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## How international trade is affected by the financial crisis: The gravity trade equation

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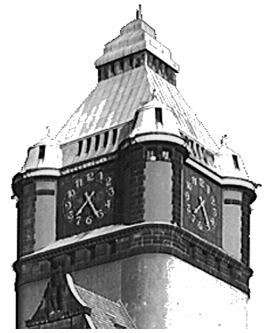
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*Dresden Discussion Paper Series  
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*Dresden Discussion Paper in Economics No. 03/14*

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# How International Trade is affected by the Financial Crisis: The Gravity Trade Equation

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## Abstract:

The study examines the effect of financial crises on international trade with a gravity approach and a large data set covering almost 70 importing and 200 exporting countries from 1950 to 2009. Thus it is possible to put the 'Great Trade Collapse' witnessed during the financial crisis 2008/2009, especially for South Asian countries, into a historical perspective. Both, the period for which the crisis is observed, and the level of the trading partners' economic development constitute important factors to explain the negative effects of a banking crisis on international trade. As the analysis indicates, financial crises have a stronger negative effect on differentiated goods compared to overall export flows. In addition the negative effects of financial crises persist even after the income effect is accounted for. The study therefore suggests that the increasing share of differentiated goods in inter-national trade might be one possible reason for the comparatively large effect of the recent financial crisis on international trade relative to previous financial turmoil in post-war economic history.

JEL-Classification: F13; F14

Keywords: International trade, financial crisis, gravity equation markets

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## **1. Introduction**

In the first quarter 2009 international trade declined nearly 30% compared to the same period one year before after a fifty year period of quasi continuous growth. From the 1950s onwards both global economic capacity and complexity were growing with expanding international trade and complex global interdependencies developed. As a consequence national economies became interlinked globally. This interdependence did not result in positive gains only; it can also lead the entire world economy into turmoil if one economy malfunctions. This happened when the initial US housing market crisis in 2007 became a world financial crisis in 2008/2009 with effects in the real economy (Claessens et al. 2010, Didier et al. 2010). The world economy experienced one of the broadest, deepest, and most complex crises since the Great Depression and it lead to a severe decline in trade relative to GDP unobserved since 1929, that came to be called “the great trade collapse” (Baldwin 2009).

The link between the economic crisis and the decline in international trade is a complex one. The following study treats a financial crisis as an exogenous event. Previous studies suggest a negative relationship between the financial crisis and international trade. A consensus has emerged regarding the causes and effects of the recent financial crises on international trade, but some contradictions remain. While some studies emphasize the role that declining overall demand had on decreasing trade flows downplaying or rejecting the effect trade finance might have had, others point out the particular importance trade finance has for international trade especially in times of financial turmoil. And yet other studies bring forth a compositional argument, highlighting the fact that trade is composed of very different commodities and sectors, which might react differently to a financial crisis. The internationalisation of production chains, so called vertical linkages, was mentioned as one key factor in the massive trade decline.

Our study tries to provide additional insight into the question of the impact of the financial crisis on international trade and its measurement by adding the

element of focusing on goods relevant to the internationalisation of production chain and analysing trade declines during financial crisis in a global setting in a historical comparison. The paper is related to the empirical gravity approach trade literature analysing the effect of the financial crisis. It sets out to examine the underlying factors driving the trade slump in 2008/2009 using a gravity type trade flow model incorporating country specific characteristics and including external shocks. The analytical framework is based on a recent study by Berman et al. (2012) and by adding the element of disaggregated trade flows the study hopes to bring forth new evidence on the way the financial crisis affected trade this time around.

In the following section the related literature will be reviewed. In section 3 the effects of financial crises on international trade are discussed and causes and causalities are addressed leading to testable hypotheses. Section 4 will describe the theoretical approach of the standard gravity model, the estimation method applied and the data used. Section 5 will present and evaluate the empirical results. Section 6 will conclude.

## **2. Literature review**

The recent financial crisis kindled a series of studies on financial, banking and economic crisis. An extraordinary example of providing longitudinal research on cycles of debt, financial, currency and sovereign debt crises is made by Reinhart/Rogoff (2011), who also provide a publicly accessible data set dating back to the 19<sup>th</sup> century. Before the economic and financial crisis in 2008/2009 the scientific examination of the relationship between financial crises and trade as a whole was rather sparse. An anthology of essays, edited by Baldwin (2009), offers a good overview on the subject of trade decline in the recent financial crisis. According to Baldwin's calculations, the decrease in trading volume for the second quarter 2008 to second quarter 2009 was 20 per cent and for some countries even 30 per cent.

Frictions in trade finance and the drying up of trade credit during the financial crisis are suspected to have an effect on the trade collapse (see Chor/Manova 2012). Studies that focus particularly on trade finance during financial crises usually have a strong regional focus on global banking centres, or are country specific for well developed countries (see Amiti/Weinstein 2010).

Bricongne et al. (2012) also examine the compositional effect of external finance on trade with French firm level data and find that the firms more dependent on external finance are more affected by the crisis. More or less all studies find strong support that vertical linkages are quantitatively important in understanding the global trade collapse. Global production patterns can thus be expected to explain part of the massive decline in international trade this time around, because the international supply chain intensified over the last couple of decades. The sensitivity of trade towards output has increased over time and an underlying reason for this could be the growing share of certain goods, which react in a more volatile way to economic frictions than total output (Engel/Wang 2011). International production sharing or vertical specialisation leaves trade reactions increasingly sensitive to changes in the costs of international trade. Furthermore empirical studies distinguish between differentiated and non-differentiated goods and find that this distinction is crucial for understanding the extent to which price declines contributed to the decline in trade values.

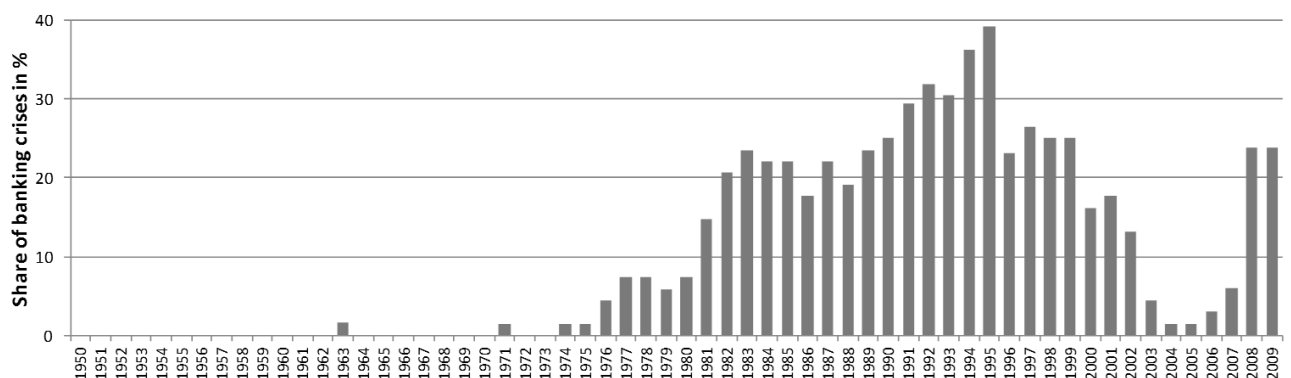
Only very few studies applied the gravity approach to examine the trade collapse during 2008/2009; although the gravity approach has proved very useful in the past with explaining about 80 per cent of the variance of trade flows. An exceptional study by Berman et al. (2012) analyzes the effect of the recent financial crisis on international trade covering the whole post-war era on a global scale and using a gravity-based approach. The fall in trade caused by financial crises is magnified by the time-to-ship goods between the origin and the destination country. The authors strongly suggest that financial crises affect trade not only through demand but also through financial frictions that are specific to international trade.

Globalisation and the internationalisation of production patterns of some traded goods, however, have not been fully addressed by this study although previous studies suggest an important role of these for international trade. A study of Eaton et al. (2011) includes also an element of the gravity model to calculate an indicator of trade frictions between individual countries. They come to the conclusion that the bulk of the decline in trade relative to GDP may be explained by shocks in the industrial demand for goods (80%), and it is only in some countries like in China and Japan, that trade decline can be explained to a large extent by increased trade frictions. The importance of the decline in demand is also emphasized by empirical studies.

### 3. The effects of the financial crisis on international trade

The years directly after World War II were remarkably tranquil and marked by the quasi-absence of banking crises. If financial crises emerged at all, they were strictly currency crises. The Bretton Woods Agreements and the gold exchange standard stabilized global economic frictions. The fixation of countries exchange rates relative to the US-dollar was abandoned in 1971. Since then banking crises were more frequent and the share of countries experiencing banking crises was rapidly increasing (see Figure 1 below).

Figure 1: Share of banking crisis in the post-war period (1950-2009)

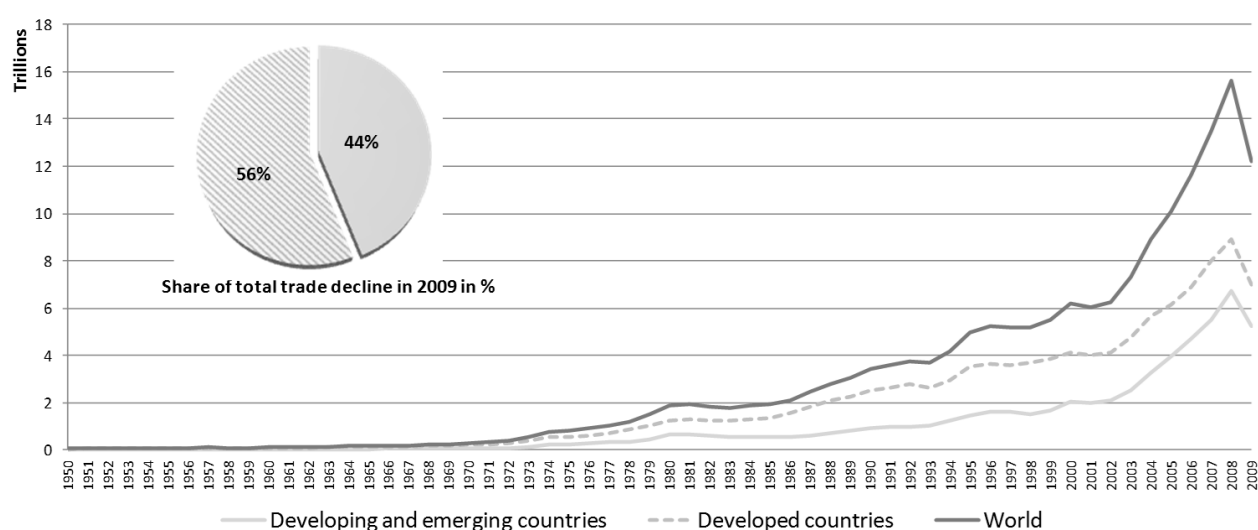


Source: Authors calculation (based on Reinhart/Rogoff (2011))



The crisis in Latin America of the 1970's and 1980's, the Japanese banking crisis in the early 1990's, the European and the Asian financial crises are well visible as peaks. The impetus of the share of countries experiencing banking crises in 2008/2009 came after a period that was relatively calm compared to the last ten years. The crisis had a tremendous effect on international trade. Even though the global economy has seen financial crises before 2008/2009, international trade declined for the first time after fifty years of more or less continuously rising trade volumes. In 2009 both developed and developing and emerging countries were experiencing trade declines, but developed countries had a relatively higher share in the decline of the total global trade drop (see Figure 2).

Figure 2: Import flows 1950-2009 for developing, emerging and developed countries in trillion US\$ and their share in the trade collapse in 2009, in per cent

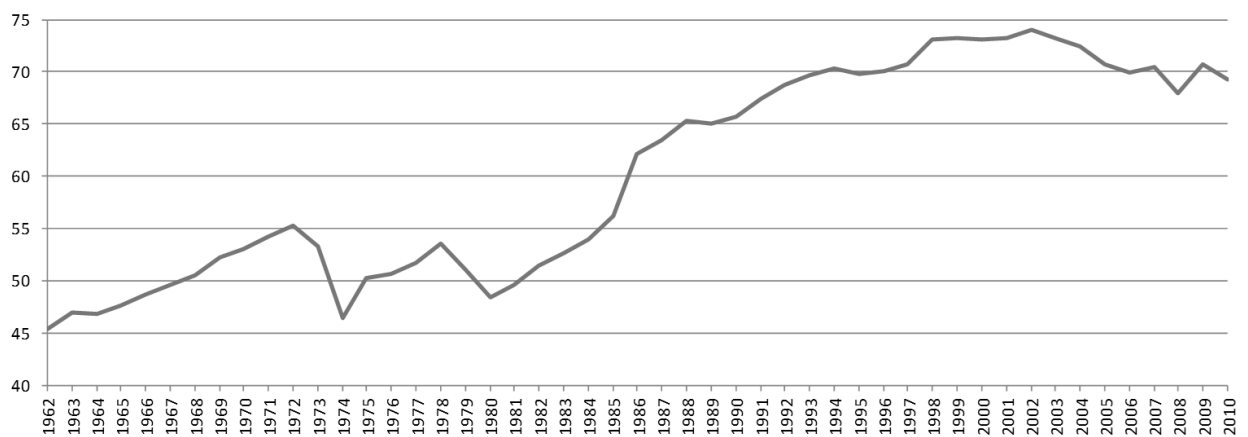


Source: Authors calculation (based on IMF DOTS)

The decline in trade flows was tremendous and on a global scale. Almost all countries experienced declines in exports and imports. Even though developed countries accounted for the larger share of the total trade decline in 2009, some developing and emerging countries' exports were also hit hard during the financial crisis.

Previous literature suggests that the internationalization of production chains could account for the increased volatility of international trade this time around. The importance of vertical linkages and the global production chain is well visible when looking at the share of differentiated goods<sup>1</sup> in total trade. The share of differentiated goods has increased dramatically in the last fifty years. In the early 1960's their share in total imports was just over 45 per cent and reached a peak in the early 2000's with over 72 per cent of all imports (see Figure 3 below).

Figure 3: Share of differentiated goods of all imports (1962-2010), in per cent

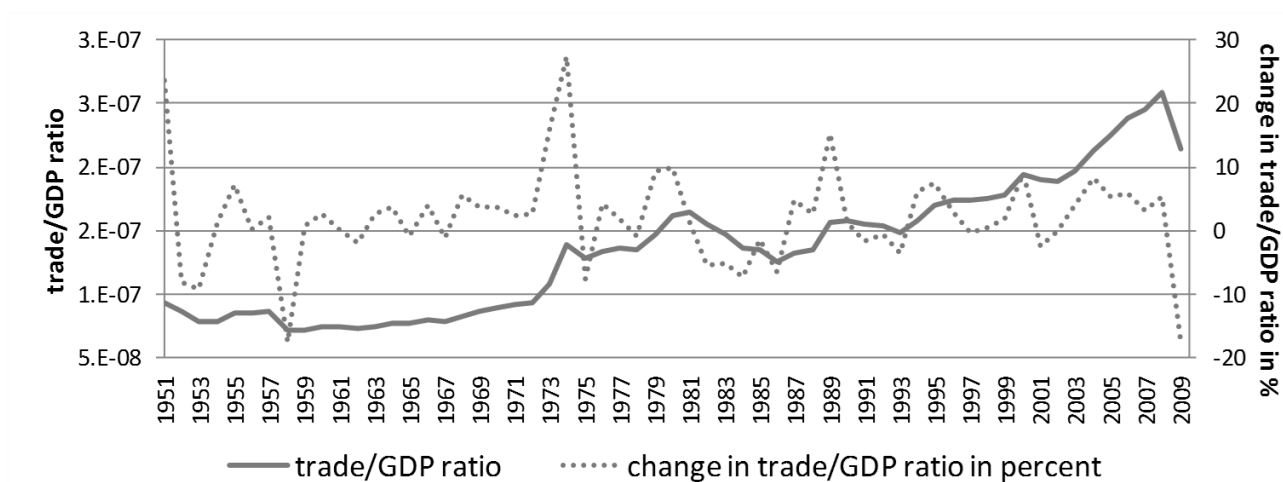


Source: Authors calculation (based on UN COMTRADE and Rauch (1999))

A decline in international trade is only natural when global income declines. What is important to keep in mind is the fact that trade declined so much more than GDP in 2008/2009. As can be seen in Figure 4 below the absolute decline of trade relative to GDP was unprecedented in post-war history, although the year 1958 had seen a similar relative decline of around 17 per cent.

<sup>1</sup> The definition of differentiated goods follows Rauch's (1999) conservative definition.

Figure 4: Evolution of global trade/GDP-ratio (1950-2009)



Source: Authors calculation (based on IMF DOTS and CEPII gravity dataset update)

Besides GDP there are of course other indicators for trade promotion and trade disruption, which need to be considered when analysing the trade decline of 2008/2009. Taking into account the behaviour of trade flows it is possible to carve out the main possible factors, in which international trade was affected by financial crisis. The OECD (2010) describes three direct ways how the financial crisis affected international trade. International trade is affected by the financial crisis through:

- 1) Global demand and income
- 2) Trade finance
- 3) Composition of internationally traded goods

In light of the literature review a fourth channel of how financial crisis affects trade can be added. The way in which goods traded react to financial crisis also depends on the:

- 4) Level of economic development for exporting countries

### 3.1 The income effect

To start with the financial crisis affects international trade indirectly through reduced consumption and therefore through the decline in demand for goods (Eaton et al. 2011). With a declining demand for foreign goods, fewer imports are purchased and fewer exports are sold. The drop in demand has significantly contributed to the drop in trade but it cannot explain it fully. Thus the decrease of income due to the financial crisis is only one factor in why international trade declined.

### 3.2 The trade finance effect

In addition to the income effect the financial crisis has had a direct effect on trade finance. Competent financial services are important for international trade (see, for example, Broll et al. 2001). During the financial crisis the sensitive cooperation of international financial service was severely disturbed and this affected international trade. Thus the price increase in trade financing or the absence of it has led to a decrease in global trade flows. This holds especially for developing countries which might have suffered from increased risk perception and therefore more expensive trade finance (Berman et al. 2012). Information on detailed trade finance on a global scale is very difficult to obtain, especially for emerging and developing countries with less integrated and less developed banking and financial systems. In response to the dearth of information on trade finance, the International Monetary Fund (IMF) has undertaken a survey of major developed countries' and emerging markets' banks. According to the IMF (2009a, 2009b) several banks reported sharp increases in the cost of trade finance – 70 % of the surveyed banks reported that the price for trade finance services has increased. Studies that use proxies find some evidence that a stronger dependence on trade finance has a negative effect on countries' exports in times of financial crises.

### 3.3 The trade compositional effect

A World Bank survey indicates that the biggest financing constraint particularly for firms operating in global supply chains is not access to trade credit (e.g. letters of credits) per se, but rather pre-export finance. Differentiated goods are

therefore more demanding in terms of (pre-) finance structures, making them particularly vulnerable to a financial crisis. This observation brings to mind that a crisis might affect exports within global supply chains or with vertical linkages in a more severe way than other goods, because in times of crisis they require specific financial provisions, which they otherwise would not need and which are even harder to come by in times of financial turmoil.

The disproportionate fall in outputs and trade of differentiated goods has contributed to the trade collapse, because differentiated goods make up a larger share of trade than of GDP. Differentiated goods account for the majority of trade flows today and are particularly vulnerable to global frictions through their linkages in the global production chain. Thus the composition of international trade has led to a distinctive decline of flows during the financial crisis.

### 3.4 The economic development level effect

The way international trade reacts to financial crisis depends on the economic development level of the exporting country. Developing countries can be more dependent on trade exports relative to their GDP than developed economies. A trade slump therefore can have an amplified affect for developing countries. Available data indicates that trade in some regions – Asia, Middle East and Northern Africa and South America – was more severely impacted by changes in short-term trade finance than other regions (Europe and North America). This may be due to the fact that some countries in these regions were considered higher risk, or their level of risk was re-evaluated after the onset of the crisis and thus due to increasing trade finance prices it became unaffordable for those countries. On the other hand the lack of integration with the international financial system could have been a blessing in disguise in protecting developing and emerging countries against negative chain reactions and providing those countries with a regional advantage and a gain in a competitive edge that would lead to a lesser decline in trade and faster recovery (see e.g. Didier et al. 2011).

The compositional effect of international trade is also quite different regarding the level of economic development. In general developing countries' exports

differ from the exports of developed countries. If differentiated goods have a higher elasticity than other exports developing countries might react differently compared to developed countries in times of crisis.

From these different ways (3.1-3.4) in which financial crises affect international trade certain expectations for the empirical results can be formulated through the following hypotheses:

H<sub>0</sub>: Financial crises have in general a negative impact on international trade.

H<sub>1</sub>: Financial crises are not tangent to international trade due to the income effect alone.

H<sub>2</sub>: Trade finance has played a role in trade disruption.

H<sub>3</sub>: a) Differentiated goods are more sensitive to financial frictions and decline more strongly during financial crises.

b) Because the share of differentiated goods has increased in the last decades the impact of the financial crisis in 2008/2009 is different compared to other financial crises before.

H<sub>4</sub>: Because emerging and developing countries differ in trade composition, access to trade finance and the importance of trade for GDP their trade flows are affected in a different way during financial crises.

#### **4. Gravity trade equation, estimation method and data**

Gravity has long been one of the most successful models in empirical economics (Anderson/van Wincoop (2004, 2010)). The gravity equation is fundamentally about inferring trade costs in a setting where much of what impedes trade is not per se observable to the econometrician, because there is only limited information on direct measures of trade costs<sup>2</sup>. However observable are trade flows and proxies for different types of trade costs.

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<sup>2</sup> For a comprehensive and up to date introduction of the theories behind the gravity model see Head and Mayer (2013).

The gravity model to explain trade flows stating that trade flows depend positively on the GDP of trading partners (as a measure of economic size) and negatively on geographical distance (as a proxy for transaction costs):

$$force\ of\ trade = \frac{G[Y_i Y_j]}{dist_{i,j}^{(elasticity-1)}}, \text{ where } G \equiv \left(\frac{1}{\Omega_i}\right) \left(\frac{1}{P_j^{1-elasticity}}\right). \quad (1)$$

Where  $Y_i$  ( $Y_j$ ) is the GDP of country  $i$  and  $j$ .  $P_j$  is country  $j$ 's price index and  $\Omega_i$  a proxy to what is called 'market potential' in the economic geography literature (often measured by the sum of its trade partners GDPs divided by bilateral distance). It is a mnemonic for 'openness' of  $i$ . Here  $G$  is the 'gravital un-constant', because it varies over time (price and GDP changes). This is what Anderson/van Wincoop called the multilateral trade resistance. Two countries ( $i$  and  $j$ ) exchange more bilateral trade the bigger the two countries are and less the further they are away from one another. The average elasticity of international trade is estimated close to unity to around 0.9 says a meta-study by Disdier/Head (2008) on standard gravity estimations.

A structural gravity model has the following general form:

$$X_{ij} = \frac{Y_i Y_j}{Y_w} \left( \frac{t_{ji}}{P_i P_j} \right)^{1-\sigma}. \quad (2)$$

The volume of exports  $X_{ij}$  of a country  $i$  to country  $j$  in equation (2) is explained by the relative size of the exporter (measured as a proportion of income  $Y_i$ ), the importer (measured as a proportion of income  $Y_j$ ) and of the world GDP  $Y_w$ . In addition, exports  $X$  depend on the bilateral trade cost  $t_{ji}$ , which are set in relation to all trade barriers of international trade as price indices of the respective trading partners  $P_i$  and  $P_j$ . The elasticity of substitution between different types of goods is recognized by  $\sigma$ .

The unobservable trade cost factor  $t_{ij}$  can be formulated as a log-linear function of observable characteristics, namely as the bilateral distance  $d_{ij}$  and whether there is an international border  $b_{ij}$  between  $i$  and  $j$ . Including this function into equation (2) yield to the logarithmic theoretical gravity equation:

$$\ln(X_{ij}) = \alpha + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \rho \ln(d_{ij}) + \beta_4 \ln(b_{ij}) - \beta_5 \ln(P_i) - \beta_6 \ln(P_j) + \varepsilon_{ij} \quad (3)$$

where  $\alpha$  is a constant,  $\beta$  is  $(1-\sigma)$  and  $\varepsilon$  represents the normally distributed error term. Equation (3) is expanded by adding other factors to the trade cost as dummy variables such as common language, common currency, free trade union member, currency unions, common border etc. The fact that history played a role in shaping trade relationships can also be accounted for by including colony dummies, controlling for a same colonizer, similarities in religion and legal system and military conflicts (see Martin et al. (2008), Head et al. (2010)).

#### Estimation Method

A consensus has emerged in gravity literature to use fixed effects (FE) for panel trade flows. According to the literature replacing the remoteness variable with exporter and importer dummies to proxy for multilateral resistance terms is the ‘correct specification’ of the gravity model. Exporter and importer dummies will be added to equation (3) and the estimations will also be made for country-pair dummies in addition. To measure the effect that banking crises have on trade flows a further adjustment to equation (3) has to be made. A dummy variable for banking crises is introduced, which takes one when a banking crisis has occurred in the importing country at time  $t$ .

$$\ln(X_{ijt}) = \alpha + \beta_1 \ln(Y_{it}) + \beta_2 \ln(Y_{jt}) + \beta_3 \rho \ln(d_{ij}) + \beta_4 \ln(b_{ij}) + \beta_5 \ln(RER_{ijt}) + \beta_6 (T_{ijt}) + \beta_7 BC_{jt} + \beta_8 (\text{developing country}_{ij}) + \mu_{ij} + \varepsilon_{ijt} \quad (4)$$

where  $T_{ijt}$  stands for a set of time-varying bilateral controls (like regional trade agreements, colonial relationships, currency unions etc). Because for a large



sample of countries, representative price indexes are not available the best alternative is to use real exchange rate (RER) indexes.  $RER_{ijt}$  is the bilateral real exchange rate between country  $i$  and  $j$ ; fixed effects are included with  $\mu_{ij}$ . This allows controlling for all time independent country specific characteristics which might influence the bilateral trade relation.

The second dummy introduced in equation (4) is the level of development for the partner's economy. To assess whether the financial crisis in the importing country has a different effect on developing and emerging countries an interaction effect of the financial crisis dummy and the level of economic development dummy is included in the estimation (see Berman et al. 2010). Effect of banking crisis on trade is expected to be negative. It is not quite clear however how exports from developing and emerging countries are affected by the banking crises, because theory argues in both ways. It is however assumed that they have a different reaction to banking crises than developed countries.

It is assumed that differentiated goods are more prone to the effects of financial crises. Therefore equation (4) will also be estimated separately for exports of differentiated goods only. The negative effect of banking crisis on trade is expected to be stronger for differentiated goods. Looking at the banking crises before the global financial crises in 2008 and the recent crises separately will allow making inference about the different impact the financial crisis had on trade this time around.

## Data

Trade data comes from two sources. Aggregated trade flows come from the International Monetary Fund Direction of Trade Statistic (IMF DOTS) dataset, which covers the trade flows of almost all country pairs of the world from 1949 onwards. Reported bilateral imports by the importing countries will be used. Disaggregated trade flows come from the UN COMTRADE. The data is transformed in a series of steps to match the classification of disaggregated

goods provided by Rauch (1999)<sup>3</sup>. The data for banking crisis comes from Reinhart/Rogoff (2011). A period from 1950 until 2009 is used. The occurrence of a banking crisis for a given year is marked by a binary variable for up to 69 different countries. Banking crisis are defined by two types of events: (i) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions; or (ii) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institutions.

Gravity relevant variables come from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) Gravity Dataset which is publicly available and covers the period from 1948-2006. The forthcoming updated version until 2009 will be used for the estimations below. The definition for developed countries versus developing and emerging countries come from the United Nations Statistics Division (UN STATS)<sup>4</sup>. There are two final data sets used for the following estimations. One is based on the IMF DOTS trade flows and consists of 69 importing countries and 206 exporting countries from 1950 to 2009 and the second data set consists of 68 importing countries and 198 destination countries from 1962 to 2009. The lower number of importing countries for both datasets is due to the limited data of banking crises.

## 5. Empirical Results

Estimation results for equation (3) for the two different datasets are shown in Table 1 (see below). The overall fit is promising (with  $R^2$  from 0.70 to 0.89). All the variables have the expected sign and plausible values. As suggested by the theory, the elasticity of trade with respect to income is significant and close to unity. Column 1 and 5 display the estimation results for the full sample available of the IMF DOTS bilateral export flows. The first column is estimated with exporter and importer fixed effects and column 5 is estimated with country-pair fixed effects. The time invariant variables are therefore omitted in the country-

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<sup>3</sup> On request the authors can provide more detailed information about this procedure.

<sup>4</sup> <http://unstats.un.org/unsd/methods/m49/m49regin.htm>

pair fixed effects estimations in the columns 5 to 8. Column 2 and 6 show the estimates for the full sample available for UN COMTRADE bilateral export data. Column 3 and 7, 4 and 8 present the results for the sample available for both IMF DOTS and UN COMTRADE respectively. The estimations coefficient values for the same observation of years and trading partners slightly differ for IMF DOTS and UN COMTRADE bilateral export data, but they correspond in sign and magnitude.

Table 1: Gravity trade model for export flows

	IMF DOTS	UN COMTRADE	IMF DOTS same	UN COMTRADE same	IMF DOTS	UN COMTRADE	IMF DOTS same	UN COMTRADE same
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lngdp_o	0.923*** (0.000)	0.856*** (0.000)	1.085*** (0.000)	0.929*** (0.000)	0.852*** (0.000)	0.844*** (0.000)	0.961*** (0.000)	0.888*** (0.000)
lngdp_d	0.816*** (0.000)	0.837*** (0.000)	0.835*** (0.000)	0.890*** (0.000)	0.777*** (0.000)	0.780*** (0.000)	0.844*** (0.000)	0.811*** (0.000)
Indistw	-1.046*** (0.000)	-1.307*** (0.000)	-1.094*** (0.000)	-1.199*** (0.000)				
lnexchange_rate_o_d	0.007*** (0.000)	-0.002 (0.407)	0.005*** (0.006)	-0.000 (0.907)	-0.005*** (0.000)	-0.002 (0.297)	-0.006*** (0.000)	-0.001 (0.455)
contig	0.532*** (0.000)	0.480*** (0.000)	0.479*** (0.000)	0.454*** (0.000)				
comcur	0.303*** (0.000)	0.101 (0.126)	0.050 (0.322)	0.062 (0.345)	0.442*** (0.000)	-0.019 (0.614)	0.181*** (0.000)	-0.021 (0.539)
rta	0.494*** (0.000)	0.092*** (0.000)	0.343*** (0.000)	0.219*** (0.000)	0.575*** (0.000)	0.342*** (0.000)	0.423*** (0.000)	0.357*** (0.000)
comlang_off	0.557*** (0.000)	0.658*** (0.000)	0.555*** (0.000)	0.620*** (0.000)				
comcol	0.359*** (0.000)	0.267*** (0.000)	0.353*** (0.000)	0.100** (0.033)				
curcol	1.040*** (0.000)	1.157*** (0.000)	0.886*** (0.000)	1.645*** (0.000)	0.236** (0.028)	0.923*** (0.000)	0.474** (0.016)	1.382*** (0.000)
cursib	1.520*** (0.000)	0.405 (0.454)	0.822*** (0.001)	1.560*** (0.000)	1.509*** (0.004)	1.283*** (0.003)	1.057*** (0.000)	2.002*** (0.000)
comrelig	0.406*** (0.000)	0.390*** (0.000)	0.435*** (0.000)	0.351*** (0.000)				
comleg_posttrans	0.224*** (0.000)	0.159*** (0.000)	0.215*** (0.000)	0.208*** (0.000)				
Observations	317,045	271,210	218,652	218,652	317,114	271,210	218,652	218,652
R <sup>2</sup>	0.703	0.766	0.734	0.761	0.836	0.879	0.869	0.887
Exporter and importer fixed effects	Yes	Yes	Yes	Yes	No	No	No	No
Country-pair fixed effects	No	No	No	No	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses, clustered by destination-year, with \*, \*\*, and \*\*\* respectively denoting significance at the 1%, 5% and 10% levels. Year dummies are included in all estimations.

Source: IMF DOTS, UN COMTRADE, Reinhart/Rogoff (2011) CEPII Gravity dataset (update); author's estimation

The following estimations will exploit the richness of the full samples available respectively, keeping in mind that IMF DOTS covers a longer time span – 12 years more – than the UN COMTRADE data.

Table 2 below displays the estimation results for equation (4). The estimated coefficient of the banking crisis dummy variable is only significant for columns (5) and (6), where the coefficient is negative as expected and its magnitude is in line with previous studies (Berman et al. 2012). A dummy variable included for

developing and emerging countries reveals a positive and significant effect, meaning that more trade volumes involve emerging and developing countries as an importing or exporting partner. When the estimations include an interaction effect of the dummy for developing or emerging countries and the financial crisis an interesting effect becomes visible. Exports involving only developed countries are more negatively impacted by banking crises than exports for trading partners involving developing and emerging countries.

Table 2: The effect of banking crises on exports

	IMF DOTS	UN COMTRADE	IMF DOTS	UN COMTRADE	IMF DOTS	UN COMTRADE	IMF DOTS	UN COMTRADE	IMF DOTS	UN COMTRADE	IMF DOTS	UN COMTRADE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
lngdp_o	0.923*** (0.000)	0.856*** (0.000)	0.907*** (0.000)	0.844*** (0.000)	0.905*** (0.000)	0.844*** (0.000)	0.852*** (0.000)	0.844*** (0.000)	0.852*** (0.000)	0.844*** (0.000)	0.852*** (0.000)	0.844*** (0.000)
lngdp_d	0.816*** (0.000)	0.837*** (0.000)	0.815*** (0.000)	0.841*** (0.000)	0.809*** (0.000)	0.840*** (0.000)	0.777*** (0.000)	0.780*** (0.000)	0.777*** (0.000)	0.780*** (0.000)	0.777*** (0.000)	0.780*** (0.000)
lndistw	-1.046*** (0.000)	-1.307*** (0.000)	-1.148*** (0.000)	-1.410*** (0.000)	-1.163*** (0.000)	-1.414*** (0.000)						
lnexchange_rate_o_d	0.007*** (0.000)	-0.002 (0.406)	0.005*** (0.003)	-0.003 (0.170)	0.005*** (0.003)	-0.003 (0.166)	-0.005*** (0.000)	-0.002 (0.297)	-0.005*** (0.000)	-0.002 (0.297)	-0.005*** (0.000)	-0.002 (0.297)
contig	0.532*** (0.000)	0.480*** (0.000)	0.495*** (0.000)	0.435*** (0.000)	0.474*** (0.000)	0.428*** (0.000)						
comcur	0.303*** (0.000)	0.101 (0.126)	0.347*** (0.000)	0.180*** (0.002)	0.373*** (0.000)	0.195*** (0.001)	0.442*** (0.000)	-0.019 (0.614)	0.442*** (0.000)	-0.019 (0.614)	0.441*** (0.000)	-0.019 (0.613)
rta	0.494*** (0.000)	0.092*** (0.000)	0.639*** (0.000)	0.289*** (0.000)	0.667*** (0.000)	0.305*** (0.000)	0.575*** (0.000)	0.342*** (0.000)	0.575*** (0.000)	0.342*** (0.000)	0.575*** (0.000)	0.342*** (0.000)
comlang_off	0.556*** (0.000)	0.658*** (0.000)	0.519*** (0.000)	0.611*** (0.000)	0.511*** (0.000)	0.608*** (0.000)						
comcol	0.359*** (0.000)	0.267*** (0.000)	0.470*** (0.000)	0.390*** (0.000)	0.472*** (0.000)	0.391*** (0.000)						
curcol	1.040*** (0.000)	1.157*** (0.000)	1.034*** (0.000)	1.141*** (0.000)	1.057*** (0.000)	1.151*** (0.000)	0.236** (0.028)	0.923*** (0.000)	0.236** (0.028)	0.923*** (0.000)	0.236** (0.028)	0.923*** (0.000)
curtib	1.520*** (0.000)	0.405 (0.453)	1.564*** (0.000)	0.411 (0.467)	1.569*** (0.000)	0.413 (0.464)	1.509*** (0.004)	1.283*** (0.003)	1.509*** (0.004)	1.283*** (0.003)	1.509*** (0.004)	1.283*** (0.003)
comrelig	0.406*** (0.000)	0.390*** (0.000)	0.477*** (0.000)	0.460*** (0.000)	0.476*** (0.000)	0.459*** (0.000)						
comleg_posttrans	0.224*** (0.000)	0.159*** (0.000)	0.227*** (0.000)	0.168*** (0.000)	0.220*** (0.000)	0.165*** (0.000)						
banking_crisis_d	-0.026 (0.728)	-0.098 (0.111)	-0.030 (0.686)	-0.094 (0.129)	-0.532*** (0.000)	-0.316*** (0.000)	-0.010 (0.851)	-0.013 (0.776)	-0.010 (0.851)	-0.013 (0.776)	-0.085 (0.132)	-0.035 (0.533)
developingcountries			1.049*** (0.000)	1.169*** (0.000)	0.704*** (0.000)	1.021*** (0.000)						
BKdDevel					0.621*** (0.000)	0.274*** (0.000)					0.092 (0.275)	0.027 (0.722)
Observations	317,045	271,210	317,045	271,210	317,045	271,210	317,114	271,210	317,114	271,210	317,114	271,210
R <sup>2</sup>	0.703	0.766	0.707	0.771	0.707	0.771	0.836	0.879	0.836	0.879	0.836	0.879
Exporter and importer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Country-pair fixed effects	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses, clustered by destination-year, with \*, \*\*, and \*\*\* respectively denoting significance at the 1%, 5% and 10% levels. Year dummies are included in all estimations.

Source: IMF DOTS, UN COMTRADE, Reinhart/Rogoff (2011) CEPII Gravity dataset (update); author's estimation

The interaction effect of banking crisis and developing countries is statistically significant and strongly positive both for the estimations with IMF DOTS data and with UN COMTRADE data. The coefficient for banking crises when controlled for the level of economic development and the interaction effect becomes statistically significant and is of economic relevance with a negative impact on exports between –27.1 per cent and –41.3 per cent.

When the estimations of Table 2 are replicated for differentiated goods only (results not displayed but available upon request) the negative effect for banking crisis gets even larger (–32.4 per cent compared to –27.1 per cent). This is probably not only due to the fact that differentiated goods react more vulnerable to financial frictions than homogenous goods, but also due to the fact that developing and emerging countries are relatively more involved in the trade of homogenous goods than developed countries.

When the banking crises dummy is split into two variables (a dummy for the recent crisis and a dummy for the previous banking crises) following the approach by Berman et al. (2012) the results support the hypothesis that the effect on trade of the recent crisis was different compared to previous crises (results not displayed but available upon request). The financial crises prior to 2008 had no statistically significant effect. However for aggregated export flows a statistically significant negative effect of the recent financial crisis on exports between –25.2 per cent and –26.8 per cent is estimated and the effect on differentiated goods of the recent financial crisis is even 10 per cent higher. When controlled for the level of economic development for the trading partner this effect becomes more pronounced. For differentiated goods however both effects of the financial crises are magnified. For the previous financial crises a significant decreasing effect on trade of –31.3 per cent is estimated. The effect for the recent financial crisis is still larger (–47.7 per cent).

Table 3 below shows result from testing the income effect on trade during a financial crisis. We use an additional dummy variable for the income effect. The dummy variable used in the estimations presented in Table 3 takes 1 when the global GDP grew less than 3 percent in one year following the standard classification of a recession by the IMF.

Table 3: Banking crises, GDP slowdown and level of economic development

	IMF DOTS		UN COMTRADE		UN COMTRADE differentiated goods	
	(1)	(2)	(3)	(4)	(5)	(6)
lngdp_o	0.906*** (0.000)	0.904*** (0.000)	0.844*** (0.000)	0.844*** (0.000)	0.994*** (0.000)	0.993*** (0.000)
lngdp_d	0.815*** (0.000)	0.809*** (0.000)	0.841*** (0.000)	0.840*** (0.000)	0.950*** (0.000)	0.949*** (0.000)
Indistw	-1.150*** (0.000)	-1.164*** (0.000)	-1.410*** (0.000)	-1.414*** (0.000)	-1.537*** (0.000)	-1.543*** (0.000)
lnexchange_rate_o_d	0.005*** (0.003)	0.005*** (0.004)	-0.003 (0.170)	-0.003 (0.166)	-0.013*** (0.000)	-0.013*** (0.000)
contig	0.501*** (0.000)	0.481*** (0.000)	0.435*** (0.000)	0.428*** (0.000)	0.485*** (0.000)	0.475*** (0.000)
comcur	0.342*** (0.000)	0.368*** (0.000)	0.180*** (0.002)	0.195*** (0.001)	0.312*** (0.000)	0.336*** (0.000)
rta	0.635*** (0.000)	0.663*** (0.000)	0.289*** (0.000)	0.305*** (0.000)	0.259*** (0.000)	0.283*** (0.000)
comlang_off	0.519*** (0.000)	0.511*** (0.000)	0.611*** (0.000)	0.608*** (0.000)	0.704*** (0.000)	0.699*** (0.000)
comcol	0.469*** (0.000)	0.471*** (0.000)	0.390*** (0.000)	0.391*** (0.000)	0.485*** (0.000)	0.486*** (0.000)
curcol	1.034*** (0.000)	1.057*** (0.000)	1.141*** (0.000)	1.151*** (0.000)	1.227*** (0.000)	1.242*** (0.000)
cursub	1.565*** (0.000)	1.569*** (0.000)	0.411 (0.467)	0.413 (0.464)	-0.070 (0.920)	-0.067 (0.923)
comrelig	0.478*** (0.000)	0.477*** (0.000)	0.460*** (0.000)	0.459*** (0.000)	0.538*** (0.000)	0.537*** (0.000)
comleg_posttrans	0.228*** (0.000)	0.221*** (0.000)	0.168*** (0.000)	0.165*** (0.000)	0.165*** (0.000)	0.161*** (0.000)
banking_crisis_d	-0.031 (0.669)	-0.534*** (0.000)	-0.094 (0.129)	-0.316*** (0.000)	-0.051 (0.436)	-0.391*** (0.000)
globalgdpslowdown_d	-0.121 (0.195)	-0.122 (0.192)	-1.874*** (0.000)	-1.871*** (0.000)	-2.148*** (0.000)	-2.144*** (0.000)
developingcountries	1.046*** (0.000)	0.702*** (0.000)	1.169*** (0.000)	1.021*** (0.000)	0.766*** (0.000)	0.539*** (0.000)
BKdDevel		0.620*** (0.000)		0.274*** (0.000)		0.419*** (0.000)
Observations	315,890	315,890	271,210	271,210	271,210	271,210
R <sup>2</sup>	0.707	0.707	0.771	0.771	0.798	0.798

Note: Robust standard errors in parentheses, clustered by destination-year, with \*, \*\*, and \*\*\* respectively denoting significance at the 1%, 5% and 10% levels. Year dummies are included in all estimations. Only exporter and importer fixed effects reported.

Source: UN COMTRADE, Rauch (1999), Reinhart/Rogoff (2011) CEPII Gravity dataset (update); author's estimation

The coefficient on the slowdown variable is significant and negative for the estimations made for the UN COMTRADE export aggregate and disaggregated data even when controlling for GDP. Thus exports are found to respond more negatively to large changes in world GDP. This result also holds when including interaction effects of the level of economic development and banking crisis. In addition to the negative effect of GDP slowdown on exports, the effect of financial crisis continues to be statistically significant and negative. This suggests that the statistically negative coefficient of banking crisis holds beyond a recession effect. Other components of financial crises, such as the disruption of trade finance, play an independent role. Since there is no valid data available on international trade finance, the specific factors other than GDP slowdown remain elusive.

The strong negative effect of the recent financial crisis and the higher volatility of trade for developed countries, generally trading more differentiated goods, can be interpreted as a support of the sector compositional hypothesis. The increased elasticity of trade flows due to vertical linkages and a therefore higher share of differentiated goods exported offers a good explanatory starting point. But a gravity model capturing vertical linkages and the increased vulnerability of international trade remains to be thoroughly developed theoretically and tested empirically.

## **6. Conclusion**

The financial crisis of 2008/2009 had severe consequences for international trade. The gravity model proves a valuable economic instrument for measuring the effect of financial crises on bilateral trade. It proved helpful in addressing the differences in country specific trade relations and the effect of financial crises over time. The negative effect of financial crises goes beyond the income effect. An important explanatory power for the negative effect of banking crises on trade is the period for which the financial crisis is observed and the level of economic development of the trading partners.

Especially developed countries seem to be effected more by a financial crisis than developing and emerging economy countries. The higher share of differentiated goods in exports traded by developed countries seems to be an explanatory factor for this phenomenon. Financial crises have a stronger negative effect on differentiated goods compared to overall export flows. The increasing share of differentiated goods in international trade (from 45 per cent in the early 1960's to just over 70 per cent in the eve of the 2008/2009 crisis) might be one possible reason for why the effect of the financial crises was so much stronger this time compared to other financial turmoil in recent economic history. The trading of differentiated goods suffered more during the financial crisis 2008/2009 with a statistical and economical significance of over 17 percentage points compared to aggregated trade flows. The level of economic development, factor specialisation and the globalisation of production chains

are all parts of the puzzle presented in attempting to explain the enormous negative effect that the recent financial crisis had on international trade flows.

What are the implications one can derive from this study's estimates of the effects of financial crises on international trade? Financial crises represent an increase in trading costs especially for those countries that usually seem to be better equipped with stable and secure trading relations. Maybe this is an answer in the puzzle of why exports involving developed countries as trading partners are so vulnerable to banking crises. Under normal circumstances they can build on well established networks and institutions that provide a well functioning framework for trade financing and international trading. In this state there is no need for the securitized and highly insured trade transactions that many countries, perceived to be at higher risk, have to provide in order to trade on the international market.

Perhaps the absence of a 'statutory' safety net was a major problem for exporters in developed countries. This remains however speculation as long as there is no global valid information on international trade finance. Differentiated goods are particularly vulnerable to financial crises, because of their complex pre-finance structures. It is therefore worthwhile thinking about extra financial provisional instruments for exports of this type, although an international coordination might be difficult to achieve. But because of the vulnerability of differentiated traded goods, as shown clearly in the analysis, and because of the increasingly complex international system that produces ever more in its global factory, it seems reasonable to promote trade financing and additional financing instruments for differentiated goods. The increasing globalisation of the financial markets leaves the financial system in peril of contagious crises and calls for such provisional action. Through its internationalisation it also offers a chance to provide it. If global financial crises cannot be avoided, it is important to at least minimize the increased cost that they present for international trade. This is of great consequence because decreasing



international trade flows have the potential to damage the economic situation even more and to increase the recession instigated by the financial crisis.

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