macroeconomic policy making at the zero lower interest rate bound, and market integration challenges not least in view of deepening EMU.

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Abstract

We re-examine the globalisation-income inequality nexus. Globalisation is measured by the KOF globalisation index and sub-indicators for trade, financial, political and social global globalisation. Income inequality is measured by Solt's pre tax/transfer and the post tax/transfer Gini indices. We use data for 140 countries over the period 1970-2014 and deal with the endogeneity of globalisation measures. Our instrumental variable is predicted openness based on a time-varying gravity model.

OLS results show that globalisation and income inequality are positively correlated within the full sample of countries and the sample of emerging and developing countries. The positive relationship is mainly driven by export openness, FDIs and social globalisation. The 2SLS results do not show that overall globalisation or any sub-indicator influences income inequality. The effect, however, is positive within the sample of higher developed countries and driven by transition countries from Eastern Europe and China. Within the sample of the most advanced economies, neither OLS nor 2SLS results show any significant positive relationship between globalisation and inequality.

CONTENTS

1. INTRODUCTION

Globalisation is widely seen as a factor increasing income inequality. As far as global inequality is concerned, globalisation rather seems to give rise to income convergence. Many emerging countries, especially China, have caught up with the developed world in the course of globalisation. But a large part of the debate focuses on income inequality within countries, in particular within advanced economies. The United States, for example, is widely seen as the country that has experienced the most pronounced increase in income inequality, but other industrialized countries also report growing divergence between rich and poor. The Brexit referendum in the United Kingdom in 2016 or the victory of Donald Trump in the United States in 2016 are widely seen as reflecting the growing anger of globalisation losers.[1]

How should economic policy respond to the development of inequality? Clearly, the answer to this question should be based on a sound understanding of the key factors driving inequality trends. Various factors are likely to play a role. These include globalisation, skill biased technological change, economic reforms like deregulation in financial markets, rolling back the welfare state or reforms of the tax system, the growing role of telecommunication and the mass media, growing regional disparities within countries and many more.

We examine how globalisation affects income inequality. Globalisation may affect inequality in various ways. Firstly, it changes wages and other factor prices and thus changes the distribution of market incomes. Secondly, globalisation affects political decisions and leads governments to change the tax system and public spending including spending on the welfare state. This affects the distribution of disposable incomes. In our analysis we distinguish between the impact of globalisation on market income inequality and net income inequality. As measures of income inequality we employ the pre tax/transfer and the post tax/transfer Gini indices taken from Solt's (2016) Standardized World Income Inequality Database (V 5.1).

The debate about the consequences of globalisation often focuses on trade outcomes. Globalisation itself is a complex process with many facets including economic, political and cultural aspects. Economic globalisation includes the growing weight of international trade in goods and services, international mobility of capital and labour, the increasing availability of information worldwide, facilitated by declining costs of transport and communication. The increasing importance of multinational firms is another important aspect of globalisation. These different aspects of economic globalisation are, to a significant extent, the result of political globalisation such as the creation of international organisations and agreements like the WTO, the World Bank and the IMF as well as regional free trade agreements and forms of regional political integration like the European Union.

Globalisation is a multifaceted concept. We therefore use use the overall KOF index of globalisation (Dreher 2006a, and Dreher et al. 2008) to measure globalisation. Various channels of globalisation,

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[1] While inequality might be desirable if it is a precondition that everyone is better off in real terms, the debate also reflects social concerns about a lack of equal economic opportunities and fairness which, in turn, might itself limit growth potentials of economies. If not addressed, rising inequality might give rise to populism and movements which favours economic protectionism at the expense of the gains from globalization.

however, may have different effects on inequality. We also employ indicators for trade openness, financial openness, political and social global integration.

The Stolper-Samuelson mechanism predicts that global integration increases income inequality within developed countries and decreases inequality within developing countries. Several theoretical contributions, however, have shown shortcomings of the Stolper-Samuelson assumptions and have provided various potential channels and implications how globalisation shapes income inequality. The link between globalisation and inequality has been analysed in many empirical studies during the 1990s (Wood 1994, 1995; Cragg and Eppelbaum 1996; Borjas et al. 1997; Sebastian 1997; Feenstra and Hanson 1996, 1997, 1999; Leamer 1998; Savvides 1998), and has been revisited by several scholars in the last decade (Goldberg and Pavcnik 2007; Dreher and Gaston 2008; Roine et al. 2009; Bergh and Nilsson 2010; Figini and Görg 2011; Jaumotte et al. 2013; Doerrenberg and Peichl 2014; Schinke 2014; Dabla-Norris et al. 2015; Gozgor and Ranjan 2015). The results differ depending on the measures of globalisation and income inequality used and the sample of countries examined. The majority of studies using Gini indices as inequality measure, however, report a positive relationship between globalisation and income inequality (see Dreher and Gaston 2008; Bergh and Nilsson 2010; Jaumotte et al. 2013; Dabla-Norris et al. 2015; Gozgor and Ranjan 2015).

Our sample includes up to 140 countries over the period 1970-2014. OLS-results confirm the findings of previous studies indicating a positive relationship between globalisation and income inequality. Examining sub-indicators of globalisation show that rising export openness, foreign direct investments and social globalisation being the main drivers of the positive relationship. The results vary depending on the sample of countries. Significance of the positive relationship holds within the full sample of countries, the sample of emerging and developing countries and the higher income sample. However, the relationship within the higher income countries lacks statistical significance when we exclude transition countries from Eastern Europe and China. Our OLS results, moreover, do not show that globalisation and income inequality are positively correlated within the sample of the most advanced economies.

Examining the causal effect of globalisation on inequality is challenging. We control for many variables, but other unobserved omitted variables may still cause biased estimates by influencing both, globalisation and income inequality. Secondly, reverse causality may occur because changes in income inequality are likely to influence policies which affect globalisation. Previous studies, however, do little to deal with the endogeneity of globalisation and therefore mostly provide descriptive evidence on the link between globalisation and inequality. This descriptive evidence is useful but it is important to ask whether there is a causal effect running from globalisation to inequality. We deal with the endogeneity problem of globalisation by using an instrumental variable (IV) approach. Our IV is predicted openness based on a gravity equation using a time-varying interaction of geography and natural disaster as proposed by Felbermayr and Gröschl (2013). Predicted openness has been used as an IV for trade openness (Frankel and Romer 1999, Felbermayr and Gröschl 2013) and the KOF index of globalisation (Potrafke 2013, Eppinger and Potrafke 2016). For the full country sample and the sample of emerging and developing countries, the 2SLS results do not support the view that globalisation influences income inequality. Within the sample of higher income countries, which include transition countries, we do find a positive effect of globalisation on inequality. However, this effect is driven by China and transition countries from Eastern Europe. It seems that these countries have experienced a particularly fast change towards globalisation accompanied by a simultaneous privatisation and economic transition process, both with a huge impact on the income distribution that has not been cushioned by either labor market institutions or welfare states which characterize most

advanced economies in the rest of the world. 2SLS results within the most advanced economies do not show that globalisation increased income inequality.

2. THEORETICAL PREDICTIONS

One of the fundamental results of international economics predicts overall gains from globalisation. Globalisation has, in fact, brought hundreds of million people out of poverty.[2] It is, however, not guaranteed that everyone within each country is better off when globalisation is proceeding rapidly. Many studies have examined the effect of globalisation on income distribution within countries.

The classical theoretical framework for analyzing the relationship between globalisation and distributional market outcomes is the Heckscher-Ohlin (HO) model (Ohlin 1933). It explains the inequality effect of globalisaion as a result of productivity differences and the relative factor content of countries, and the extent to which individuals depend on labor or capital income. Countries specialize in production in their relative abundant factor and export these goods, when they open up to trade. The Stolper-Samuelson theorem (Stolper and Samuelson 1941) shows that the subsequent trade-induced relative changes in product prices increase the real return to the factors used intensively in the production of the factor-abundant export goods and decrease the returns to the other factors. As a consequence, the country's relative abundant production factors gain from openness, while scarce factors lose. Most theories distinguish between the production factors labor and capital, or between unskilled and skilled labor. Because capital and skilled labor are relative abundant in advanced economies, income inequality and income concentration towards the top incomes is expected to increase within these countries. In low-income countries, unskilled labor, which is intensively used in local production, would benefit from economic openness by increasing wages. Income inequality is therefore expected to decrease within low-income countries. Based on the HO-model assumptions, the direction of how globalisation influences income inequality depends on a country's development level.

Since the 1990s, several studies have discussed inconsistencies of the standard HO-model implications and provided different insights by showing various channels how globalisation may rise income inequality in both, the developed and the developing world.[3] On the one hand, the predictions of the Heckscher-Ohlin-model rely on between sector reallocations and neglect within-sector shifts in production and vertical specialisations across countries. While offshoring and outsourcing of less-skilled production within a sector decreases wages and bargaining power of less skilled workers in advanced economies, the offshored and outsourced activities along the value chain might be relatively skill-intensive from the perspective of the developing countries (see Feenstra and Hanson 1996, 1999, 2003). On the other hand, the standard trade model of Heckscher-Ohlin neglects that capital and labor are rather mobile in a globalized world. Feenstra and Hanson (1997), for example, describe that Foreign Direct Investment (FDI) increases the relative demand for skilled labor and the skill premium due to capital-skill-complementarities in the developing world. As a response to the rising exposure to import competition, occupations in traded sectors of the developing world, moreover, may become more skill-intensive which also lowers the relative demand for and relative wages of low-skilled workers (Cragg and Eppelbaum 1996). Income inequality may also rise due to heterogeneous firms within sectors and countries and resulting wage premiums for workers in firms participating in international trade. Exporting firms are identified to be more productive and producing higher quality-

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[2] Since the pioneering work of Samuelson (1939) about the gains of trade, several contributions in economic research verifying the result that trade is welfare improving compared to autarky due to productivity gains and a new variety of products. Arkolakis et al. (2012) and Costinot and Rodríguez-Clare (2014) provide a more recent review about the welfare gains released from new trade models.

[3] Several empirical studies have shown poor performance of the factor bias assumption of the Heckscher-Ohlin model. Leamer (1998), for example, have found evidence for the Stolper-Samuelson mechanism in the 1970s only, while there is a lack of evidence in other decades. Goldberg and Pavcnik (2007) show also poor performance of the model predictions in a large literature review about the relationship of trade and earnings in developing countries.

products than non-exporting firms and are expected to pay higher wages to hire higher-skilled labor (see Yeaple 2005; Munch and Skaksen 2008; Verhoogen 2008; Egger and Kreickemeier 2009; Frias et al. 2012; Egger et al. 2013; Sampson 2014; Helpman et al. 2017).

In the economics literature the skill biased technological change is discussed as one of the main alternative explanations of the rising skill premium and income inequality within countries. As new technologies are assumed to be complementarities to capital and skilled labor, the technological change occurring in the last four decades is attributed to be skill-driven and capital-augmenting. Several scholars have discussed how innovations and new labor-saving technologies have eliminated low-skilled jobs by automation or by upgrading the required skill levels, which has raised the premiums for high-skilled employees and capital owners (see Berman et al. 1994, 1998; Machin and van Reenen 1998; Acemoglu 1998, 2002; Krusell et al. 2000; Card and DiNardo 2002). While technological innovations primarily occur in advanced economies, global integration, however, may induce also technology transfers across borders and a skill biased technological change in less developed countries (see Berman and Machin 2000; Burstein et al. 2013). Rising import competition may, moreover, induce investments in new technologies and accelerate technological shifts which also lead to falls in the employment of relatively unskilled workers (Bloom et al. 2016).

Apart from economic indicators of globalisation, political and social globalisation are also likely to influence income inequality, for example by enabling international transactions and migration. Political globalisation, moreover, may well set minimum standards and therefore enhance equality within countries (Dreher 2006b). Cultural proximity and social globalisation augment exchange of information, promote economic transactions and social migration, and hence may affect distributional outcomes as well. Changing social norms, which results from more interaction and integration around the world, may change the social acceptance of income inequality and therefore affect the behavior of people, for example the wage bargaining of unions (Atkinson 1997).

Governments are likely to influence market outcomes by setting agreements, regulations and tariffs; and design taxation and social policies to redistribute income from the rich to the poor. There are two competing views on the relationship between globalisation, welfare state policies and the impact on inequality: the race to the bottom hypothesis and the compensation hypothesis.

The "race-to-the-bottom" theory (e.g., Sinn 2003) describes that globalisation puts a downward pressure on tax rates and regulations for mobile factors such as tax rates on capital. This gives rise to lower public spending and less redistribution. From this perspective globalisation is expected to increase income inequality after taxes and transfers. Authors emphasizing the 'dark side of globalisation' such as Stiglitz (2002, 2004), claim that globalisation is responsible for diminishing redistribution activities and shrinking social security systems.

In contrast, the compensation hypothesis (Rodrik 1998) predicts an expansion of the welfare state in response to globalisation. In particular, losers from globalisation are assumed to demand compensation for the increasing, globalisation-induced risk exposures and income inequality outcomes. Globalisation is therefore expected to increase the size and scope of government. In a similar vein, Gozgor and Ranjan (2015) suggest that when globalisation raises market income inequality, policymakers interested in maximizing the sum of welfares of all agents would increase redistribution. Meltzer and Richard (1981) describe that higher inequality tends to increase redistribution, because the median voter would favor more redistribution. Thus, voters are expected to demand more active governments, when globalisation and market income inequality increase. As a consequence, the effect of

globalisation on net income inequality is assumed to be less pronounced than the effect of globalisation on market outcomes. The empirical evidence on the globalisation-welfare state nexus is mixed (e.g., Schulze and Ursprung 1999, Ursprung 2008, Meinhard and Potrafke 2012, Kauder and Potrafke 2015, Potrafke 2015).

3. DATA AND DESCRIPTIVE STATISTICS

3.1. DATA

We use an unbalanced panel for up to 140 countries over the period 1970-2014. The data is averaged over five years in nine periods between 1970 and 2014. We use five year averages to reduce the possibility that outliers, measurement errors, missing years and short term movements in the business cycle influence the inferences.

Income Inequality: Income inequality, our dependent variable, is measured by the Gini index. We use the Gini household income inequality indices of Solt's (2016) Standardized World Income Inequality Database (SWIID, v5.1). SWIID provides Gini inequality measures for market and net outcomes based on the same welfare concept, and thus allow comparing income inequality before and after redistribution by taxation and transfers (see Dorn 2016 for a discussion of income inequality databases). We use both, the market and net income Gini coefficients. Both coefficients are quite strongly correlated (see table 1).

Globalisation: To measure overall globalisation we use the KOF globalisation index 2016 (Dreher 2006a and Dreher et al. 2008). The KOF index aggregates 23 variables to an overall index on a scale of one to hundred, where higher values denote greater globalisation. The index encompasses economic, social, and political dimensions of globalisation and has been used in some hundreds of studies (see Potrafke 2015 for a survey on the consequences of globalisation as measured by the KOF index). Examples of countries with very low levels of globalisation include Afghanistan, Ethiopia, Tanzania and many other African countries (values below 40 in our sample). Globalisation is pronounced in EU member states. The most globalized countries are small EU member states such as Belgium, Ireland or the Netherlands. Outside Europe, especially the small country of Singapore belongs to the group of the most globalized countries.

We also employ sub-indicators of globalisation for trade, financial, social and political global globalisation, to investigate whether various channels of globalisation are differently related to inequality outcomes. Data on trade are provided by the World Development Indicators (World Bank 2017). Trade openness is measured as the sum of exports and imports of goods and services as a share of the gross domestic product (GDP), import openness as imports as percentage of GDP; and export openness as exports as share of GDP. We use data for financial, social and political globalisation based on the KOF index 2016 (Dreher 2006a and Dreher et al. 2008). As proxy for financial openness, we use the KOF sub-index of inward and outward FDI stock as a percentage of GDP. The KOF sub-index of social globalisation captures eleven variables encompassing data on the spread of ideas, information, culture and people. The political KOF sub-index includes four individual variables to proxy the degree of the diffusion of government policies. Table 1 shows that all globalisation indicators are positively related to each other. Political globalisation and trade indicators, however, are negatively correlated.

Covariates: We follow previous studies by including the following control variables: real GDP per capita[4] of the new released Penn-World-Table version 9.0 by Feenstra et al. (2015), to control for any distributional effect due to different income levels. Studies show that economic growth and the GDP

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[4] We use the expenditure-side real GDP at chained PPPs to compare relative living standards across countries and over time.

per capita level are related to globalisation (see Dreher 2006a; Dreher et al. 2008) and to the development of the income distribution over time (see Barro 2000; Forbes 2000; Berg et al. 2012; Ostry et al. 2014). Demographic changes and shifts in the size of population are also likely to influence both globalisation and the income distribution (OECD 2008). We therefore add the age dependency ratio by the World Development Indicators (World Bank 2017) and the logarithm of total population of the Penn-World-Table (Feenstra et al. 2015). The dependency ratio measures proportion of dependents per 100 of the working age population, where citizens younger than 15 or older than 64 are defined as the dependent (typically non-productive) part. A higher share of dependent people is usually associated with higher income inequality and higher redistribution activities within countries. Shifts in the size of population affect the dependency ratio as well as a country's labor and skill endowment.

Covariates for robustness checks: The skill biased technological change is discussed as alternative factor for explaining the rising skill premium and income inequality within countries. New technologies, such as information and communication technologies, have given rise to improvements in productivity and a disproportionately increase in the demand for capital and skilled-labor by eliminating unskilled jobs through automation or upgrading the required skill level of jobs (see Berman et al. 1994, 1998; Machin and van Reenen 1998; Acemoglu 1998, 2002; Krusell et al. 2000; Card and DiNardo 2002). The technological spread around the world is closely related to globalisation (Berman and Machin 2000; Burstein et al. 2013; Bloom et al 2016). Neglecting the skill biased technological change in empirical estimations, therefore, may give rise to an omitted variable bias. Many empirical studies investigating the globalisation-inequality-nexus do not take the technology mechanism as alternative explanation into account. Others use ICT and IT investments as proxy for technology. Investments in new technologies, however, may be induced by globalisation shocks (see Bloom et al. 2016). Inequality rising effects of globalisation may then wrongly assigned to technology effects. We control for the skill biased technological progress by using ICT capital stock estimates of Jorgenson and Vu (2017)[5] as proxy for the technological change which is driven by information and communication technologies (section 5.5.3). The ICT capital stock has already been used by Jaumotte et al. (2013) and Dabla-Norris et al. (2015) and is widely accepted in the technology-growth empirical literature. We also include capital intensity as measured by the capital stock per employed within a country to consider effects of capital-skill complementarities on globalisation and inequality (Krusell et al. 2000). The capital stock of structures and equipment and the number of persons engaged are taken from the Penn-World-Table 9.0 (Feenstra et al. 2015). To capture the effect of varying human capital endowments of the population on globalisation and skill premia, we include the human capital index of the Penn-World-Table 9.0, based on an assumed rate of return to education and the average years of schooling. We include the ICT capital stock and the human capital index in the robustness section as these covariates are not available for the full sample of 140 countries,

We also include potential ommitted institutional variables, which might influence globalisation and the inequality within countries. We use the real output-share of government consumption to capture simultaneous effects of government expenditures on the level of global integration and the income distribution of a country (Feenstra et al. 2015). From the Economic Freedom Index by Gwartney et al. (2015) we use the overall index of economic freedom, the subindex of overall regulation (including business, credit and labor market regulation) and the sub-index on the regulation in the labor market itself (including indicators such as minimum wages, collective bargaining centralisation, or hiring, firing and hours regulations). More market-oriented policies are, for example, expected to be

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[5] We thank Dale Jorgenson and Khuong Vu for providing their ICT capital stock estimates.

correlated with globalisation and inequality. Higher regulated labor markets might promote equality at the expense of globalisation and growth. The data on economic freedom and labor market institutions is not available for the full set of 140 countries.

Variables	Gini market	Gini net	GLOB	Trade	Exports	Imports	FDI	Social	Political
Gini market	1								
Gini net	0.78***	1							
GLOB	0.01	-0.39***	1						
Trade	0.01	-0.05***	0.22***	1					
Exports	0.01	-0.08***	0.34***	0.93***	1				
Imports	0.02	-0.03	0.09***	0.94***	0.75***	1			
FDI	0.35***	0.10***	0.55***	0.42***	0.45***	0.33***	1		
Social	-0.04**	-0.45***	0.85***	0.32***	0.41***	0.20***	0.47***	1	
Political	-0.02	-0.24***	0.72***	-0.21***	-0.10***	-0.28***	0.30***	0.28***	1

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

3.2. SUBSAMPLES

Development levels: Some theories predict different outcomes on the globalisation income inequality nexus depending on the development level of countries. Next to our full sample of 140 countries, we therefore use subsamples for HIGHER INCOME countries, the most ADVANCED ECONOMIES, as well as EMERGING MARKETS & DEVELOPING ECONOMIES (EMDC).[6] The higher income sample is classified by the criterion of the World Bank as of 2015, including 82 countries having a GNI per capita of USD 4,126 or more. The 58 countries in our dataset below this threshold are classified as lower income countries. Lower income countries are more likely to have few period-observations per country due to a lack of data availability than high-income countries (see also Dorn 2016, p.58). Due to the lack of data and period observations per country, we do not investigate the relationship between globalisation and income inequality within low-income countries only. Low income countries, however, are included in the larger subsample of emerging and developing economies. The subsample of emerging markets and developing economies includes 106 countries released from both income groups, higher and lower income countries. To classify the world into advanced economies and emerging markets and developing economies we apply the system of the International Monetary Fund (IMF 2016). The IMF-classification is based on per capita income level, export diversification and the degree of integration into the global financial system.[7] The 34 countries fulfilling the criterion of the advanced economies sample are also included in the higher income sample.

Transition economies: Transition economies have experienced a large shift in globalisation since the Fall of the Iron Curtain. During the simultaneous period of transition toward market economies, however, transition countries have also experienced many massive structural and institutional changes in politics and their economy, such as privatisations of state owned enterprises, deindustrialisation, shrinking and reforming of the public sector, institutional liberalisations and (partly) political reformation. The systemic change and restructuring of the economy and governance may also have

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[6] See Annex I for the classification of countries by development levels.
[7] Oil exporters that have high per capita GDP, for example, would not make the advanced classification because around 70% of its exports are oil.

influenced income inequality (see Milanovic 1999; Milanovic and Ersado 2011; Aristei and Perugini 2014). We therefore use a sample of the (new) European Union member states from Eastern Europe (EAST EU) and other transition countries such as China.

Unbalanced panel: The overall panel of 140 countries is unbalanced: the number of country-period observations varies across countries and 5-year-periods. Some countries have observations for many periods; some have observations for just two periods. Figure 1 shows the distribution of country-period observations. There are, for example, fewer observations in periods before the 1990s and the most recent period 2010-14. The lack of observations in these periods, however, is primarily based on the lack of data availability within the sample of lower income countries and countries such as members of the Former Republic of Yugoslavia, for example Serbia or Montenegro, that were only existent in later periods. We investigate the robustness of the relationship between globalisation and income inequality using different samples. In our robustness checks (section 5.5.2), we focus on three subsamples requiring a minimum of period observations by each country. By doing so we ensure that the estimates measuring how globalisation influences income inequality are based on several within variations by each country. We use a LARGE sample of 117 countries having at least four period observations for each country, an INTERMEDIATE sample of 70 countries having at least six period observations, and a SMALL sample of 56 countries having at least seven period observations. The intermediate and small samples primarily include higher income countries as lower income countries are more likely to have a lack of data availability.

Figure 1: **Distribution of country-period observations**

Source: SWIID 5.1, KOF 2016, own calculations

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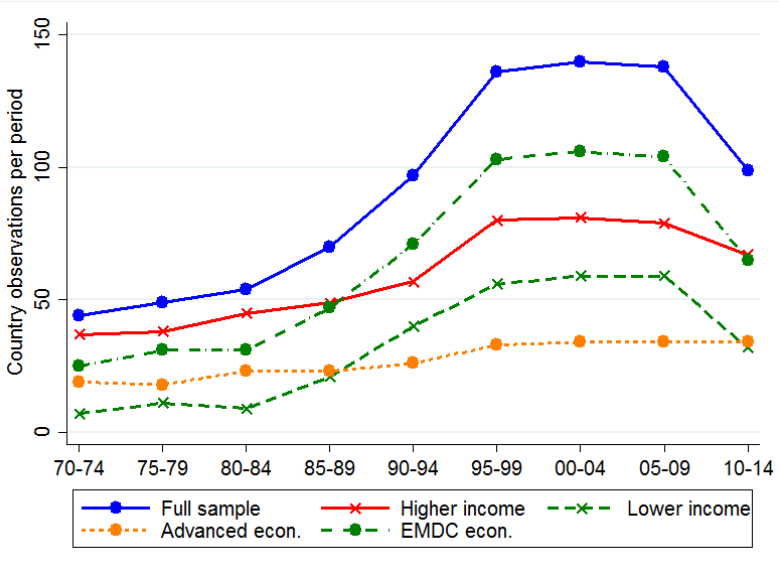
3.3.   GLOBALISATION AND INCOME INEQUALITY ACROSS COUNTRIES

We examine the correlation between globalisation and income inequality across countries: income inequality before taxes and transfers is weakly correlated with globalisation (table 1 for all periods and Figure 2a for the five year period 2010-2014). More globalized countries tend to have larger market inequality outcomes in the last period of observation 2010-14. The coefficient of correlation is 0.08.

For inequality after taxes and transfers the picture is different. Net income inequality in highly globalized countries is lower than in less globalized countries. The correlation coefficient between KOF globalisation and Gini market is -0.24. Clearly, this reflects that more developed countries have larger welfare states. EU member states and other advanced economies belong to the most globalized countries and have the lowest levels of income inequality after redistribution around the world. This is why there is a negative relationship between globalisation and after taxation and transfer income inequality across countries (table 1 for all periods and Figure 2b for the five year period 2010-2014).

Figure 2: **Cross-section of Gini income inequality and globalisation around the world, averaged by country in period 2010-14**

a) Gini market
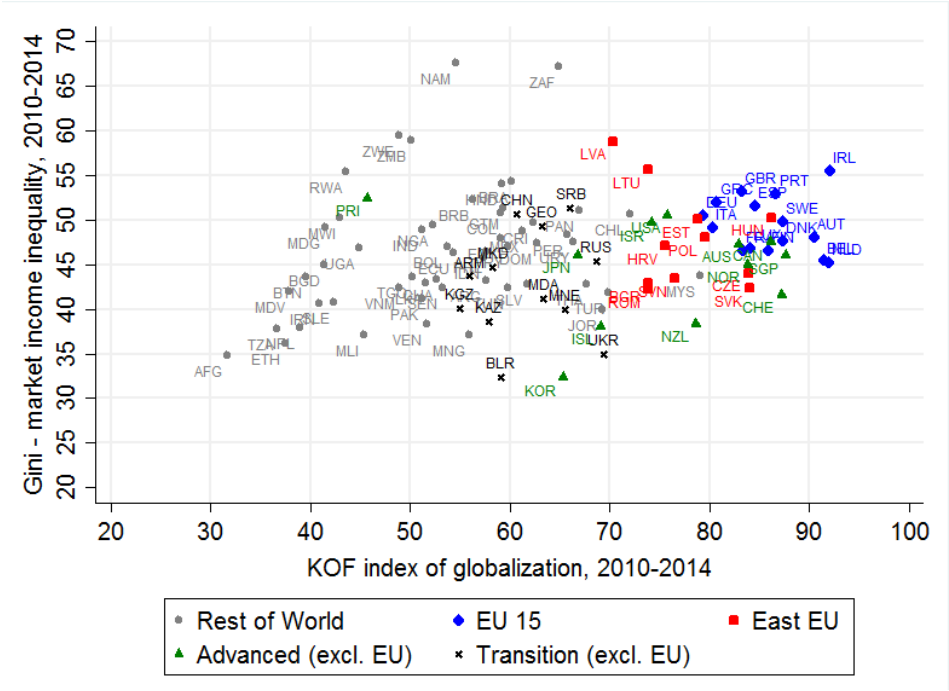
b) Gini net
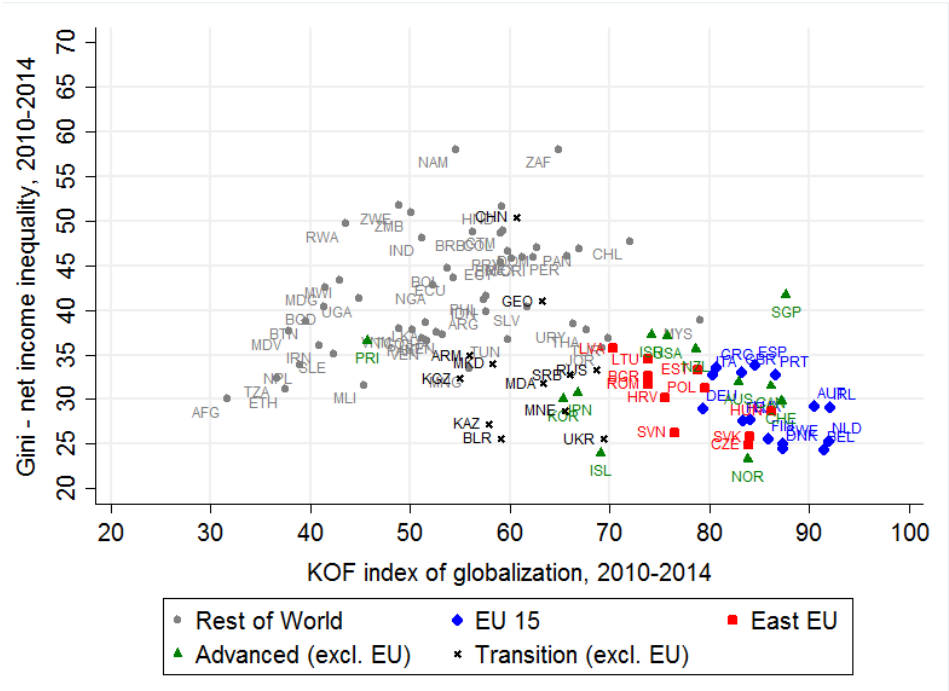
Source: SWIID 5.1, KOF 2016, own calculations

Note: Figures 2a and 2b capture the full country sample within the period 2010-14. Transition (excl. EU) capture former members of the Soviet Union, Western Balkan (Non-EU) states, and China.

3.4 TRENDS WITHIN COUNTRIES

Figure 3 shows changes in income inequality and globalisation between the periods 1985-89 and 2005-09 (based on 73 countries of all income levels having observations in both periods). Globalisation and income inequality both proceeded quite rapidly in many countries. The coefficients of correlation between the change in the KOF globalisation index and the change in the pre/post taxation and transfer GINI index are 0.33 and 0.23.

In Figure 4 we focus on countries of the higher income sample (based on 52 countries of higher income countries having observations in both periods). The unconditional linear correlation between the changes in the globalisation index and the market and net income inequality is also positive and significant.[8] The coefficients of correlation are 0.22 and 0.14. There is, however, a group of countries which can be identified as the key driver of the linear relationship between the late 1980s and late 2000s: the transition countries in Eastern Europe and China have experienced a huge opening process (globalisation shift) and a huge rise in income inequality. The other countries of the higher income sample have also enjoyed rapidly proceeding globalisation, but experienced less pronounced increases in income inequality than Eastern European countries and China. When we exclude the transition countries, the unconditional linear correlation between the change in globalisation and income inequality lacks statistical significance and turns out to be rather negative in the period of observation. The coefficients of correlation are -0.12 and 0.07 when we exclude transition countries from the higher income sample. Within the sample of EU-15 countries and other advanced economies (without transition economies), the changes in the globalisation index and income inequality outcomes are hardly correlated and not significant. The coefficients of correlation are -0.06 and 0.01.

Figure 3: **Changes in Gini income inequality and globalisation, between 1985/89 – 2005/09 (N=73)**

a) *Gini market*   b) *Gini net*
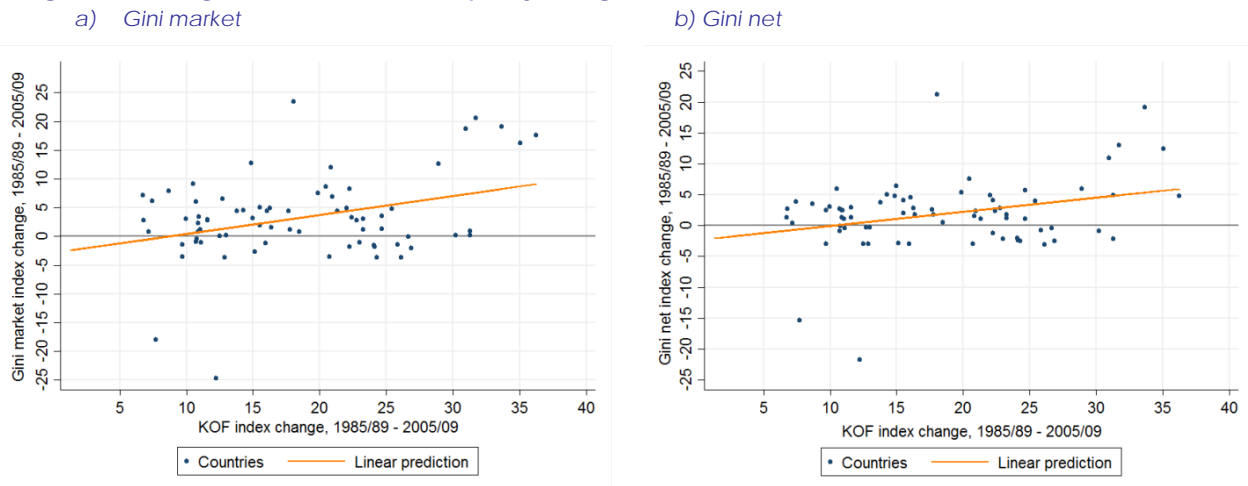
Source: SWIID 5.1, KOF 2016, own calculations
Note: Figures 3a and 3b capture countries within the full sample having observations in periods 1985-89 and 2005-09. The unconditional linear predictors are $\hat{\beta}_{market} = 0.33^{***}, \hat{\beta}_{net} = 0.23^{***}; ***\ p < 0.01$.

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[8] See Annex II for figures comparing the changes between the periods 1990/94 and 2005/09. Inferences do not change compared to the discussed change between the periods 1985/89 and 2005/09.

Figure 4: **Changes in Gini income inequality and globalisation, between 1985/89 – 2005/09 (higher income sample, N=52)**
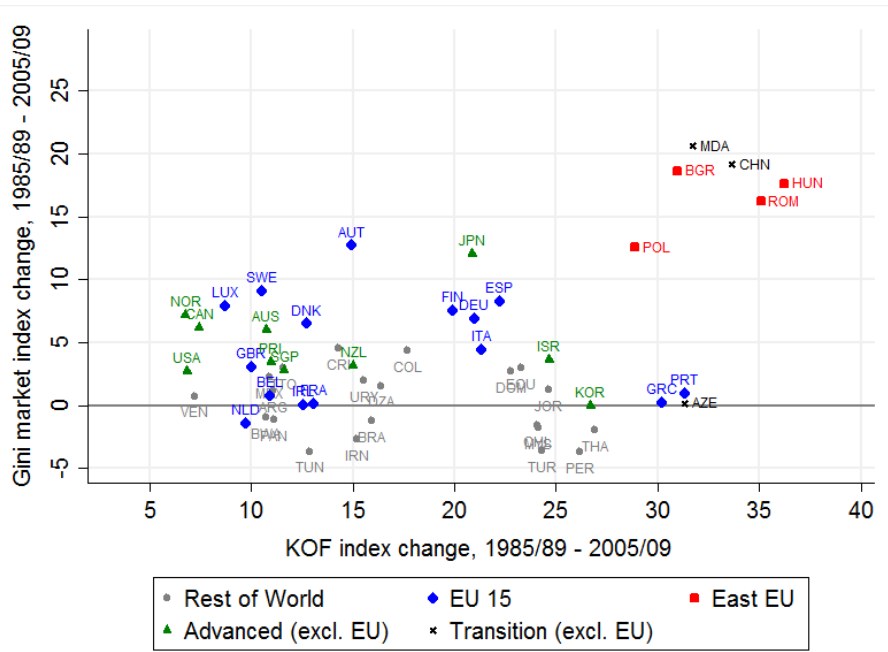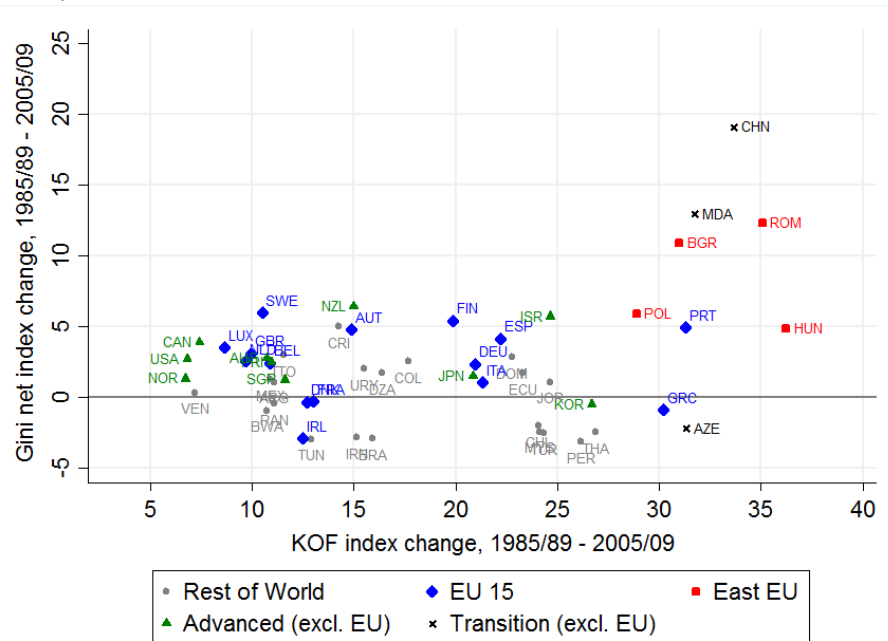
  a)   Gini market

  b)   Gini net

Source: SWIID 5.1, KOF 2016, own calculations

Note: Figures 4a and 4b describe countries within the higher income sample having observations in periods 1985-89 and 2005-09. Classification as higher income country if GNI per capita of USD 4.126 or more (World Bank, 2015). Transition (excl. EU) captures former members of the Soviet Union, Western Balkan (Non-EU) states, and China. The unconditional linear predictors in the higher income sample are $\hat{\beta}_{market} = 0.22^{**}, \hat{\beta}_{net} = 0.14^{**}$; ,** $p < 0.05$.

4 EMPIRICAL ANALYSIS

4.1. OLS – PANEL FIXED EFFECTS MODEL

We estimate the baseline panel model by Ordinary Least Squares (OLS), where countries are described by i and 5-year-periods by τ:

$$y_{i,\tau} = \beta_0 + \beta_1 \times GLOB_{i,\tau} + \Theta' \times \chi_{i,\tau} + \upsilon_i + \upsilon_\tau + \varepsilon_{i,\tau} \,. \qquad (1)$$

$y_{i,\tau}$ describes the Gini index value of country i in period τ. The explanatory variable $GLOB_{i,\tau}$ describes the KOF index of globalisation of country i in period τ. In robustness tests, the overall KOF index is replaced by sub-indicators of globalisation in equation (1). The vector $\chi_{i,\tau}$ includes control variables as described in section 3.1, υ_i describes the country fixed effects, υ_τ describes the fixed period effects, and $\varepsilon_{i,\tau}$ is the error term. All variables are included as averages in each of the nine periods (t = 1,...,9).

By estimating ordinary least squares (OLS) in a fixed effects (FE) model we exploit the within-country variation over time, eliminating any observable and unobservable country-specific time-invariant effects. We also include fixed time effects to control for other confounding factors (e.g. period specific shocks) that affect multiple countries simultaneously. We use standard errors robust to heteroscedasticity.

4.2. 2SLS – PANEL IV MODEL

4.2.1 Endogeneity problem and IV solution

There are two reasons for potential endogeneity of the globalisation variable in our model: omitted variable bias and reverse causality. The ordinary-least-square (OLS) fixed effects estimations of equation (1) may therefore be biased.

We have included many control variables, but other unobserved omitted variables may cause biased estimates. The omitted variable bias indicates that there is still a third (or more) variable(s) which both influence(s) globalisation and income inequality. For example, increasing mobility may induce countries to reduce (capital) taxes and cut welfare benefits, which in turn, will influence disposable income and probably also employment. If competition from countries with cheap labor induces companies in high income countries to specialize in the production of high tech goods and services, which requires highly skilled labor, this will have an impact on the skill premium. It is difficult to disentangle these effects from the 'direct' influence of globalisation on income inequality, that is the influence of globalisation, given other factors.

Secondly, reverse causality may occur because changes in income inequality are likely to have an impact on policies which affect globalisation.[9] The debate on the Transatlantic Trade and Investment Partnership (TTIP), for instance, is also influenced by the perception that gains from trade may be distributed rather unevenly. Shifts in the income distribution within a country may also have direct effects on the globalisation level of the country, for example if more or less people are able to travel, to buy more expensive import-goods or to make international investments and savings.

To deal with the endogeneity problem of globalisation, we use predicted openness based on a gravity equation as an IV (see Frankel and Romer 1999). Frankel and Romer (1999) apply predicted openness in a cross-sectional approach. We would like to exploit exogenous time variation in predicted openness using the IV in a panel model and controlling for unobserved country effects (see Feyrer 2009; Felbermayr and Gröschl 2013). We employ the exogenous component of variations in openness predicted by geography and time-varying natural disasters in foreign countries, as proposed by Felbermayr and Gröschl (2013) for a panel data model, as an IV for globalisation. Based on a modified gravity framework, Felbermayr and Gröschl (2013) show that the incidence of natural disasters such as earthquakes, hurricans or volcanic eruptions in one country influence openness of its trading partners, depending on the two countries' geographic proximity.[10] Gravity model based predicted openness variables have been shown to be a relevant IV for the KOF globalisation index (Potrafke 2013; Eppinger and Potrafke 2016) and trade openness (see Frankel and Romer 1999; Felbermayr and Gröschl 2013).

4.2.2 IV construction and quality

Following Felbermayr and Gröschl (2013), we construct predicted openness in two steps:

First, we predict bilateral openness by a reduced[11] gravity model using Poisson Pseudo Maximum Likelihood (PPML) estimation and standard errors clustered by country pairs. We regress bilateral openness on variables strictly exogenous to income inequality such as large scale natural disasters in foreign countries, interactions of the incidence of natural disasters and bilateral geographic variables, or population. We estimate

$$\widehat{\omega}_t^{ij} = \exp\left[\delta_1 \times D_t^j + \boldsymbol{\gamma}' \times \mathbf{Z}_t^{ij} + \boldsymbol{\lambda}' \times \left(\boldsymbol{\Phi}_t^{ij} \times D_t^j\right) + v^i + v^j + v_t\right] + \varepsilon_t^{ij}, \qquad (2)$$

where $\mathbf{Z}_t^{ij} = \left[\ln POP_t^i\,;\, \ln POP_t^j\,;\, \ln DIST^{ij};\, BOR^{ij}\right]$ contains exogenous controls such as population (*POP*) in countries i and j in year t, and the bilateral geographic variables distance *DIST*, and a common border dummy *BOR*, based on Frankel and Romer (1999). D_t^j denotes exogenous large scale natural disasters in country j, while $\boldsymbol{\Phi}_t^{ij} = \left[\ln FINDIST_t^j\,;\, \ln AREA^j\,;\, \ln POP_t^j\,;\, BOR^{ij}\right]$ describes the exogenous variables interacted with D_t^j, such as the international financial remoteness *FINDIST*, the

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surface area *AREA*, or population *POP* of country j.[12] Country and time fixed effects[13] are captured by v^i, v^j, v_t, while ε_t^{ij} accounts for the idiosyncratic error.

We follow the preferred approach by Felbermayr and Gröschl (2013) and use truly exogenous "large" scale natural disasters (as D_t^j) to make sure that a disaster is of a sufficiently large dimension and not caused by local determinants or the development level of the country, but rather by exogenous global phenomena. This classification of natural disasters includes "large" earthquakes, droughts, storms, storm floods, and volcanic erruptions that (i) caused 1,000 or more deaths; or (ii) injured 1,000 or more people; or (iii) affected 100,000 or more people. In our robustness checks, we use alternative definitions of disasters to construct the instrument, such as a broader specification of disasters that includes all kinds of natural disasters[14] or counting all sizes of disasters (see section 5.5.3).

We use an exogenous proxy for multilateral openness $\Omega_{i,t}$ by aggregating the obtained predicted openness values $\widehat{\omega}_t^{ij}$ of country i over all bilateral country-pairs and years t:

$$\Omega_{i,t} = \sum_{i \neq j} \widehat{\omega}_t^{ij} . \tag{3}$$

Based on our underlying data[15] we obtain values from 1966 to 2008. Averaging over nine periods τ and using one period lags of predicted openness $\Omega_{i,\tau-1}$, we obtain our instrument for $GLOB_i, \tau$ in equation (1).

The relevance of the IV predicted openness $\Omega_{i,\tau-1}$ depends on its conditional correlation with the KOF globalisation index values $GLOB_i, \tau$. The first stage regression has the following form:

$$GLOB_i, \tau = \alpha_1 \times \Omega_{i,\tau-1} + \boldsymbol{\varphi}' \times \boldsymbol{\chi}_{i,\tau} + v_i + v_\tau + \varepsilon_{i,\tau} . \tag{4}$$

The model is estimated by applying the FE estimator, controlling for any time-invariant country characteristics, and using robust standard errors. The first stage also includes period dummies to control for common period effects.

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[12] As large scale natural disasters may hit both bordering countries, an interaction of disasters and the common border dummy is included. Interactions of the disaster variable with surface area and population in country j consider the fact that economic and population density matters for the aggregate damage caused by large scale natural disasters. The interaction of disasters with financial remoteness is motivated by related literature (see Felbermayr and Gröschl 2013).

[13] Time fixed effects also account for improved reporting of natural disasters and its consequences (see Felbermayr and Gröschl 2013).

[14] Natural disasters caused by extreme temperature, floods, (mud)slides, or wildfires are additionally included in this extended definition of natural disasters. Epidemics are not included in any of our classifications.

[15] Our calculations are primarily based on supplied data from Felbermayr and Gröschl (2013) and Felbermayr et al. (2010). The trade data originally comes from the IMF's Direction of Trade Statistics (DoTS), nominal GDPs and populations are taken from Word Development Indicators (WDI) and Barbieri (2002), and the geographic variables are from the CEPII's Geographic and Bilateral Distance Database. Data on natural disasters is taken from the Emergency Events database (EM-DAT), and data on financial centers is based on Rose and Spiegel (2009).

The first stage regression results in table 2 show that the IV is relevant. Our predicted openness variable correlates positively and significantly with the overall KOF globalisation index (GLOB) and the sub-indicators of globalisation (Trade, Exports, Imports, FDI, social and political openness). The F-statistics on the excluded instrument are well above Staiger and Stock's (1997) rule of thumb (F≥10) and the 10 % critical value (F≥16.38) of the weak instrument test by Stock and Yogo (2005) for the overall KOF index and four out of six further specifications of sub-indicators (trade, exports, imports, and political globalisation). In the specifications for foreign direct investments (FDI) and the social globalisation index, the F-test statistic is above the 15% (F≥8.96) and 25% (F≥5.53) critical values. The partial R^2 of lagged predicted openness ranges between 1.1% in the specification for FDIs and 8.1% in the specification for exports.

We do not believe that predicted openness influences income inequality directly or through other explanatory variables that we did not include in our model. Predicted openness should therefore be an excludable IV. Large scale natural disasters - as key component of the constructed instrument - may, however, cause changes in the income distribution within countries. Felbermayr and Gröschl (2013, 2014), for example, have shown that natural disasters influence overall per capita income. We directly control for the effect of large scale natural disasters on the income distribution within countries as robustness test in section 5.5.1.[16]

Table 2: **First stage regression results (2SLS), based on nine periods using 5-year averages and FE estimates**

Instrumented var.	(1) GLOB	(2) Trade	(3) Exports	(4) Imports	(5) FDI	(6) Social	(7) Political
$\Omega^i_{\tau-1}$	0.075***	0.450***	0.258***	0.192***	0.129***	0.068**	0.184***
	(0.015)	(0.088)	(0.050)	(0.043)	(0.038)	(0.028)	(0.038)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects							
Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Partial R^2	0.029	0.075	0.081	0.048	0.011	0.014	0.055
F-Test, excl. IV	24.40	25.93	26.13	20.31	11.24	5.94	23.44
F-Test, p-value	0.000	0.000	0.000	0.000	0.001	0.015	0.000
Stock-Yogo critical value	16.38	16.38	16.38	16.38	8.96	5.53	16.38
Countries	140	139	139	139	140	140	140
Observations	815	800	800	800	821	815	815

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

All specifications include baseline control variables: GDP per capita, ln population, and dependency ratio.

Stock and Yogo (2005) weak identification test – critical values:16.38 (10%); 8.96 (15%); 6.66 (20%); 5.53 (25%).

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[16] The gravity model also includes population growth to construct predicted openness. We already control for population growth as baseline control in the OLS and IV regressions.

5. RESULTS

5.1. BASELINE MODEL

OLS-results in Table 3 confirm the findings of previous empirical studies indicating a positive relationship between globalisation and income inequality. The coefficient of the globalisation index is larger when we use the Gini market index (before taxation and transfers) than when we use the Gini net index (after taxation and transfers) as the dependent variable. Columns (1) and (2) show the estimated coefficient of globalisation when we control for heterogenous period and country effects. The coefficient slightly decreases by 0.03 and 0.014 when we control for our baseline control variables income per capita, population growth and the dependency ratio, see columns (3) and (4). Holding all baseline covariates constant, a ten unit increase in the KOF globalisation index is associated with a 2.34 higher Gini market index value and a 1.62 higher Gini net index value. An increase of population by one percent decreases Gini inequality by 8.9 and 4.2 index points. When the ratio of dependent people within the population increases, income inequality rises significantly. The per capita income level does not have a significant effect in the full sample of 140 countries.

The 2SLS results in Table 3, however, do not show that globalisation influences income inequality in the full sample of countries. The coefficientestimate of the globalisation index is close to zero and lacks statistical significance in columns (5) to (8).

Table 3: **Baseline: OLS and 2SLS – panel fixed effects estimates, based on nine periods using 5-year averages between 1970 and 2014**

	OLS				2SLS			
	(1) Gini market	(2) Gini net	(3) Gini market	(4) Gini net	(5) Gini market	(6) Gini net	(7) Gini market	(8) Gini net
GLOB	0.264***	0.176***	0.234***	0.162***	-0.012	0.040	-0.031	0.122
	(0.080)	(0.063)	(0.071)	(0.058)	(0.299)	(0.235)	(0.249)	(0.206)
GDP pc			0.065	-0.004			0.034	-0.009
			(0.066)	(0.055)			(0.049)	(0.039)
ln POP			-8.925***	-4.201**			-12.164***	-4.680*
			(2.486)	(2.104)			(3.469)	(2.835)
Dependency			0.140***	0.070*			0.106**	0.065*
			(0.049)	(0.041)			(0.047)	(0.039)
Fixed Effects								
Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	140	140	140	140	140	140	140	140
Observations	815	815	815	815	815	815	815	815
R^2(within)	0.1205	0.0733	0.2526	0.1187	0.0663	0.0500	0.2083	0.1170

Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

5.2. GLOBALISATION SUB-INDICATORS

Table 4 shows regression results for the individual openness indicators using equations (1) and (4). The results show that different sub-indicators of globalisation are differently related to inequality outcomes.

Columns (1a) and (1b) show OLS-results including the baseline control variables and fixed effects for countries and periods. Trade openness is positively correlated with income inequality. The coefficient of the trade variable, however, lacks statistical significance when we use Gini market as dependent variable (column 1a). The positive relationship between trade and income inequality within countries is mainly driven by the relative export openness. While higher export shares, measured as percentage of the GDP, are positively and significantly related to higher market and net Gini inequality indices, changing import shares do not show any statistically significant relationship with both Gini inequality measures.

The coefficients of actual inflows and outflows of foreign direct investments (FDI) as percentage of GDP are positive and statistically significant in both OLS specifications (columns 1a,b). The coefficient of the political globalisation index does not turn out to be statistically significant. The social globalisation index is positively associated with the Gini market index (column 1a). Higher social and cultural globalisation is, thus, associated with higher income inequality outcomes before taxation and transfers within countries. The coefficient estimate, however, is smaller and lacks statistical significance after redistribution policies of the governments (column 1b).

2SLS estimates confirm the findings of the baseline regression of section 5.1 when we use the full sample of 140 countries: neither the overall KOF index of globalisation, nor any sub-indicator of globalisation affects income inequality before or after redistribution (columns 2a,b).

Sub-indicators of globalisation: OLS and 2SLS – panel fixed effects estimates, based on nine periods using 5-year averages between 1970 and 2014

	OLS FE		2SLS	
	(1a) Gini market	(1b) Gini net	(2a) Gini market	(2b) Gini net
Trade	0.019 (0.013)	0.020* (0.012)	-0.029 (0.046)	-0.001 (0.038)
Observations R^2(within)	801 0.1829	801 0.0764	800 0.1629	800 0.0700
Exports	0.048* (0.026)	0.045** (0.023)	-0.050 (0.081)	-0.002 (0.066)
Observations R^2(within)	801 0.1858	801 0.0798	800 0.1603	800 0.0699
Imports	0.016 (0.027)	0.022 (0.023)	-0.068 (0.108)	-0.002 (0.088)
Observations R^2(within)	801 0.1804	801 0.0725	800 0.1632	800 0.0702
FDI	0.083*** (0.020)	0.051*** (0.015)	-0.015 (0.143)	0.077 (0.120)
Observations R^2(within)	821 0.2544	821 0.1147	821 0.2051	821 0.1086
Social	0.129** (0.062)	0.078 (0.052)	-0.034 (0.278)	0.135 (0.226)
Observations R^2(within)	815 0.2364	815 0.1013	815 0.2071	815 0.0949
Political	0.023 (0.039)	0.033 (0.035)	-0.013 (0.100)	0.050 (0.086)
Observations R^2(within)	815 0.2192	815 0.0935	815 0.2166	815 0.0925
Controls	Yes	Yes	Yes	Yes
Fixed Effects Country Period	 Yes Yes	 Yes Yes	 Yes Yes	 Yes Yes

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

All specifications include baseline control variables: GDP per capita, ln population, and dependency ratio.

5.3.   THE ROLE OF DEVELOPMENT LEVELS

The effect of globalisation on income inequality is likely to differ depending on the development and income level of countries. We therefore examine subsamples depending on the development and income level of countries.

OLS fixed effects estimates in Table 5 show a positive and significant correlation between globalisation and income inequality within the sample of the 106 emerging markets and developing economies (columns 3 and 4), but no statistical significance within the 34 most advanced economies (columns 1 and 2). OLS fixed effects estimates show, however, a positive and significant correlation between globalisation and income inequality for all 82 higher income countries (columns 5 and 6). The higher income sample includes the advanced economies sample and the 48 emerging economies having a per capita income level above a minimum threshold. All subsample-results confirm the baseline results indicating that the relationship between globalisation and income inequality is larger when we use the Gini market index (before taxation and transfers) than when we use the Gini net index (after taxation and transfers) as the dependent variable. The results also suggest that the relationship between globalisation and income inequality is larger for less developed countries than for more advanced economies: an increase of ten KOF globalisation index points is associated with a 3.23 higher Gini market and a 2.49 higher Gini net inequality index within the sample of emerging and developing countries. Within the higher income sample, which does not include developing countries having a GNI per capita below 4,126 USD (World Bank 2015), the correlation becomes smaller. An increase of the globalisation by 10 index points is associated with a 2.12 higher Gini market and a 1.36 higher Gini net index value. Within the sample of 34 advanced economies around the world, the estimators are even below 0.1 and 0.01 (and statistically not different from zero).

When we exclude the 58 poorest countries, 2SLS estimates show that globalisation influences income inequality within the remaining 82 higher income countries (Table 5, columns 5 and 6). The effect on income inequality is positive in both specifications, before and after redistribution (2SLS results, columns 5 and 6). When the globalisation index increases by 10 points, the Gini income inequality value increases by 3.11 to 3.83 points. The coefficient of the 2SLS estimator is larger than the OLS estimator indicating that OLS results underestimate the effect of globalisation upon income inequality.[17] Predicted openness is a strong instrument for globalisation within the higher income country sample. The F-statistic on the excluded instrument is well above the 10% critical value of the weak IV-test of Stock and Yogo (2005). 2SLS results, however, do not show that globalisation influences income inequality within the most advanced economies and within the sample of emerging markets and developing economies (columns 1-4). The coefficients are neither positive nor statistically significant. The instrument is strong and relevant within both sub-samples. The F-statistic on the excluded instrument is well above the 20% and 15% critical values of the weak IV-test.

We also examine the relationship of the globalisation sub-indicators (trade, exports, imports, FDIs, social integration, and political integration) and income inequality within the three subsamples.[18] Within advanced economies, neither the OLS nor 2SLS results suggest any statistically significant effects. Within the emerging and developing economies, the OLS-results suggest that export openness,

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[17] Poor countries are more likely to have a lack of data availability. Measurement errors might be a reason for underestimating the effect.

[18] Estimation results for globalization sub-indicators are not reported in the table.

foreign direct investments and social globalisation are positively associated with income inequality (Gini market and Gini net indices). The import share and political globalisation is not significantly related to inequality. 2SLS results, however, do not show that any sub-indicator influences income inequality within the sample of emerging markets and developing economies. Applying our sub-indicators as explanatory variable shows that export openness, foreign direct investments and social and political globalisation do have a positive influence on income inequality after redistribution within this subsample of countries. Before redistribution, the significance only holds for FDIs and social globalisation.

Our results based on our sub-samples do not suggest that globalisation or any sub-indicator influences income inequality within countries. While we cannot confirm any significant relationship within advanced economies, our findings suggest that globalisation influences income inequality within higher income economies. As 41.5 percent of the higher income sample are advanced economies, other countries within the higher income subsample might be the drivers of the significant results.

Table 5: **Development levels: OLS and 2SLS – panel fixed effects estimates, based on nine periods using 5-year averages between 1970 and 2014**

| | Advanced Economies | | Emerging and Developing | | Higher Inc. Countries | |
	(1) Gini market	(2) Gini net	(3) Gini market	(4) Gini net	(5) Gini market	(6) Gini net
OLS-results						
GLOB	0.086	0.009	0.323***	0.249***	0.213**	0.136**
	(0.74)	(0.16)	(3.79)	(3.16)	(2.54)	(2.01)
2SLS-results						
GLOB	-0.254	-0.025	-0.449	-0.416	0.311*	0.383**
	(-0.99)	(-0.14)	(-1.06)	(-1.14)	(1.76)	(2.26)
F-Test excl. IV	7.64		10.27		25.93	
F-Test, p-value	0.0062		0.0014		0.000	
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects						
Country	Yes	Yes	Yes	Yes	Yes	Yes
Period	Yes	Yes	Yes	Yes	Yes	Yes
Countries	34	34	106	106	82	82
Observations	244	244	571	571	529	529

Estimates use robust standard errors; t- statistics in OLS and z-statistics in 2SLS in parentheses; *** p<0.01, ** p<0.05, * p<0.1. All specifications include baseline control variables: GDP per capita, ln population, and dependency ratio. Stock and Yogo (2005) weak identification test – critical values:16.38 (10%); 8.96 (15%); 6.66 (20%); 5.53 (25%).

5.4.   THE ROLE OF TRANSITION COUNTRIES

The unconditional relationship between the change in globalisation and income inequality seems to be mainly driven by Eastern European countries (East-EU) and China (see section 3). We therefore

exclude the eleven Eastern European EU member countries and China from the higher income sample. The results in Tables 6 show indeed that the significant effect of overall globalisation on income inequality vanishes. The coefficient of the globalisation variable becomes smaller and does not turn out to be statistically significant, estimating the model by OLS or 2SLS notwithstanding. The 2SLS-estimators of the marginal effect of any globalisation sub-indicator upon income inequality lack statistical significance in the subset of the remaining 70 higher income economies.[19]

Table 6: **Excluding transition economies: OLS and 2SLS – panel fixed effects estimates, based on nine periods using 5-year averages between 1970 and 2014**

	OLS				2SLS			
	Higher Inc. (all)		Higher Inc. (excl. East-EU and China)		Higher Inc. (all)		Higher Inc. (excl. East-EU and China)	
	(1a) Gini market	(1b) Gini net	(2a) Gini market	(2b) Gini net	(3a) Gini market	(3b) Gini net	(4a) Gini market	(4b) Gini net
GLOB	0.213** (0.0840)	0.136** (0.0675)	0.101 (0.0820)	0.0313 (0.0520)	0.311* (0.177)	0.383** (0.169)	-0.348 (0.316)	-0.103 (0.244)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects								
Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	82	82	70	70	82	82	70	70
Observations	529	529	459	459	529	529	459	459
R^2(within)	0.361	0.178	0.284	0.149	0.354	0.083	0.116	0.118
F-Test excl. IV					25.93		10.40	
F-Test, p-value					0.000		0.0014	

Estimates use robust standard errors; t- statistics in OLS and z-statistics in 2SLS in parentheses; *** p<0.01, ** p<0.05, * p<0.1. All specifications include baseline control variables: GDP per capita, ln population, and dependency ratio. Stock and Yogo (2005) weak identification test – critical values:16.38 (10%); 8.96 (15%); 6.66 (20%); 5.53 (25%).

5.5. ROBUSTNESS CHECKS

5.5.1 Accounting for direct effects of natural disasters

Our instrument predicted openness is constructed by using exogenous large scale natural disasters. Natural disasters itself are shown to influence trade openness and the per capita income level of countries (see Felbermayr and Gröschl 2013, 2014). To make sure that our estimated relationship between globalisation and inequality as well as the functionality of our instrument is not driven by the correlation between disasters and income inequality, we directly control for the effect of large scale natural disasters on the income distribution within countries. Table 7 provides results for including contemporaneous and one period lagged large scale natural disasters in our OLS and 2SLS baseline equations. Inferences do not change compared to the baseline results in Table 3.

Columns (1) – (4) in Table 7 show the results using Gini market as dependent variable; columns (5) – (8) show the results using Gini net. As we do not take into account natural disasters in the period 2011-

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[19] Estimation results for globalization sub-indicators are not reported in the table.

14, columns (1) – (3) and (5) – (6) have less observations than our baseline results of Table 3. Columns (1) and (5) show baseline results without observations of the last period and before including the disasters variable as an explanatory variable. The size of the coefficient of the globalisation variable hardly changes when excluding the period 2011-14. By including natural disasters as covariate, the size of the coefficient of the globalisation index decreases. Both, contemporaneous and lagged disasters are positively correlated with market and net income inequality at the 1% significance level. When we control for contemporenous and lagged disasters simultaneously (see columns 3 and 7), the results suggest that an average of one large scale natural disaster per year in the contemporenous period increases the level of Gini inequality between 1.01 and 1.31 index points, and additionally by 1.15 to 1.59 index points for an average of one large scale natural disaster per year in the previous 5-year-period. In all models, the instrument remains strong and above Staiger and Stock's (1997) rule of thumb (F≥10).

Table 7: **Direct effect of natural disasters: OLS and 2SLS – panel fixed effects estimates, based on periods using 5-year averages between 1970 and 2014**

	Gini market				Gini net			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OLS-results								
GLOB	0.249***	0.208***	0.197***	0.196***	0.169**	0.126**	0.115**	0.122***
	(3.10)	(2.82)	(2.65)	(3.05)	(2.56)	(2.38)	(2.17)	(2.75)
Disaster		1.758***	1.013***			1.838***	1.127***	
		(5.39)	(3.83)			(4.70)	(4.73)	
L. Disaster ($\tau - 1$)			1.197***	1.927***			1.145***	1.996***
			(4.70)	(5.78)			(5.28)	(4.55)
2SLS-results								
GLOB	-0.055	-0.152	-0.139	-0.070	0.068	-0.018	-0.007	0.088
	(-0.18)	(-0.44)	(-0.41)	(-0.28)	(0.28)	(-0.07)	(-0.03)	(0.43)
Disaster		2.342***	1.306***			2.072***	1.233***	
		(3.50)	(2.76)			(3.71)	(3.35)	
L. Disaster ($\tau - 1$)			1.591***	2.330***			1.288***	2.048***
			(2.85)	(4.91)			(2.82)	(4.86)
F-Test excl. IV	15.14	12.92	13.40	23.82	15.14	12.92	13.40	23.82
F-Test, p-value	0.0001	0.0004	0.0003	0.0000	0.0001	0.0004	0.0003	0.0000
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects								
Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	140	140	140	140	140	140	140	140
Observations	716	716	716	815	716	716	716	815

Estimates use robust standard errors; t- statistics in OLS and z-statistics in 2SLS in parentheses; *** p<0.01, ** p<0.05, * p<0.1. All specifications include baseline control variables: GDP per capita, ln population, and dependency ratio. Stock and Yogo (2005) weak identification test – critical values:16.38 (10%); 8.96 (15%); 6.66 (20%); 5.53 (25%).

5.5.2 Variations in country-period observations

Our data on country-period observations varies across countries and time. We test the robustness of our baseline results by controlling for effects of the unequal distribution of observations. We use restricted subsamples of countries, which have a minimum number of period-observations. Results are shown in Table 8. Inferences do not change.

OLS-results among all specifications in Table 8 confirm the findings about a positive relationship between globalisation and income inequality of the full country sample in table 3. The size of the coefficient of the globalisation index decreases whenincreasing the minimum number of period-observations per country, and even lacks statistical significance in the most stringent sample of 56 countries having at least seven period observations. In the small sample, the t-statistic is slightly below the 10%-significance level threshold. The small sample contains mainly advanced economies and other higher income countries.

The 2SLS results of the large sample of 117 countries (columns 1a,b in Table 8), which have at least four period-observations per country, do not show that globalisation generally influences income inequality. The large sample result confirms the findings of the full sample in table 3. The coefficient, however, is positive and statistically significant in the smaller samples when we use the Gini index as dependent variable (columns 2b, and 3a,b). The smaller samples mainly contain higher income countries. The results are therefore driven by the income level of different subsamples. The F-statistic on the excluded instrument is well above the most stringent 10% criterion of the weak IV-test of Stock and Yogo (2005) in all three subsamples. Predicted openness remains a strong and relevant instrument for globalisation.

Diverging results among the subsamples are not driven by variations in country-period observations but rather by the development levels within the subsamples of countries, as developed and higher income countries are more likely to have more period-observations per country (see Figure 1). Results depending on the development levels are reported in section 5.3.

Table 8: **Variations in country-period observations: OLS and 2SLS – panel fixed effects estimates, based on nine periods using 5-year averages between 1970 and 2014**

| | Large | | Intermediate | | Small | |
	(1a) Gini market	(1b) Gini net	(2a) Gini market	(2b) Gini net	(3a) Gini market	(3b) Gini net
OLS-results						
GLOB	0.233*** (3.22)	0.158*** (2.70)	0.198** (2.23)	0.144* (1.92)	0.172 (1.64)	0.120 (1.34)
2SLS-results						
GLOB	-0.001 (-0.00)	0.145 (0.77)	0.223 (1.16)	0.317* (1.84)	0.415** (2.40)	0.485*** (2.92)
F-Test excl. IV	27.10		30.74		28.24	
F-Test, p-value	0.000		0.000		0.000	
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects						
Country	Yes	Yes	Yes	Yes	Yes	Yes
Period	Yes	Yes	Yes	Yes	Yes	Yes
Countries	117	117	70	70	56	56
Observations	753	753	549	549	465	465
Period-obs. by country	$\succeq 4(9)$	$\succeq 4(9)$	$\succeq 6(9)$	$\succeq 6(9)$	$\succeq 7(9)$	$\succeq 7(9)$

Estimates use robust standard errors; t- statistics in OLS and z-statistics in 2SLS in parentheses; *** p<0.01, ** p<0.05, * p<0.1. All specifications include baseline control variables: GDP per capita, ln population, and dependency ratio. Stock and Yogo (2005) weak identification test – critical values:16.38 (10%); 8.96 (15%); 6.66 (20%); 5.53 (25%). The large sample requires at least four period-observations per country (columns 1a-1b). The intermediate sample requires six periods (columns 2a-2b), the small sample requires seven out of nine periods (columns 3a-3b).

5.5.3 Sensitivity tests on baseline specification

We have tested the sensitivity of our OLS FE and 2SLS baseline panel data models in many ways. Inferences of our results do not change.

First, we have included several covariates to test potential omitted variables: including the human capital index shows that a higher human capital endowment is associated with a lower Gini index value. The coefficient, however, is only statistical significant in the OLS model when we use Gini market as dependent variable. Inferences about the relationship of globalisation and income inequality do, however, not change when we control for the human capital endowment. When we control for the regulation in the labor market, inferences of our baseline results do not change. A higher labor market regulation is, however, related to a lower level of income inequality. The coefficient of labor market regulation is statistically significant at the 1% level when we use Gini income inequality after redistribution.While the ICT capital stock is positively related to changes of the Gini inequality outcomes in all OLS and 2SLS models, inferences about the relationship of globalisation and income inequality do not change when we control for the technological change. We have also included capital intensity, an index on economic freedom, an index of overall regulation, and the share of government consumption as percent of GDP as additional explanatory variable in the baseline OLS and 2SLS models. All control variables do not turn out to be statistically significant in any model,

notwithstanding using Gini market or Gini net as dependent variable. Inferences about the relationship of globalisation and income inequality do not change in any specification.

Second, we have estimated the OLS and 2SLS models using robust standard errors clustered by country and using classical standard errors. Inferences do not change.

Third, we have used alternative definitions of natural disasters by constructing the instrument predicted openness in the panel model, such as broader specifications that includes all kinds of natural disasters or counting all sizes of disasters (small and large), as suggested by Felbermyr and Gröschl (2013). Using the alternative instruments, inferences do not change.

6. CONCLUSION

We have re-examined the relationship between globalisation and income inequality. OLS results confirm previous findings that income inequality and globalisation are positively correlated within countries. The positive relationship is mainly driven by export openness, FDIs and social globalisation. Significance of the positive relationship holds within the full sample of countries and the sample of emerging markets and developing economies. For the most advanced economies the results do not suggest that globalisation and income inequality are positively correlated.

We use predicted openness as an IV for globalisation. The 2SLS results show that globalisation does not seem to affect income inequality, neither within the full sample of countries, nor the subsamples of advanced economies or the emerging and developing countries. Within the sample of higher income countries, however, the effect is positive. But this effect is mainly driven by China and transition countries from Eastern Europe. The relationship between globalisation and income inequality does not turn out to be statistically significant when we exclude China and Eastern European transition countries, estimating the model by OLS or 2SLS notwithstanding.

The transition countries of Eastern Europe and China have experienced a rapid process of globalisation while the welfare states and labor market institutions in these countries were less developed than in advanced countries in the rest of the world. Transition countries from Eastern Europe have also experienced systematic structural and institutional changes towards market economies which might be the omitted drivers of rising globalisation levels and inequality outcomes in our results. Our findings, therefore, do not provide empirical evidence for any subsample of countries that globalisation influences the income distribution within countries.

There are many issues that should be addressed in future research such as non-linear relationships between globalisation and income inequality and using other measures for income inequality. The shortcoming of Gini indices is that they do not consider, for example, whether income inequality changes because of the rich becoming richer, the poor becoming poorer (or both). In particular, income inequality increases, when both the poor and rich become richer, but the income-increases are just larger for the rich. Moreover, income increases of the rich may well be a precondition for the poor to experience increases in income as well.

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ANNEX I

Summary statistics

Table A: **Summary statistics and data sources, based on nine 5-year averaged periods between 1970 and 2014**

Variable	Mean	Std. Dev.	Min.	Max.	N	Source
Dependent variables						
Gini market	44.99	8.59	20.03	75.29	1028	SWIID v5.1 (Solt 2016)
Gini net	36.85	9.77	15.96	65.72	1028	SWIID v5.1 (Solt 2016)
Globalization variables						
GLOB	45.64	17.72	12.32	92.18	1596	KOF 2016 (Dreher 2006)
FDI	51.19	28.65	1	100	1710	KOF 2016 (Dreher 2006)
Social	41.62	21.41	3.13	93	1668	KOF 2016 (Dreher 2006)
Political	46.85	26.62	1	97.67	1728	KOF 2016 (Dreher 2006)
Trade	80.24	50.65	0.22	444.84	1521	WDI (World Bank 2017)
Exports	36.97	26.25	0.14	223.57	1521	WDI (World Bank 2017)
Imports	43.27	27.94	0.08	339.76	1521	WDI (World Bank 2017)

List of countries

Advanced Economies*:

Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Republic of Korea, Latvia, Lithuania, Luxembourg, Macao (China), Malta, Netherlands, New Zealand, Norway, Portugal, Puerto Rico, San Marino, Singapore, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States

Emerging and Developing Economies:

Afghanistan, Albania*, Algeria*, American Samoa*, Andorra*, Angola*, Anguilla, Antigua and Barbuda*, Argentina*, Armenia, Aruba*, Azerbaijan*, Bahamas*, Bahrain*, Bangladesh, Barbados*, Belarus*, Belize*, Benin, Bermuda*, Bhutan, Bolivia, Bosnia and Herzegovina*, Botswana*, Brazil*, British Virgin Islands, Brunei Darussalam*, Bulgaria*, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Cayman Islands*, Central African Republic, Chad, Channel Islands*, Chile*, China*, Colombia*, Comoros, Congo (Dem. Rep.), Congo (Republic), Costa Rica*, Cote d'Ivoire, Croatia*, Cuba*, Curaçao*, Czechoslovakia, Djibouti, Dominica*, Dominican Republic*, Ecuador*, Egypt, El Salvador, Equatorial Guinea*, Eritrea, Ethiopia, Faeroe Islands*, Fiji*, French Polynesia*, Gabon*, Gambia, Georgia, Ghana, Greenland*, Grenada*, Guam*, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary*, India, Indonesia, Iran*, Iraq*, Isle of Man, Jamaica*, Jordan*, Kazakhstan*, Kenya, Kiribati, Korea, Dem., Rep., Kuwait*, Kyrgyz Republic, Lao, Lebanon*, Lesotho, Liberia, Libya*, Liechtenstein*, Macedonia (FYR)*, Madagascar, Malawi, Malaysia*, Maldives*, Mali, Marshall Islands*, Mauritania, Mauritius*, Mexico*, Micronesia (Fed. Sts.), Moldova, Monaco*, Mongolia*, Montenegro*, Montserrat, Morocco, Mozambique, Myanmar, Namibia*, Nepal, Netherlands, Antilles, New Caledonia*, Nicaragua, Niger, Nigeria, Northern Mariana Islands*, Oman*, Pakistan, Palau*, Panama*, Papua New Guinea, Paraguay*, Peru*, Philippines, Poland*, Qatar*, Romania*, Russian Federation*, Rwanda, Samoa, Sao Tome and Principe, Saudi Arabia*, Senegal, Serbia*, Serbia and Montenegro, Seychelles*, Sierra Leone, Solomon Islands, Somalia, South Africa*, Sri Lanka, St. Kitts and Nevis*, St. Lucia*, St. Vincent and the Grenadines*, Suriname*, Swaziland, Syria, Tajikistan, Tanzania, Thailand*, Timor-Leste, Togo, Tonga*, Trinidad and Tobago*, Tunisia*, Turkey, Turkmenistan*, USSR, Uganda, Ukraine, United Arab Emirates*, Uruguay*, Uzbekistan, Vanuatu, Venezuela*, Viet Nam, Virgin Islands (U.S.)*, West Bank and Gaza, Republic of Yemen

*Countries marked with * are higher income countries. The World Bank (2015) classified countries having a GNI per capita of.4,126 USD or more as relatively higher income countries.*

Central and Eastern European EU Members:

Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia

Former Members of the Soviet Union:

Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan

Western Balkan:

Albania, Bosnia and Herzegovina, Macedonia (FYR), Montenegro, Serbia, Serbia and Montenegro

EU 15:

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom

ANNEX II

Additional figures

Figure B: **Changes in Gini income inequality and globalisation, between 1990/94 – 2005/09 (higher income sample, N=52)**
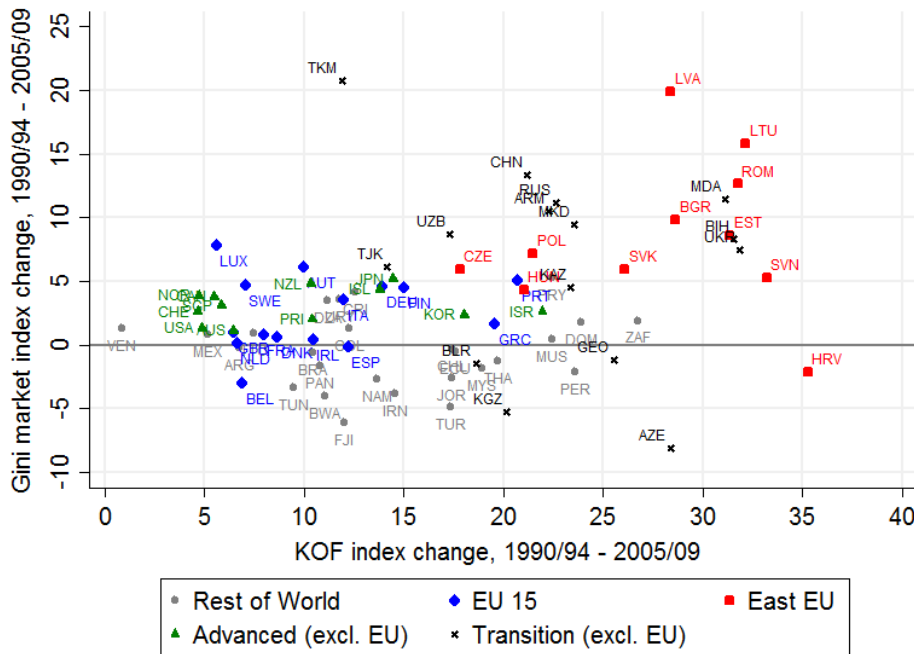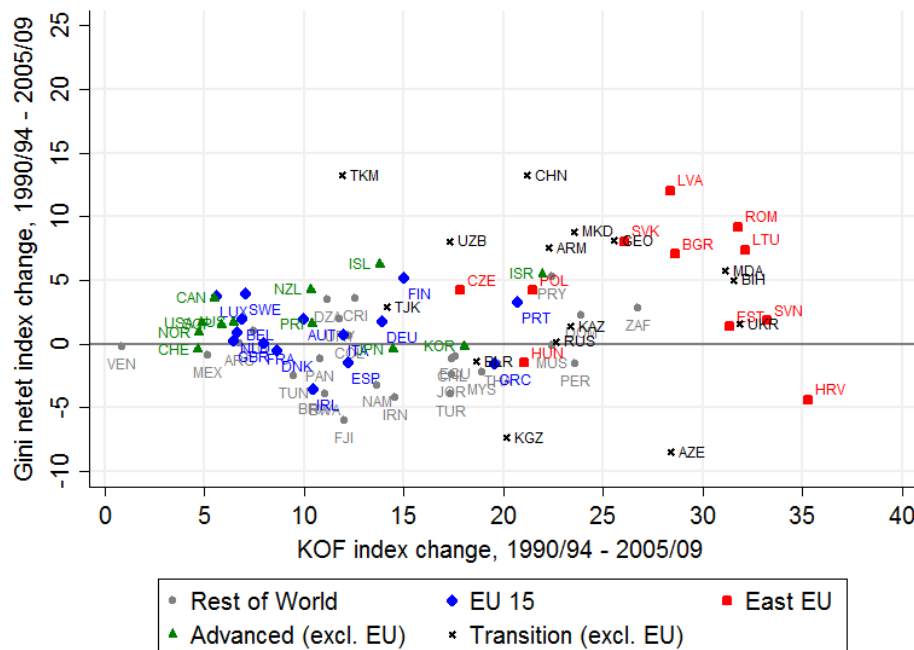
   a)   Gini market

   b)   Gini net

Source: SWIID 5.1, KOF 2016, own calculations

Note: Figures 4a and 4b describe countries within the higher income sample having observations in periods 1990-94 and 2005-09. Classification as higher income country if GNI per capita of USD 4.126 or more (World Bank, 2015). Transition (excl. EU) captures former members of the Soviet Union, Western Balkan (Non-EU) states, and China.

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