Direct and Indirect Crisis Effects on International Trade or: Is There a Chance to Employ an Income Stimulus to Stimulate Exports?

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While research concerning the fundamental connection between financial crises and international trade, at first appearance, provides conclusive results, it displays two specific methodological biases by ignoring income effects: first, crisis influence is underestimated; second, crisis dynamics do not take account of income dynamics, thereby giving the analysis a touch of avoidable incompleteness. This paper offers a solution to both problems without leaving the standard framework of the gravity model of trade. The solution is brought by a basic crisis adjustment technique of income. As an empirical test, the developed approach is employed to estimate the crisis response of German trade during the recent global crisis. Results correspond to consequences deducted from an elementary impact model for a quasi-non-crisis country: exports are mainly affected by non-income effects and foreign income effects; imports are influenced by domestic income and global non-income effects, and reveal expected dynamics. The outcome has two implications of interest for policy decisions: (i) stimulus spillovers can come back, and (ii) the indirect effect sensitivity of imports delivers a strong case for an international coordination of fiscal measures.

1 Introduction

Research on the connection between financial crises and international trade, nowadays, takes two directions. First, there is a question about a contagious effect—a crisis in one country causes a crisis in a second country—contingent on highly developed trade linkages and changes in relative prices. Corresponding results are ambivalent, viz.: on the grounds that trade and finance links are highly correlated, separating trade effects from finance effects is a complex undertaking.[1] Second, there is an issue about crisis influence on trade. At first glance, results in this research sector look obvious. At second glance, one can perceive a specific (methodological) bias.

To clarify this point: Abiad *et al.* (2011) investigate trade dynamics in economies experiencing a financial crisis (179 crisis episodes) in the period 1970–2009. The main findings are a negative long-term effect on real imports and no significant effects on real exports. Another reference study is Ma and Cheng (2005), who analyze banking and currency crises from 1981 until 1998. The results are akin to Abiad *et al.* (2011): banking crises lead up to a short-term reduction in imports and a rise in exports; and a currency crisis gives rise to a short-term reduction in imports *and* exports. These conclusions seem contra-intuitive or not-so-consistent for three reasons.

(i) Both studies employ a closed trade system. Imports and exports are complementary variables, e. g. a fall in imports in one country has to be accommodated by a fall in exports in another country. If reduced imports are induced by a financial crisis, so are reduced exports. In the first

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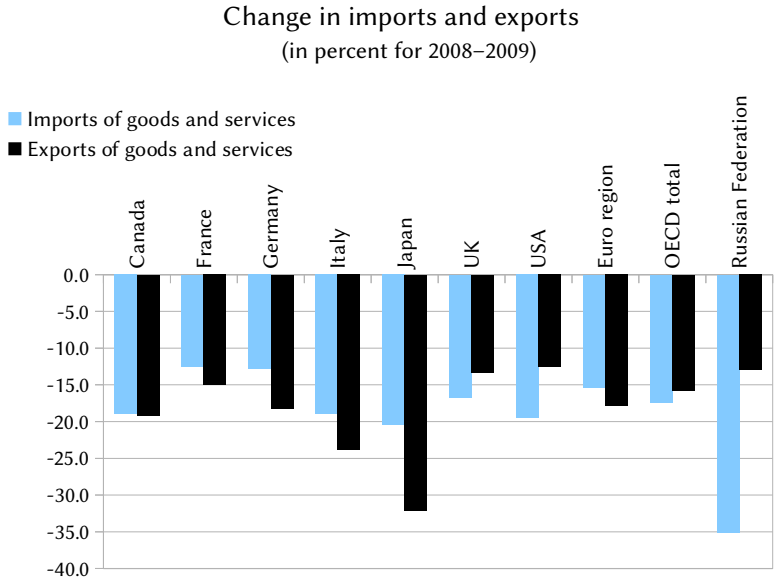
1 See Van Rijckeghem and Weder (2001) or—for an overview about methodology and results—Forbes (2002). In case of Forbes (2002), half of the six referenced studies (Eichengreen and Rose 1996; Glick and Rose 1999; Forbes 2000; Masson 1998; Baig and Goldfajn 1998; Harrigan 2000) speak against the significance of the contagious effect and the other half finds evidence for its relevance. Forbes' (2002) own conclusion is that crisis induced changes in international competitiveness and income effects can eventuate in crisis transfers.

place, exports in the crisis country might not be touched by the crisis but in general exports decline. Declining exports reduce income or: a trade effect is a *ceteris-paribus* income effect. Consequently, in the second place, exports in the crisis country should decline as well. So, why do exports stay constant or rise? (ii) In both estimations the authors control for income. This leads to the question: which type of effect is quantified? While Ma and Cheng (2005) do not explicitly answer this question, Abiad *et al.* (2011) regard the effect as abnormal trade behavior after crisis excluding output dynamics. However, altered output dynamics are an essential consequence of financial crises. Thus, the analysis is not complete. (iii) Apparently, there is an aggregation problem. Given results may hold for single crisis episodes in a particular country—which is debatable—but not for a global crisis. Even though in Abiad *et al.* (2011) the global crisis 2008–2009 is part of the data, study results contradict the actual crisis outcome, given in Figure 1. Worldwide, economies reacted with a reduction in exports by approximately 13% (USA and UK)



Source: OECD Factbook 2010

Figure 1: Development of exports and imports during the international financial crisis

to 32% (Japan) and a decrease in imports by 13% (France and Germany) to 35% (Russia), thereby displaying consistent properties regarding imports and exports.

The main argumentative line of this paper is that described inconsistencies and difficulties of interpretation occur due to examining only one type of crisis effects. Accordingly, a solution is brought by adding a second type of effects to the investigation: indirect or income effects. The following questions summarize the main focus: What kind of effects do matter? Is there empirical evidence for the dominance of one kind of effects over the other. Are imports and exports affected differently?

Against the background of rising exports and stagnating imports in financial crises, there is a policy (better: no-need-for-policy) story. This policy story is premised on an automatic counter-crisis mechanism and goes like this: a country with a financial crisis devaluates making exports more competitive and imports more expensive. On a short-term basis, there is no fundamental need for fiscal policy to gain (regain) international competitiveness; the exchange rate adjustment is a "natural" counter-crisis measure. Au naturel, every rule has an exception—in this case, there are at least two of them. First and trivially, in a currency union exchange rate adjustments are

not possible. Ordinarily, a fixed exchange rate requires to simulate a devaluation (often called an internal devaluation) by reducing nominal wages and prices. If wages are sticky, then this involves higher rates of unemployment—frequently accompanied by social frictions rooted in rejections of wage cuts by workers. Second, even if a country has its own currency a devaluation does not necessarily improve competitiveness in a *global* crisis. A trade rival may devalue more quickly because of a more severe crisis. If the trade partner is hit by the same crisis shock, then an adjustment might not take place at all. (All of this belongs to the aggregation problem.)

In settings with constrained currency instruments fiscal policy could take on a supportive role. Still, some preconditions must be fulfilled. First of all, fiscal measures have to alter aggregated income. Post hoc, the intrinsic income shock must be spread across countries. As Cooper and Kempf (2009) have shown, fiscal spillovers are unavoidable in a monetary union. Beetsma *et al.* (2005) established statistically significant spillover effects in Europe. (The transmission channel is trade.) As a second condition, there must be a cross-boarder feedback effect. What is meant by feedback is the last element of the following sequence: country 1 stimulates its income; income stimulation of 1 leads to a higher import demand of country 1 directed at country 2; country 2 expands exports to country 1; income in country 2 rises (a fiscal spillover); and import demand of country 2 directed at country 1 rises (stimulus feedback).

The feedback effect works independent from any currency mechanism, besides, it depends on income effects. Namely: by examining the relevance of income effects on trade, the importance of the stimulus feedback can be evaluated. A feedback stimulus of exports and improvements in competitiveness do not have the same basal properties. For instance, competitiveness gains reduce trade deficits; feedback effects are neutral on trade deficits. Howbeit, they have one overlapping property: both stabilize the economic situation—a high priority task in a crisis.

The paper is organized as follows: Section 2 takes a theoretical look at effect types; direct and indirect effects are inducted. With the aid of a minimalist two-country-two-year model the conjunction of direct and indirect crisis effects is untangled. Furthermore, the model allows to designate some principal determinants. Beyond, several direct and indirect effects are identified with the help of available literature. Section 3 carries the distinction, from Section 2, forward into the gravity model of trade. Subsequently, in Section 4, devised analytical procedures are applied utilizing the example of Germany and the contemporary global crisis. Section 5 concludes.

This paper provides two contributions to research. One contribution is an implementation of indirect effects on trade without altering the gravity model. The other contribution is a dissection of crisis effects on German trade from diverging prospects.

2 Direct and indirect crisis effects in a theoretical perspective

An elementary description of indirect effects is that these kind of effects are straight related to income. Estimations that control for income abstract from every first-hand income effect. As opposed to this, direct effects are not directly income related and covered by income controlled estimations. The difference between these two types of effects is a good starting point to explicate occurring inconsistencies.

To explain the Abiad *et al.* (2011) scenario, reduced imports and constant exports, suppose there are only two countries: country 1 and country 2, which constitutes the rest of the world. Country 1 imports goods and services from 2. Mirror-inverted, country 2 exports goods and services to 1 *et vice versa.* Let real imports, respectively real exports, be a linear function of real income with an upward slope as depicted in Figure 2. Every point on the linear function represents an indirect effect and every point elsewhere a combination of direct and indirect effects. Whilst direct effects

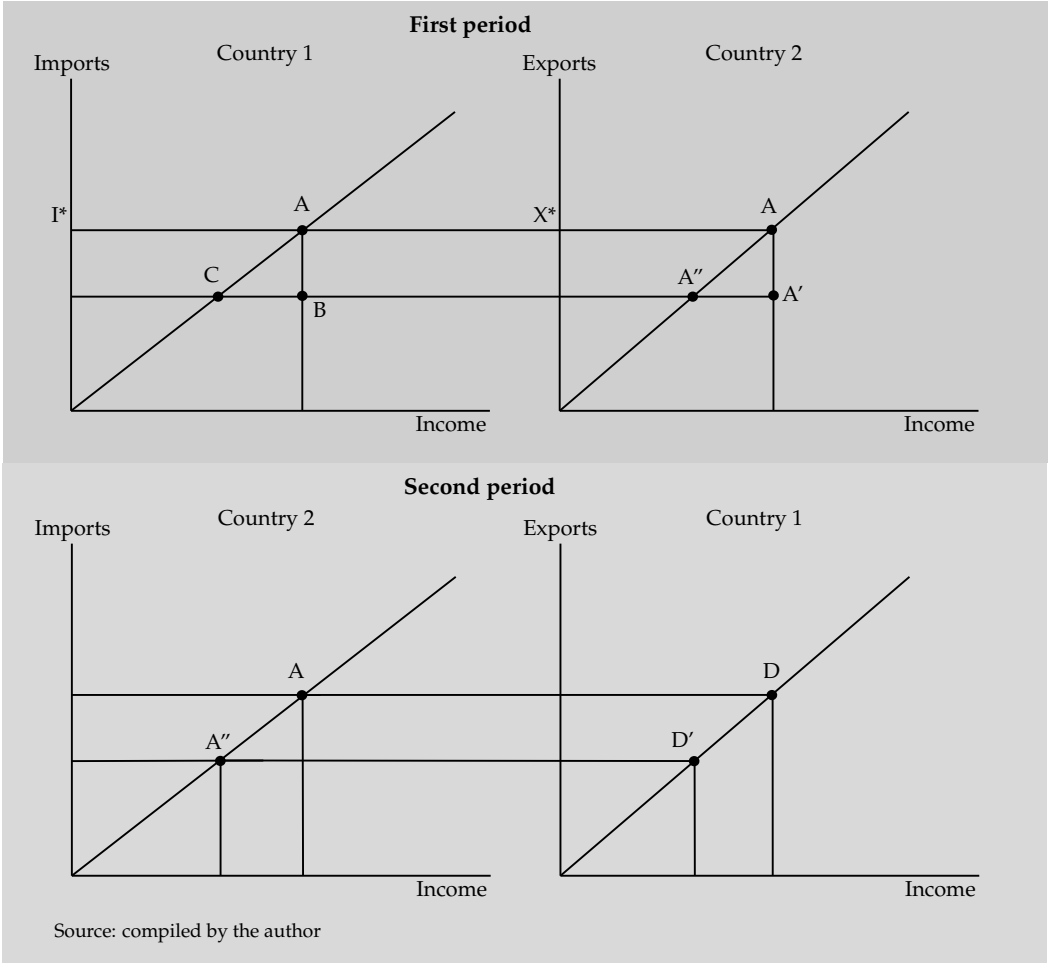


Figure 2: Direct and indirect effects in a minimalist two-period-two-country model

are assumed to be exogenous, indirect effects in 1 are determined by the marginal propensity to import, which is equivalent to the slope of the curve. Indirect effects in 2 are regulated by the inverse of the marginal propensity to export, which is equivalent to the slope of the inverse function. Start from the premise that propensities are identical in both countries. This is an implication of the figure's construction but not a necessary postulate. Pre-crisis situation, in the first period, is depicted by point A. Country 1 experiences a financial crisis with direct effects only. New imports are represented by point B. Income in 1 does not change. This is the basic scenario ignoring indirect effects. What happens in the second country is that owing to a negative demand shock exports decrease to point A′. Simultaneously, production adjusts to a reduced demand level, meaning that income is reduced too. Export level moves from A to A″. In total, country 1 moves from A to B, country 2 from A to A″. A direct effect in 1 provokes an indirect effect in 2. From the standpoint of a direct-effect-only approach, imports decrease and exports do not shift at all.

In the second period, second row of Figure 2, an analogous pattern continues. Because the demand shock in 1 reduces production in 2, income in 2 and hence import demand is weakened. Imports in 2 move from A to A″. The export sector in 1 adapts and reduces production from D to D′. Ergo, in the second period, there are indirect effects only. The overall direct effect is a decrease in imports in the first country; exports are not varied by means of direct effects in the first country; and there are no direct effects in the second country. This is exactly the Abiad *et al.*

(2011) scenario but the actual crisis upshot is a reduction in imports *and* exports. A byproduct of the argument is that the aggregation problem disappears because crisis effects on exports and imports act in the same direction. Global crises would induce effects in both countries modifying the strength of reaction but not changing the reaction altogether.

But, the rationality behind the proposition may not be valid in at least three cases. (i) The examined trade system is not self-contained. While this problem is unavoidable in empirical investigations, measurement errors should not carry as much weight if the number of countries taken into consideration is high. (ii) The structure of trade is altered. For example, if the country experiencing a foreign demand shock finds new markets for selling its goods and services, then, perhaps, it will keep its original export niveau. Although, this is rather a Leibnizian best of the possible worlds outcome and not general rule. (iii) Income losses are compensated by debt financed government measures. Remember that income reduction in country 2 bears responsibility for export reduction in country 1. Now, imagine that income losses in 2 are fully compensated by a government stimulus: in the second row of Figure 2, the crisis shock moves economy of 2 from A to A$''$ and government activity back from A$''$ to A. In that case, import demand in 2 is not lowered and the second region's exports are unchanged. This rule applies primarily to government actions with the goal of income stabilization. Special non-discriminating government subsidies, which, under the assumption that recipients are sufficiently numerous, can be portrayed as positive supply shocks, should manifest as positive direct effects. (Especially, since subsidies linked to specific actions cannot be saved.)

Collectively, there are three conceivable model scenarios: (1) indirect effects on a country with a domestic financial crisis, (2) indirect effects on a country without a domestic crisis but involved in trade with countries suffering from financial crises and (3) indirect crisis effects on a global scale. Functional chains are as described above. Table 1 gives an overview on main

Table 1: Main determinants of indirect effects

Scenario	Characterization of effect	Determinants*
(1) Domestic crisis	1. Indirect effect on imports	Home propensity to import
	2. Indirect effect on exports	(i) Inverse of foreign propensity to export, (ii) foreign propensity to import, (iii) inverse of home propensity to export
(2) Foreign crisis	1. Indirect effect on exports	Inverse of home propensity to export
	2. Indirect effect on imports	Home propensity to import
(3) Global crisis	1. Indirect effects on imports	Home and foreign propensities to import
	2. Indirect effects on exports	Inverse of home and foreign propensity to export

* Higher value leads to a stronger indirect effect.

determinants. Note that a reaction to a domestic or global crisis initiates with altered imports, whereas a non-crisis country starts with an export reaction. As well, short-term income reduction in a non-crisis country is fully explained by export decreases and domestic propensity to export. Income decreases in crisis countries have an additional domestic component—income reduction does not equal export reduction divided by the marginal domestic propensity to export. From

a purely theoretical standpoint, it is difficult to infer which effect type will dominate, but the probability of indirect effect domination rises with its rising determinant values.

So far, rather broad definitions were made use of. Some more precise effect explanations can be given if currency and debt crises are differentiated from banking crises. As Forbes (2002) stated, currency devaluations invoked by a currency crisis or by poor debt politics work through two direct channels. First, the exporting crisis country obtains a competitive advantage because its exports become relatively cheaper. Second, and this is the other side of the coin, the importing non-crisis country receives a positive import shock as it profits from lower prices. Indirect devaluation effects arise because income and import demand are diminished.

The listed emanations may appear slightly simplifying. A more sophisticated distinction is delivered by Ma and Cheng (2005). The addressed authors derive the most plausible repercussions from a bank run in a principal-agent model with domestic and foreign agents. Both types of agents terminate their accounts *before* the financed project is completed. Because aggregated panic sale value is lower than aggregated account value, some agents do not get their money back. Basically, this leads to two direct effect offsprings. For one thing, foreign agents reduce their long-ranging investment activity. By implications, exports fall. For other thing, overall investment demand falls leading to reduced imports of foreign input goods. Contemporaneously, foreign capital expenditure is reduced and more domestic goods must be exported in exchange for the same amount of foreign investment goods. Indirect effects emerge because bank default causes domestic and foreign demand to drop, and imports and exports drop too.

The central aspect of currency crises, as presented by Ma and Cheng (2005), is a high exchange rate volatility causing agents to avoid overseas business activity. Direct effects include a domestic substitution of foreign goods, lowering imports and exports, and domestic agents' welfare losses due devaluation that are offset by partial non-consumption, lowering imports but increasing the potential to export. Effects indirectly involving imports and exports are straight-forward: to avoid risk, foreign agents cut their import demand, domestic income decreases cutting domestic imports.

All crisis channels forecast sinking imports while exports, at least in the short run, can rise. Up to now, all indirect effects were income effects induced by a crisis. *Qua* definition this type of income effects is negative. As described above, indirect effects are not necessarily restricted to negative effects. Usually, a crisis sparks off government reactions to compensate for output losses or to overcome the crisis. Albeit, fiscal policy is not obligatorily expansive and negative fiscal multipliers are not something unheard of (see Spilimbergo *et al.* 2009), its impact *can* be positive. In an aggregate, indirect effects are comprised of negative crisis effects and effective policy actions.

The standard approach to estimate trade relations—also instrumentalized by Ma and Cheng (2005), and Abiad *et al.* (2011)—is the gravity model of trade. In the gravity model's framework, it is difficult to generate suitable tests for every channel. I suggest to test for four effect clusters: currency effects, direct non-currency effects, indirect effects excluding government measures, and government action effects.

3 Direct and indirect crisis effects in a gravity equation framework

Assume that trade flows (sum of imports and exports) can be fitted by a gravity model of trade, which is well tested (see Bun and Klaassen 2002; Cheng and Wall 2005) and can be derived from a basic Heckscher-Ohlin model (see Deardorff 1995) or, like Egger (2000) trenchantly stated, from

every plausible trade model. The corresponding equation for a trade flow between country i and j at the time t in log-linear form is

$$\log(F_{ijt}) = C + C_{ij} + \alpha_1 \log(y_{it}) + \alpha_2 \log(y_{jt}) + \boldsymbol{\beta}_1' \boldsymbol{x}_{ijt} + \boldsymbol{\beta}_2' \boldsymbol{z}_{ij} + \boldsymbol{\gamma}' \boldsymbol{c}_{ijt} + \epsilon_{ijt}. \tag{1}$$

C is a constant. C_{ij} is a deterministic or stochastic country-specific effect. Real income of i is y_{it} and of j y_{ij}. Vector $\boldsymbol{x}_{ijt}$ covers time variant control variables like time itself or the log of exchange rates. $\boldsymbol{z}_{ij}$ contains time invariant effects like log of distance, constituting transport costs, preference divergence or different cultural characteristics (see Feyrer 2009), or dummies for common boarder, membership in the same political or economic entity and so on. ϵ_{ijt} is an unspecified error term.

$\boldsymbol{c}_{ijt}$ is a crisis vector with crisis indicator variables. Suppose, for reasons of simplicity, that the crisis vectors consists of non lagged and lagged dummies (1 if there was a crisis and else 0) for a financial crisis in i c_{it}, a crisis in j c_{ij} and a twin crisis in i and j c_{ijt}. Coefficient vector $\boldsymbol{\gamma}$ defines the particular economies' crisis response. Response function of i to a domestic crisis stroke is

$$R_{iT} = \sum_{s=0}^{T} \gamma_{is} \tag{2}$$

with T as periods after crisis start. Estimating equation (1) solely calculates direct effects. Let us denote the corresponding response function R_{iT}^D.

To compute income losses, it is required to make a counterfactual statement about how income would have developed if there was no crisis. Suppose that income would follow its estimated long-ranging trend τ_{it}. Then a crisis loss at the time t in percent of trend income is

$$y_{it}^{Loss} = \frac{\tau_{it} - y_{it}}{\tau_{it}}. \tag{3}$$

Trend income can, for example, be calculated in line with Hodrick and Prescott (1981) by solving the following minimization problem:

$$\min_{\{\tau_{it}\}} = \left\{ \sum_{t=1}^{T} (y_{it} - \tau_{it})^2 + \lambda \sum_{t=2}^{T} [(\tau_{i[t+1]} - \tau_{it}) - (\tau_{it} - \tau_{i[t-1]})]^2 \right\}. \tag{4}$$

Smoothing factor λ has to be set accordingly to data frequency. Conventionally, for quarterly data the factor is $\lambda = 1,600$. Succeedingly, actual income can be adjusted, eliminating crisis losses and handing out crisis adjusted income y_{it}^*, by

$$y_{it}^* = \begin{cases} y_{it} - c_{it}(y_{it} - \tau_{it}) & \text{if } y_{it} > \tau_{it} \\ y_{it} & \text{else} \end{cases}. \tag{5}$$

Plugging adjusted income from equation (5) into equation (1) gives the full crisis response R_{iT}^F in i.

Let $D_{iT} \equiv R_{iT}^F - R_{iT}^D$ be a decomposition function. D_{iT} is built up of at least three components. At the outset, there is a cyclical component because the adjustment procedure liquidates cycle from income such that it is caught by the response function. Second off, there are income effects that are negative. Thirdly, government actions can crystallize as positive effects on income. Altogether, the decomposition function captures indirect effects and non-crisis cycle. An inquiry of direct and indirect effects can proceed as follows: the first step is to estimate crisis response with non-adjusted income. The second step is to estimate the response function with adjusted

income, and as a side-off product calculate gross crisis effects. The last step is to compare both estimated functions, i. e. the computation of the extent of indirect effects.

It is feasible to roughly predict the direction of action for most of the effect clusters. This is performed in Table 2. Naturally, government activity is not inevitably trade stimulating. A

Table 2: Direction of action from the standpoint of a country with an inherent crisis

Effect cluster	Theoretical direction for imports	Theoretical direction for exports
Currency effects	$-$	$\pm$
Non-currency direct effects	$-$ if no specific supply stimulus from government $\pm$ if specific supply stimulus	$\pm$
Indirect effects without government action	$-$	$-$
Broad government action effects	$+$	$+$

prerequisite is, however, that effects are measurable and, in the specified frame of reference, negative government effects are indiscernible from income effects. Strictly speaking, in the event of exports, income effects equal positive and negative shocks in the production sphere. Negative production shocks are a reflection of demand shocks. Positive shocks on production are successful government measures to rise the competitiveness of domestic firms. Hence, there is no urgent need to come up with a specific realm of production effects.

Currency effects can be calculated by estimating one model with the exchange rate variable and one without, and making a comparison between estimated crisis response functions. Income effects usually take some time to reveal themselves. There is a chance that the application of the adjustment procedure causes a time shift, so that aggregate effects may take place with a stronger delay than direct effects.

4 THE CASE OF GERMANY AND THE CRISIS

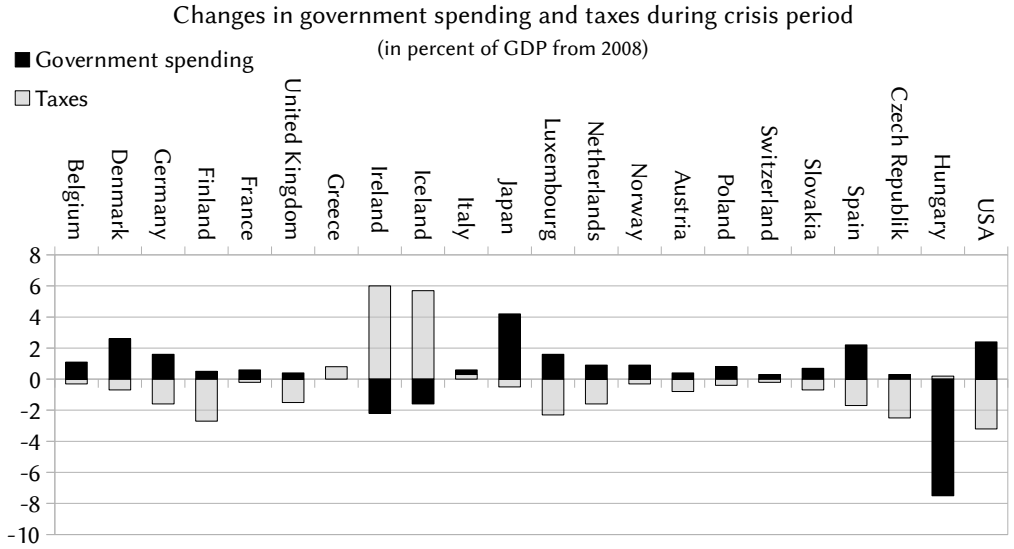
The purpose to examine only one country and one crisis period is motivated twofold. An asymmetric system allows to concentrate on a restricted set of determinants: domestic and foreign propensities. Germany as a special case permits to narrow down relevant criteria even further because there is simulation evidence that the crisis irruption was mainly not caused by a domestic banking crisis (see Quaas and Klein 2011). In the wake of this, Germany might be treated as a *quasi*-non-crisis country. A second motivational complex is that Germany did not experience a debt crisis in the aftermath of the global crisis as, for example, Greece. Debt crises provoked by state reactions to banking crises embody a somehow "twisted" causality in the scope of the gravity model of trade. At this juncture, measures to control one financial crisis are the cause of the eruption of an another crisis. Trade would be affected by a cumulative effect without the possibility to distinguish between root causes.

An another exemplar of obscure causality is crisis contagion. Direct and indirect effects could take two routes: a crisis causes transformations of trade or trade transformations trigger a crisis. Crisis contagion through trade renders a stringent causality interpretation impossible. Yet, according to Berkmen *et al.* (2010) shocks are transmitted through finance channels in developed

economies and through trade channels, mainly because of absence of finance links, in developing economies. Trade finance would affect both types of economies but appears extraneous in case of the recent crisis (see Asmundson *et al.* 2011). On these grounds, it is safe to presuppose no contagion.

As for government activity, Germany implemented two stimulus packages: *Konjunkturpaket I* and *Konjunkturpaket II*.[2] The first package was passed in November 2008. It was mainly designed as a measure to secure employment. The second package was passed in January 2009. A widely popular element of the second package was an environmental bonus of 2,500 Euros for scrapping older vehicles (the so-called *Umweltprämie*) starting in January 2009 and ending in June 2010. So, there exist two candidates for government effects. Inherently, the *Umweltprämie* is a positive supply shock on the automobile market and, therefore, should exhibit direct effects' qualities. Both packages were implemented with the goal of income stabilization and qualify as broad government activity, and should have indirect effects' features.

Figure 3 showcases changes in government spending and taxation during the crisis period for



Source: OECD Factbook 2010

Figure 3: Spending and taxes of selected OECD countries in crisis times

selected OECD countries, which are all part of the sample made use of in the next subsections. Compared to European countries, German stimulus packages were of relatively extended scope. The two economically largest non-European countries inducted a surpassing stimulus. Potentially, there are two likely sources for positive income effects: German and foreign government stimulus. This should be taken into account in the formulation of models.

2 A description of packages and its elements can be found on the website of the German Federal Ministry for Finance *www.bundesfinanzministerium.de*.

4.1 *Description of basic model and estimation method*

The export equation to be estimated is

$$\log(X_{it}) = C + C_i + \alpha_1 \log(y_{it}) + \alpha_2 \log(y_t) + \boldsymbol{\beta}_1' \boldsymbol{x}_{it} + \boldsymbol{\beta}_2' \boldsymbol{z}_i + \sum_{k=0}^{K} \gamma_k c_{t-k} + \epsilon_{it}. \qquad (6)$$

Imports are estimated analogously but with the assumption that exports and imports can react differently, respectively that exports and imports can have differing coefficients. Variables are: y_{it} is income of trade partner i. y_t is German income. $\boldsymbol{x}_{it}$ consists of time t, a dummy for EU membership eu_{it} (1 if EU member and else 0) and the log of exchange rate $\log(ex_{it})$ of country i based on the Euro. Vector $\boldsymbol{z}_i$ covers the log of distance $\log(D_i)$ from Berlin to the capital city of i and a dummy for common boarder with Germany ggd_i (1 if there is a common boarder and else 0). Data frequency is quarters. The global crisis dummy c_t is set to 1 for the first quarter 2008 until third quarter 2009, and else is 0.

C_i is a country-specific effect. There are three options to model C_i. Normally, differences between countries can be ascribed to historical, political or geographical developments (see Egger 2000) and are of deterministic nature. Modeling C_i as a deterministic effect—the most intuitive approach—is in accordance with a fixed effects (FE) estimator. A random effects (RE) estimator treats C_i as a stochastic factor. With basic FE estimators it is not possible to estimate $\boldsymbol{\beta}_2$ because $\boldsymbol{z}_i$ is perfectly correlated with C_i but non-perfect correlation between C_i and other exogenous variables is allowed. (There are enhanced methods like Hausman and Taylor (1981) to estimate time-invariant effects with fixed country effects.) RE estimators do not allow error term correlation with C_i but coefficients of time-invariant variables can be estimated. In addition, RE estimators permit generalization, whereas FE estimators are bound to the sample. Finally, one could simply ignore C_i and employ an pooled regression (POLS).

At this point a rather pragmatic strategy was chosen. First, every model is estimated with FE, RE and POLS. Then, the best estimator is selected in accordance with two specification tests portrayed in Table 3, which as well deliver hints of consistency. However, POLS is abandoned

Table 3: Criteria for model selection

Test	Null hypothesis	Conclusion if null hypothesis is rejected
F-Test	All country specific constants are identical.	RE or FE model is adequate.
Hausman test	RE estimator is consistent.	FE model is adequate.

Note: All tests are valid at the 5% level.

after the first estimations because every test and even common sense suggests that there *are* country-specific effects.

Appropriated models and corresponding model descriptions are depicted in Table 4. Estimated crisis response functions are calculated in the manner of equation (2) with $T = 0, \ldots, K$ and $K = 8$. Equation (5) strictly takes account of losses but I am more interested in across-the-board output dynamics. On that score, income is adjusted in consonance with the following equation:

$$y_{it}^* = y_{it} - c_{it}(y_{it} - \tau_{it}). \qquad (5')$$

The construction of the BC17 group is described in the next section. First models 1a and 1b are similar to conventional crisis estimation techniques. Model 2 helps to calculate the German

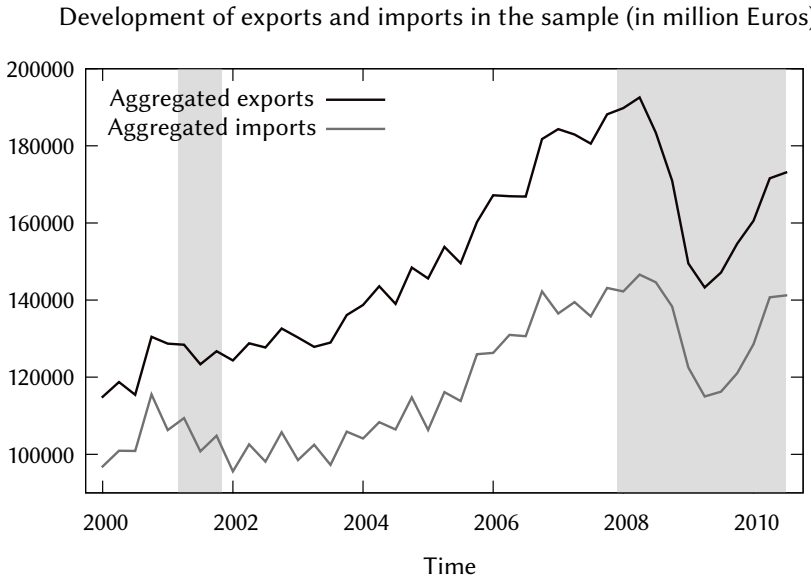
Table 4: Descriptions of estimation models

	Main assumptions	Equivalent adjustment process and specific control variables
Model 1a	All countries were hit by direct effects only excluding exchange rate effects.	No adjustment, controlling for exchange rates
Model 1b	Every country was affected by direct effects including currency effects but not by indirect effects.	No adjustment, no controlling for exchange rates
Model 2	During the crisis, Germany experienced direct and indirect effects. Trade partners were spared from indirect effects but not from direct effects.	Crisis adjustment of German income, no controlling for exchange rates
Model 3	Germany and the BC17 were affected by direct and indirect effects but the rest not by indirect effects.	Crisis adjustment of German income and BC17 income, no controlling for exchange rates
Model 4	All countries were pertained by income and direct effects, although not necessarily in consequence of a domestic crisis.	Crisis adjustment of all incomes, no controlling for exchange rates

indirect effect. Model 3 aids in the estimation of overall indirect effects. Model 4 serves for comparison purposes. Conceptually, in model 4, income decrease is eliminated from the chain of causation by the adjustment procedure for every country. In theory, this should isolate all income effects giving an estimation of the entire impact of income sacrifice on trade; producing in the process the highest response estimation result regarding its absolute value. All models are estimated in two versions: an unrestricted estimation with all crisis coefficients and a restricted estimation with crisis coefficients significant at the 5% level only. Non-significant crisis coefficients are successively eliminated starting with the highest lag.

4.2 *Data*

Evaluation period is 43 quarters from the first quarter 2000 until the third quarter 2010. The data panel was constructed using the following sources: import and export time series are taken from the Federal Statistical Office of Germany. Monthly data was aggregated to quarterly data. In the process, 31 countries were selected for a sample. A list of chosen countries with import and export ratios relatively to German overall imports and exports is given in Table 6. Most of the countries are European and members of the European Union with the Euro as currency or currencies linked to the Euro (for example, former Estonian currency board). For the first quarter 2010, the sample corresponds to approximately 70% of the German trade volume and captures most of German international interchange of goods. Figure 4 shows the aggregated sample. Exports appear to be permanently reduced and imports nearly fully recovered in the last quarter of 2010. There is a persistent trade surplus. Fluctuations are lightly more common in imports than in exports. In Figure 5, countries with a fixed exchange rate to the Euro and countries with variable exchange rates are grouped together. Import curves display aligned movement and export curves more divergent motions, a predictor of higher exchange rate sensitivity of exports. Added together, 1,333 data points are available.



Source: Federal Statistical Office of Germany

Figure 4: Exports and imports in the sample (2000Q1–2010Q3)

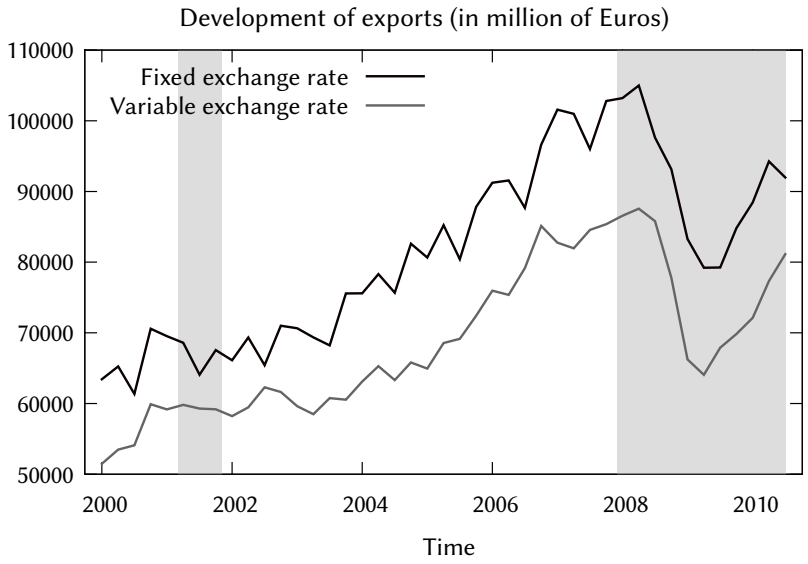
According to Laeven and Valencia (2010) 17 of the 31 examined German trade partners experienced a banking crisis starting 2007 or 2008. These countries are subsumed under the label "BC17 group". Seasonally adjusted real GDP data and exchange rate values were taken from Eurostat. Distances were calculated with the help of *Google Maps* and entry times into the European Union were acquired from *europa.eu*.

Table 7 gives a summary on basic statistics. Table 8 contains a correlation matrix. There is no observable pairwise collinearity. Income losses of trade partners are depicted in Figure 6. Interestingly enough, all of the countries show a typical bubble pattern: exceptional expansion and a sudden contraction. Worth mentioning is that in the first three and in some cases all quarters of 2008 income was systematically higher than trend GDP. Put another way, from the income's point of view the financial bubble bursted in the end of 2008 or the beginning of 2009 and not immediately. Germany evinces the same pattern but with moderate losses around 2% in the first quarter 2009—the drop height was 4.5% over trend GDP in the beginning of 2008—and a steady recovery reaching trend GDP in the last quarter of 2009.[3] In sum, German losses were not extraordinary; the speed of recovery was indeed remarkable.

4.3 *Main determinants*

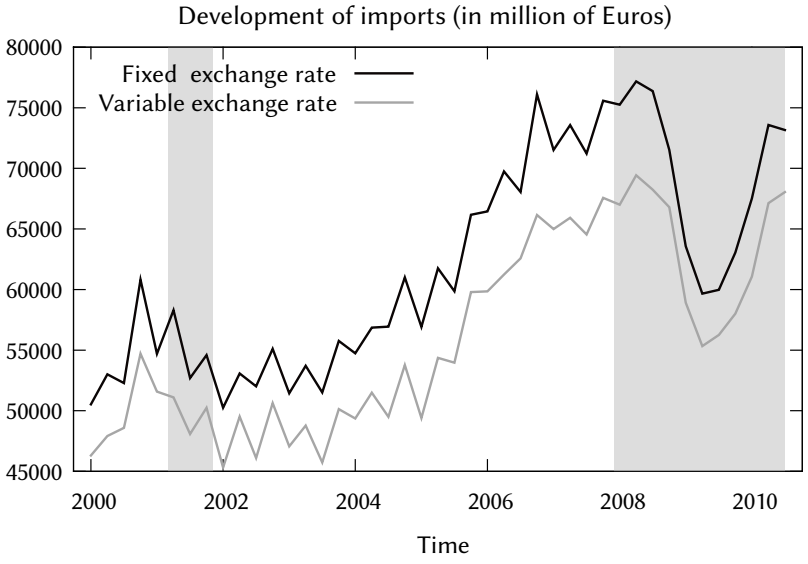
As pointed out in the second section, effect type proportion is governed by marginal propensities to export and import. These are the analytical model's main determinants. If Germany was of the type of internal crisis country, then exports were influenced by a chain reaction depending on propensities to export and import in the rest of the world. Notwithstanding, as countries typically do not rely on only one trade partner, the particular chain effect may not be that important. Germany as external crisis country would simplify necessary inquiry because then short-run reaction would depend exclusively on domestic propensities. In all, there are two issues. The first

3 The calculated losses are rather conservative because smoothed income is based on crisis GDP.



Source: Federal Statistical Office of Germany and own calculations

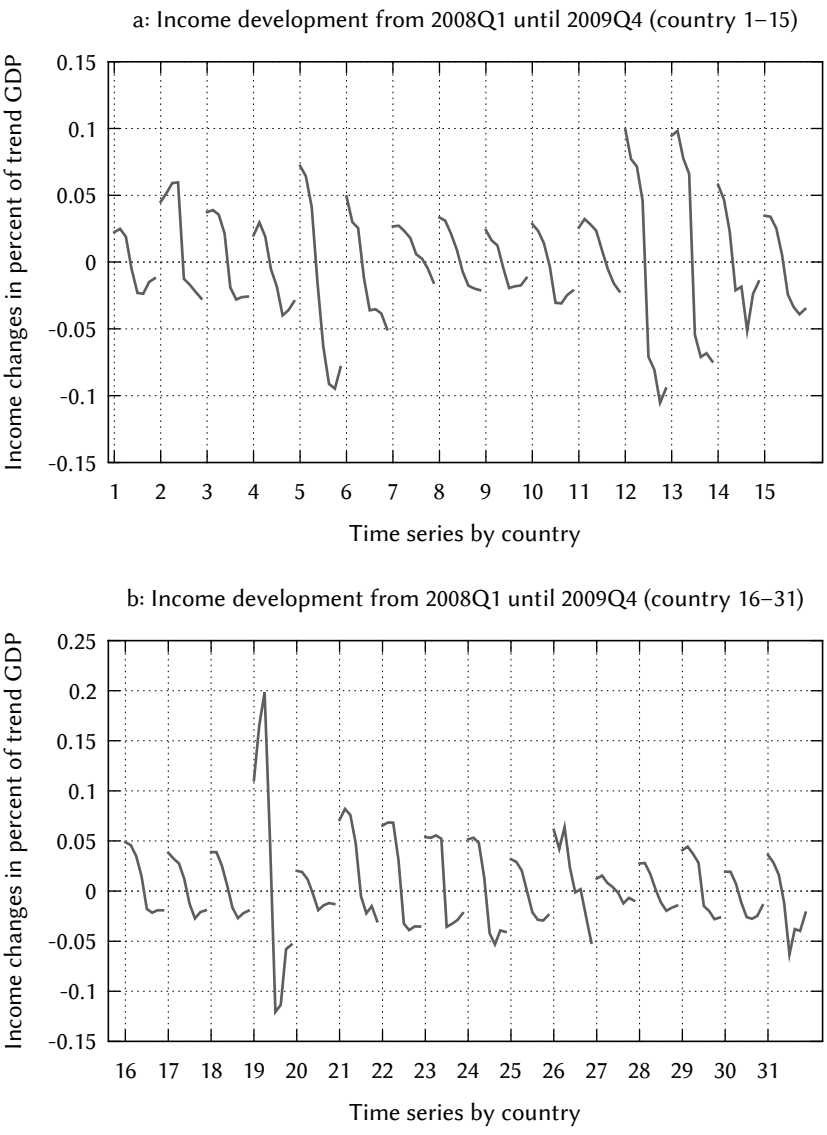
(a) Exports (2000Q1–2010Q3)



Source: Federal Statistical Office of Germany and own calculations

(b) Imports (2000Q1–2010Q3)

Figure 5: Exports and imports grouped according to exchange rate relevance



Source: Federal Statistical Office of Germany, Eurostat and own calculations

Figure 6: Estimated income losses (negative values = loss)

question is: was German income affected by a domestic banking crisis or was income diminution mainly an impact of foreign banking, currency or debt crises? The second question is about the plausibility of dominance of one type of effects in respect of imports and exports.

To estimate propensities one could calculate mean trade-to-GDP ratios. An other possibility is to use an estimate of the following equation system, avoiding crisis distortions and selection bias by utilization of pre-crisis data and controlling for panel heterogeneity, exchange rates evolution, time, and membership in the European Union:

$$X_{it} = C_1 + C_{1i} + mpx^{\text{Indiv}} y_t + \lambda_{11} t + \lambda_{12} \Delta ex_{it} + \lambda_{13} eu_{it} + \epsilon_{1it}, \quad (7)$$

$$I_{it} = C_2 + C_{2i} + mpi^{\text{Indiv}} y_t + \lambda_{21} t + \lambda_{22} \Delta ex_{it} + \lambda_{23} eu_{it} + \epsilon_{2it}. \quad (8)$$

Here, coefficients of income represent an average individual response to a change in trade relation with one country, which can be aggregated to total propensity by multiplication with the number of considered countries—if the assumption that all individual reactions are identical is made. Anticipate that estimated individual German propensities are higher than actual individual propensities because the sample accounts for just a fraction of German trade. Estimation results are given in Table 9. As a robustness test, foreign propensities to export to Germany and import from Germany are also estimated by replacing German income with trade partner income and interchanging imports and exports. Coefficients resulting from this are encapsulated in Table 9. RE estimators are consistent in case of German propensities and, such being the case, results can be generalized. Alternative estimates for Germany are summarized in the second column of Table 5.[4] The third column depicts foreign propensities that turn out as small as expected. German ratios were calculated with total volume data.

Table 5: Estimations of pre-crisis (2000–2007) propensities

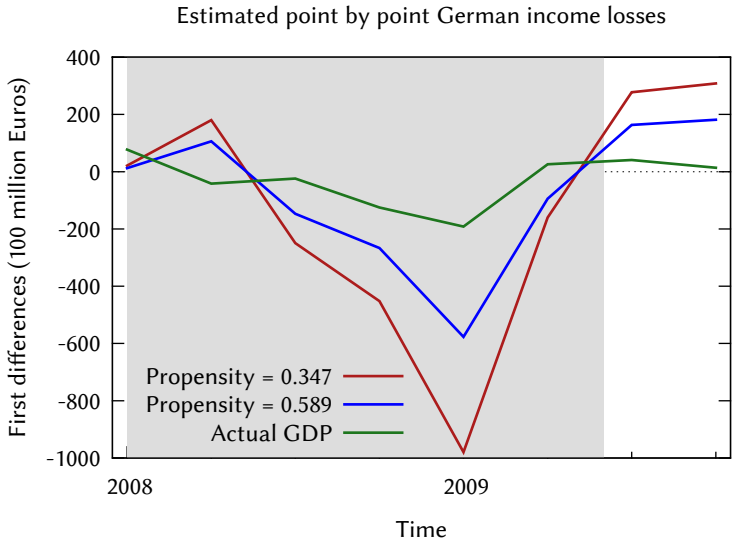
	Estimates for Germany	Estimates for trade partners
Mean exports-to-GDP ratio	0.347	0.072
Mean imports-to-GDP ratio	0.284	0.089
Individual propensity to export	0.019	0.001
Individual propensity to import	0.021	0.002
Aggregated propensity to export	0.589	Not applicable
Aggregated propensity to import	0.651	Not applicable

With this information, it is possible to estimate the expected, export associated, short-time income effect

$$\hat{\Delta y_t}^{\text{Induced by exports}} \equiv \frac{1}{\hat{mpx}} \Delta X_t. \quad (9)$$

Figure 7 shows two discrete estimates. By all appearances, losses are lower than expected, and if so, there is some plausibility behind the statement that, in real terms, Germany was a country without a domestic banking crisis. At least, income reduction can be explained as an outgrowth

4 Marginal propensities from equations (7) and (8), which represent a behavioral relation, fit the minimalist effect model better than propensities based on ratios, which are a technical relation. The propensity to import is not only driven by the consumption motive but, additionally, by a demand for intermediate and capital goods (see Stirböck 2006).



Source: Federal Statistical Office of Germany, Eurostat and own calculations

Figure 7: Estimated income effects resulting from a reduction in exports

of export decline without the need for further arguments. Adventitiously, there must have been an effective income stimulus preventing a sharp income decrease.

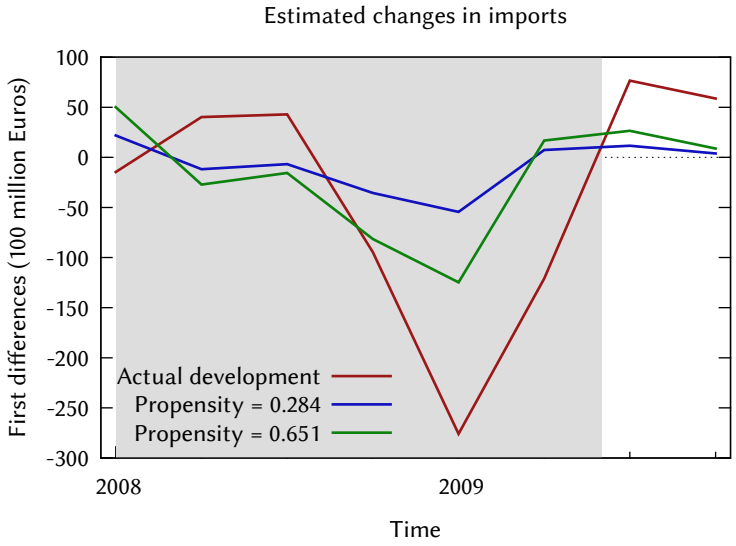
It is possible to estimate import decreases in the same fashion. Part of import reduction can be traced back to income reduction. Formally, income effects correspond to

$$\hat{\Delta I}_t^{\text{Induced by income}} \equiv \hat{mpi}\Delta y_t. \tag{10}$$

In Figure 8, two different estimates are mapped. Principally, this figure offers two important insights. Nearly half of the import decrease can be interpreted as an income effect, and there were positive and negative direct *and* indirect effects. Noteworthy is that an instant positive direct effect can be unequivocally recognized after crisis outbreak.

At this stage, gathering all given information makes it accomplishable to sketch the most plausible crisis scenario and deduce consequences on German trade. (The reaction chain presented is rather logical than temporal but temporal facets are mentioned.) Since Germany can be seen as a country hit by an exogenous crisis shock, there are only two crisis increments. To begin with, Germany's trade partners reduce their import demand. Demand reduction consists of direct and indirect effects. Because foreign propensities are rather small, it is reasonable to assume that demand reduction is, in the main, made up of direct effects. Next, German companies reduce production—this is the concurrent income effect. Due to the fact that German propensity to export is high, the share of German indirect effects in overall effects should also be rather small. En masse, there should be an immediate export reduction largely composed of direct effects.

Thereafter, income losses are transferred into the import sector but this sector is hit by direct effects too. The impact of indirect effects needs some time to entrench itself. Imagined on a time axis, the reaction should start with direct effects. After that, there should be a negative indirect effect. The next statement depends upon the effectiveness of government action. If government activity was effective, then there should be evidence for a positive indirect and maybe, arising from the *Umweltprämie,* a positive direct effect. First and last, indirect effects should have a large proportion because the propensity to import is high.



Source: Federal Statistical Office of Germany, Eurostat and own calculations

Figure 8: Estimated import reduction

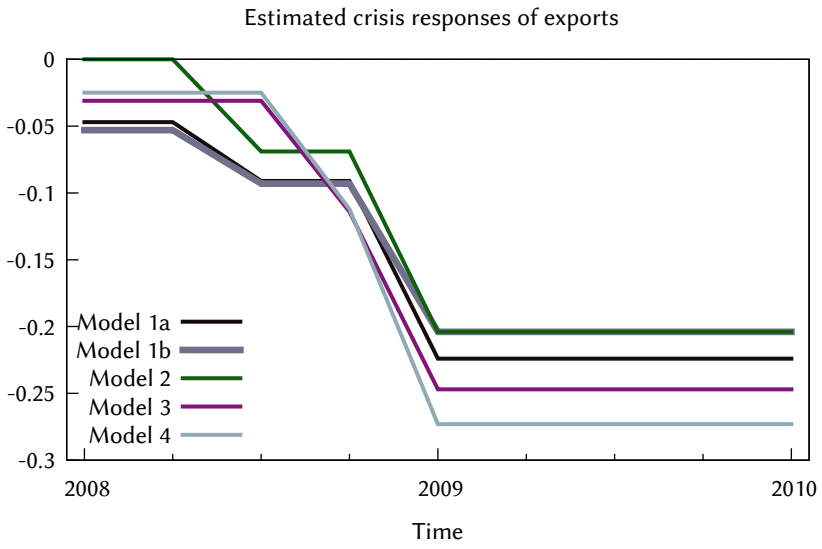
Despite that the outlined scenario reminds of a thought experiment, it can be empirically tested. Accessorily, notice that the principles I employed were just conditional relations from the basic model complemented by estimates of determinants. A *petitio prencipii* is unlikely.

4.4 *Estimating direct and indirect effects*

Unrestricted estimations of the crisis response of exports are presented in the Tables 10 and 11. Tables 12 and 13 show unrestricted estimations of response functions of imports. Sample selection emerges to be more substantial in case of exports, which are best comprehended by a FE model. An explanation for this phenomenon could be German's export sector specialization in, rather price inelastic, research intensive products (see Belitz *et al.* 2009). This could manifest as a parallel foreign demand structure. German imports, apart from that, are not concentrated around a specific category of goods. In this way, country-specific import effects are ruled by chance and are best fitted by a RE model.

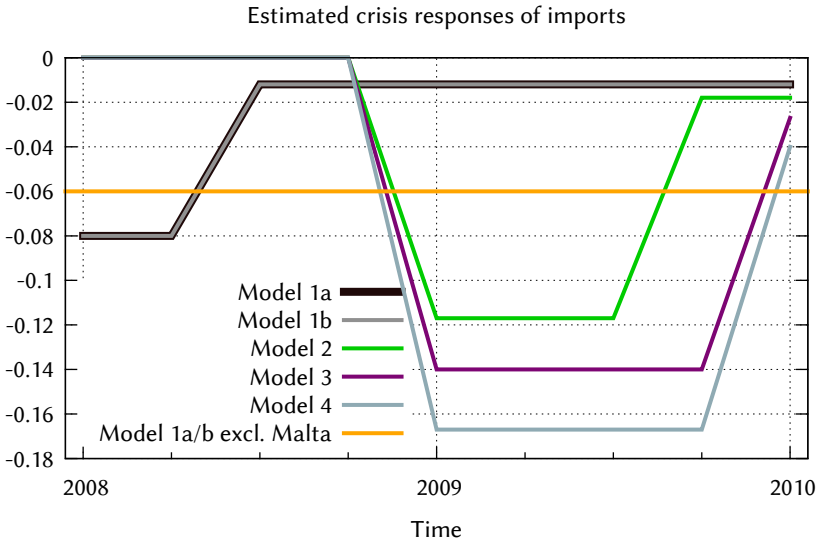
All coefficients of determination are high. So, gravity model and data harmonize well. Presumably because the country selection consists mostly of European countries, exchange rate effects are almost irrelevant. Merely, export responses at crisis start and the beginning of 2009 display some changes as a result of the elimination of the exchange rate variable. In case of exports, influence of German and foreign GDP is balanced. The gravity of German GDP on imports outmatches foreign GDP. Unquestionably, the fact itself is not surprising but the extent is striking. In unrestricted estimations not all crisis coefficients are significant and for that reason hard to interpret. Restricted estimations, with only significant crisis coefficients, are depicted in Table 14. Crisis responses, based on Table 14a and Table 14b, are drawn in Figure 9.

Exports were mostly stroked by direct effects. German income effects were barely relevant. Direct and indirect effects took place at the same time. Both effects were active immediately. There is slight evidence for positive indirect effects in the course of crisis onset. Income was systematically higher than trend in this period reflecting a financial bubble and not government



Source: Federal Statistical Office of Germany, Eurostat and own calculations

(a) Exports



Source: Federal Statistical Office of Germany, Eurostat and own calculations

(b) Imports

Figure 9: Estimated crisis responses: all models

stimulus. And there was a positive exchange rate effect at the beginning of 2009 but it was negligibly small. Individual effects are negative and so is the cumulative effect.

Imports display a positive direct effect right after crisis beginning—there is a counterpart for this effect in Figure 8—but this occurrence can be reduced to a Maltese anomaly. Malta's (country number 16) exports to Germany rose inordinately in the third and fourth quarter of 2008. I removed Malta from the sample and estimated crisis responses with a sample of 30 countries. Results are in Table 15. The positive effect becomes non-significant. Admittedly, the beneficial effect of being Malta two periods after crisis start is interesting in itself but it is not inevitably pertinent to the analysis at hand. Without Malta, direct effects were exclusively negative, providing no evidence for impact of the *Umweltprämie*.

Again, there was a positive income overheating effect after crisis beginning. Crisis dynamics are eminently modified by the introduction of income effects. Income effects occur later than direct effects *and* there is evidence for a successful government stimulus commencing operations in the late-middle of 2009. German income effect was the strongest indirect effect—responsible for about a half of import reduction. In the aggregate, imports were dominated by indirect effects. Cumulative effects are negative.

An important conclusion is that direct effects underestimate the overall crisis effect. Overall effects are systematically higher than effects that result from a method enclosing nothing but direct effects. As anticipated, model 4 (addition of direct effects and the "world income effect") yields the largest crisis responses. Exports were especially hard-hit. What is more, the derived scenario cannot be rejected.

The relevancy of feedback effects is inducible from the dissimilarity of crisis responses. With respect to feedbacks from German stimuli, suitable models are 1b and 2 from the export's angle. There is no deviation between the responses for 2009—that is to say, there was no feedback from the German stimulus packages. On the contrary, feedback effects were influential for Germany's trade partners. Looking at crisis responses in model 2 and 3 for imports, German imports would have remained static for one quarter longer without foreign income effects.

5 SUMMARY AND FURTHER RESEARCH

Synoptically stated, both, direct and indirect, effects do matter. At the macro-level, ruling determinants of effect proportion are propensities to export and import. Small propensities to export promote a strong income effect on exports and high propensities to import foster income effects on imports. In accordance, German exports were dominated by direct and imports by indirect effects. Even more important is that trade dynamics are best understood from the perspective of a conglomeration of direct effects and output or income dynamics. In succession, this allows to segregate government influence on trade, which is not possible in a direct-effects-only approach.

There are some chances to extract a double benefit from a stimulus through a feedback effect (there are no hints that Germany can profit from stimulus echoes). A portion of fiscal spillovers can return back to the emitter. By the same token, the sensitive reaction of imports to income changes can be translated into a demand for international coordination of fiscal policy.

What would be interesting is further research in two fields. Before all else, how did the crisis act in other countries than Germany? The strategy to answer this question could adopt the *modus operandi* of this paper, respectively employ the demonstrated approach in a comparative analysis involving a number of countries, in this vein, expanding the width of the analysis. Second, Ma and Cheng (2005) have found evidence for a break in crisis reaction structure initiating in 1990.

Worth knowing is if the recent crisis was different from previous crises in a basic way. With other words: from a temporal view, analysis depth should be expanded.

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A information about trade partners, essential data characteristics and estimation results

Table 6: Selection of trade partners and corresponding trade share

Index	Trade partner	Export trade share	Import trade share
1	Belgium*	0.0522	0.0414
2	Bulgaria	0.0021	0.0021
3	Czech Republic	0.0272	0.0365
4	Denmark*	0.0146	0.0133
5	Estonia	0.0012	0.0005
6	Ireland*	0.0047	0.0200
7	Greece*	0.0067	0.0026
8	Spain*	0.0390	0.0296
9	France*	0.0995	0.0792

Table 6: Selection of trade partners and corresponding trade share

Index	Trade partner	Export trade share	Import trade share
10	Italy	0.0616	0.0539
11	Cyprus	0.0007	0.0003
12	Latvia	0.0009	0.0007
13	Lithuania*	0.0017	0.0017
14	Luxembourg*	0.0061	0.0037
15	Hungary*	0.0149	0.0211
16	Malta	0.0003	0.0003
17	Netherlands*	0.0668	0.0892
18	Austria*	0.0560	0.0416
19	Poland	0.0383	0.0357
20	Portugal*	0.0076	0.0055
21	Romania	0.0076	0.0079
22	Slovenia*	0.0037	0.0044
23	Slovakia	0.0090	0.0106
24	Finland	0.0082	0.0067
25	United Kingdom*	0.0654	0.0486
26	Iceland*	0.0003	0.0009
27	Norway	0.0073	0.0236
28	Switzerland*	0.0447	0.0409
29	Croatia	0.0022	0.0009
30	USA*	0.0667	0.0552
31	Japan	0.0144	0.0283
$\sum$		0.7316	0.7069

Source: Federal Statistical Office of Germany and own calculations (trade shares for the first quarter 2010)

* banking crisis starting 2007/2008 according to Laeven and Valencia (2010)

Table 7: Descriptive statistics

Variable	Minimum	Maximum	Mean	Standard deviation
y_{it}	1012.5	3207700	204040	563980
y_t	511400	575760	537850	18580
X_{it}	47.669	24463.0	4844.5	5692.0
I_{it}	6.1990	17613.0	3810.6	4088.1
$\sum_i X_{it}$	114917.359	192550.7	150179.334	22857.680
$\sum_i I_{it}$	95567.984	146602.9	118129.369	16232.965
$\log(y_{it})$	6.9202	14.981	10.272	1.9268
$\log(y_t)$	13.145	13.263	13.195	0.034233
$\log(X_{it})$	3.8643	10.105	7.5298	1.6070
$\log(I_{it})$	1.8244	9.7764	7.2547	1.7486
$\log(D_i)$	5.6350	9.0967	6.9730	0.74284
$\log(ex_{it})$	−0.92483	7.5685	2.4929	2.2114
c_t	0.0000	1.0000	0.18605	0.38929
eu_{it}	0.0000	1.0000	0.64291	0.47932
ggd_i	0.0000	1.0000	0.29107	0.45443

Source: Federal Statistical Office of Germany. Eurostat and own calculations

Table 8: Correlation matrix

$\log(D_i)$	$\log(I_{it})$	$\log(X_{it})$	$\log(y_t)$	$\log(y_{it})$	$\log(ex_{it})$	c_t	ggd_i	eu_{it}	
1.0000	−0.1442	−0.1564	0.0000	0.2917	0.0346	−0.0000	−0.5815	−0.2817	$\log(D_i)$
−0.1442	1.0000	0.9429	0.0870	0.8476	0.1751	0.0328	0.4502	0.2036	$\log(I_{it})$
−0.1564	0.9429	1.0000	0.1174	0.8617	0.1819	0.0402	0.4840	0.2787	$\log(X_{it})$
0.0000	0.0870	0.1174	1.0000	0.0449	0.0064	0.4441	−0.0024	0.2833	$\log(y_t)$
0.2917	0.8476	0.8617	0.0449	1.0000	0.1415	0.0243	0.2035	0.0723	$\log(y_{it})$
0.0346	0.1751	0.1819	0.0064	0.1415	1.0000	0.0063	−0.0814	0.1264	$\log(ex_{it})$
−0.0000	0.0328	0.0402	0.4441	0.0243	0.0063	1.0000	−0.0008	0.1632	c_t
−0.5815	0.4502	0.4840	−0.0024	0.2035	−0.0814	−0.0008	1.0000	0.2156	ggd_i
−0.2817	0.2036	0.2787	0.2833	0.0723	0.1264	0.1632	0.2156	1.0000	eu_{it}

Source: Federal Statistical Office of Germany, Eurostat and own calculations

Table 9: Estimated models for the propensity to export and import

German propensities				
Variable	FE export coefficients	RE export coefficients	FE import coefficients	RE import coefficients
C	-6049.650^{***}	-6064.130^{***}	-7529.410^{***}	-7540.470^{***}
	(1726.670)	(2001.550)	(1363.020)	(1537.700)
y_t	0.019^{***}	0.019^{***}	0.021^{***}	0.021^{***}
	(0.019)	(0.003)	(0.003)	(0.003)
t	62.724^{***}	62.536^{***}	27.838^{***}	27.695^{***}
	(7.452)	(62.536)	(5.882)	(5.883)
Δex_{it}	-2.412	-2.426	-5.816	-5.785
	(16.058)	(16.068)	(12.676)	(12.679)
eu_{it}	-645.806^{***}	-638.327^{***}	-438.233^{***}	-432.541^{***}
	(105.951)	(105.931)	(83.637)	(83.573)
	$R^2 = 0.980$		$R^2 = 0.980$	
	p(F-Test) $= 0$	p(Hausman) $= 0.546$	p(F-Test) $= 0$	p(Hausman) $= 0.653$
Foreign propensities				
Variable	FE export coefficients	RE export coefficients	FE import coefficients	RE import coefficients
C	2545.950^{***}	2411.010^{***}	2963.370^{***}	2796.500^{***}
	(154.020)	(598.218)	(191.609)	(786.257)
y_{it}	0.001	0.002^{**}	0.002^{**}	0.003^{***}
	(0.001)	(0.001)	(0.001)	(0.001)
t	63.451^{***}	62.036^{***}	93.422^{***}	91.627^{***}
	(3.479)	(3.417)	(4.328)	(4.272)
Δex_{it}	-7.227	-7.326	-3.850	-4.073
	(13.099)	(13.164)	(16.296)	(16.431)
eu_{it}	-478.711^{***}	-452.193^{***}	-659.341^{***}	-623.888^{***}
	(87.377)	(87.306)	(108.702)	(109.024)
	$R^2 = 0.976$		$R^2 = 0.982$	
	p(F-Test) $= 0$	p(Hausman) $= 0.022$	p(F-Test) $= 0$	p(Hausman) $= 0.002$

*** significant at 1% level – ** significant at 5% level – standard errors in parentheses

Note: There is no causality behind negative EU variable coefficients but only a reflexion of sample selection.

Source: Federal Statistical Office of Germany, Eurostat and own calculations

Table 10: Unrestricted estimation results for exports: model 1a–b

	Model 1a			Model 1b		
Variable	FE	RE	POLS	FE	RE	POLS
C	-16.941^{***}	-12.643^{***}	-26.359	-23.304^{***}	-15.627^{***}	-27.029
	(4.404)	(4.822)	(15.328)	(4.681)	(4.914)	(15.706)
$\log(y_{it})$	1.331^{***}	1.002^{***}	0.786^{***}	1.506^{***}	0.961^{***}	0.797^{***}
	(0.082)	(0.043)	(0.008)	(0.086)	(0.042)	(0.008)
$\log(y_t)$	0.912^{***}	1.427^{***}	2.364^{**}	1.158^{***}	1.602^{***}	2.423^{**}
	(0.340)	(0.359)	(1.169)	(0.364)	(0.367)	(1.198)
t	0.009^{***}	0.009^{***}	0.003	0.005^{***}	0.008^{***}	0.002
	(0.002)	(0.002)	(0.005)	(0.002)	(0.002)	(0.005)
eu_{it}	-0.002	0.044^{***}	0.250^{***}	0.004	0.055^{***}	0.276^{***}
	(0.017)	(0.016)	(0.030)	(0.018)	(0.017)	(0.030)
$\log(ex_{it})$	-0.556^{***}	-0.208^{***}	0.042^{***}			
	(0.045)	(0.029)	(0.006)			
$\log(D_i)$		-1.219^{***}	-0.823^{***}		-1.143^{***}	-0.837^{***}
		(0.150)	(0.025)		(0.145)	(0.025)
ggd_i		-0.395	0.231^{***}		-0.203	0.185^{***}
		(0.241)	(0.038)		(0.232)	(0.039)
c_t	-0.047^{**}	-0.054^{**}	-0.054	-0.049^{**}	-0.056^{**}	-0.052
	(0.021)	(0.022)	(0.073)	(0.022)	(0.023)	(0.075)
c_{t-1}	-0.019	-0.014	-0.003	-0.019	-0.013	-0.001
	(0.021)	(0.022)	(0.074)	(0.022)	(0.023)	(0.076)
c_{t-2}	-0.030	-0.029	-0.028	-0.028	-0.029	-0.028
	(0.020)	(0.022)	(0.072)	(0.022)	(0.022)	(0.074)
c_{t-3}	-0.041	-0.046	-0.025	-0.039	-0.047	-0.020
	(0.028)	(0.030)	(0.098)	(0.030)	(0.031)	(0.101)
c_{t-4}	-0.105^{***}	-0.100^{***}	-0.070	-0.085^{**}	-0.095^{***}	-0.066
	(0.032)	(0.034)	(0.112)	(0.034)	(0.035)	(0.114)
c_{t-5}	-0.055	-0.061^{**}	-0.062	-0.053	-0.062	-0.061
	(0.029)	(0.031)	(0.102)	(0.031)	(0.032)	(0.104)
c_{t-6}	0.019	0.017	0.017	0.022	0.017	0.017
	(0.029)	(0.031)	(0.102)	(0.031)	(0.032)	(0.104)
c_{t-7}	0.034	0.032	0.036	0.036	0.032	0.036
	(0.029)	(0.031)	(0.102)	(0.031)	(0.032)	(0.104)
c_{t-8}	-0.042	-0.047	-0.039	-0.033	-0.047	-0.038
	(0.030)	(0.032)	(0.105)	(0.032)	(0.033)	(0.108)
	p(F-Test) $= 0$	p(Hausman) ≈ 0		p(F-Test) $= 0$	p(Hausman) ≈ 0	
	$R^2 = 0.995$		$R^2 = 0.937$	$R^2 = 0.994$		$R^2 = 0.934$

*** significant at 1% level – ** significant at 5% level – standard errors in parentheses

Source: Federal Statistical Office of Germany, Eurostat and own calculations

Table 11: Unrestricted estimation results for exports: model 2–4

	Model 2		Model 3		Model 4	
Variable	FE	RE	FE	RE	FE	RE
C	-23.023^{***}	-14.777^{***}	-23.061^{***}	-14.950^{***}	-23.054^{***}	-14.893^{***}
	(4.630)	(4.858)	(4.667)	(4.880)	(4.680)	(4.910)
$\log(y^*_{it})$	1.511^{***}	0.956^{***}	1.465^{***}	0.945^{***}	1.557^{***}	0.946^{***}
	(0.086)	(0.042)	(0.087)	(0.041)	(0.093)	(0.042)
$\log(y^*_t)$	1.133^{***}	1.537^{***}	1.171^{***}	1.549^{***}	1.100^{***}	1.545^{***}
	(0.359)	(0.363)	(0.361)	(0.365)	(0.363)	(0.367)
t	0.005^{***}	0.009^{***}	0.006^{***}	0.009^{***}	0.005^{***}	0.009^{***}
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
eu_{it}	0.003	0.056^{***}	0.008	0.057^{***}	0.004	0.060^{***}
	(0.018)	(0.017)	(0.018)	(0.017)	(0.018)	(0.017)
$\log(D_i)$		-1.136^{***}		-1.118^{***}		-1.120^{***}
		(0.142)		(0.141)		(0.142)
ggd_i		−0.192		−0.166		−0.170
		(0.227)		(0.226)		(0.228)
c_t	−0.003	0.007	0.027	0.026	0.064^{***}	0.049^{**}
	(0.021)	(0.022)	(0.021)	(0.022)	(0.022)	(0.022)
c_{t-1}	−0.023	−0.019	−0.024	−0.020	−0.024	−0.019
	(0.022)	(0.023)	(0.022)	(0.023)	(0.022)	(0.023)
c_{t-2}	−0.030	−0.032	−0.033	−0.033	−0.034	−0.034
	(0.022)	(0.022)	(0.022)	(0.023)	(0.022)	(0.023)
c_{t-3}	-0.065^{**}	-0.084^{***}	-0.086^{***}	-0.097^{***}	-0.104^{***}	-0.109^{***}
	(0.028)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
c_{t-4}	-0.124^{***}	-0.148^{***}	-0.147^{***}	-0.162^{***}	-0.185^{***}	-0.188^{***}
	(0.031)	(0.032)	(0.031)	(0.032)	(0.031)	(0.032)
c_{t-5}	−0.045	−0.051	−0.052	−0.055	−0.056	−0.058
	(0.031)	(0.032)	(0.031)	(0.032)	(0.031)	(0.032)
c_{t-6}	0.033	0.033	0.034	0.033	0.037	0.035
	(0.031)	(0.032)	(0.031)	(0.032)	(0.031)	(0.032)
c_{t-7}	0.042	0.040	0.041	0.040	0.043	0.041
	(0.031)	(0.032)	(0.031)	(0.032)	(0.031)	(0.032)
c_{t-8}	0.008	0.010	0.057	0.042	0.122^{***}	0.080^{**}
	(0.030)	(0.031)	(0.031)	(0.031)	(0.031)	(0.032)
	p(F-Test) = 0	p(Hausman) ≈ 0	p(F-Test) = 0	p(Hausman) ≈ 0	p(F-Test) = 0	p(Hausman) ≈ 0
	$R^2 = 0.994$		$R^2 = 0.994$		$R^2 = 0.994$	

*** significant at 1% level – ** significant at 5% level – standard errors in parentheses

Source: Federal Statistical Office of Germany, Eurostat and own calculations

Table 12: Unrestricted estimation results for imports: model 1a–b

	Model 1a			Model 1b		
Variable	FE	RE	POLS	FE	RE	POLS
C	-32.447^{***}	-27.319^{***}	-23.326	-32.972^{***}	-26.840^{***}	-24.050
	(7.611)	(7.757)	(22.466)	(7.556)	(7.734)	(22.765)
$\log(y_{it})$	0.436^{***}	0.786^{***}	0.862^{***}	0.450^{***}	0.792^{***}	0.874^{***}
	(0.142)	(0.062)	(0.011)	(0.139)	(0.062)	(0.011)
$\log(y_t)$	2.669^{***}	2.441^{***}	2.154	2.689^{***}	2.413^{***}	2.217
	(0.588)	(0.581)	(1.713)	(0.587)	(0.580)	(1.736)
t	0.004	0.001	0.003	0.003	0.002	0.002
	(0.003)	(0.003)	(0.008)	(0.003)	(0.003)	(0.008)
eu_{it}	0.079^{***}	0.049	-0.027	0.079^{***}	0.047	0.001
	(0.029)	(0.026)	(0.044)	(0.029)	(0.026)	(0.044)
$\log(ex_{it})$	-0.046	0.034	0.045^{***}			
	(0.078)	(0.042)	(0.008)			
$\log(D_i)$		-0.851^{***}	-0.988^{***}		-0.862^{***}	-1.003^{***}
		(0.209)	(0.036)		(0.208)	(0.036)
ggd_i		0.277	0.100		0.248	0.051
		(0.335)	(0.056)		(0.332)	(0.056)
c_t	-0.059	-0.055	-0.056	-0.059	-0.055	-0.055
	(0.036)	(0.036)	(0.107)	(0.036)	(0.036)	(0.109)
c_{t-1}	-0.031	-0.034	-0.038	-0.031	-0.035	-0.037
	(0.036)	(0.036)	(0.108)	(0.036)	(0.036)	(0.110)
c_{t-2}	0.044	0.045	0.045	0.045	0.045	0.045
	(0.035)	(0.035)	(0.106)	(0.035)	(0.035)	(0.107)
c_{t-3}	0.012	0.017	0.008	0.012	0.017	0.013
	(0.048)	(0.048)	(0.144)	(0.048)	(0.048)	(0.146)
c_{t-4}	-0.026	-0.017	-0.026	-0.024	-0.018	-0.023
	(0.055)	(0.055)	(0.164)	(0.055)	(0.055)	(0.166)
c_{t-5}	-0.062	-0.057	-0.057	-0.062	-0.056	-0.056
	(0.050)	(0.050)	(0.149)	(0.050)	(0.050)	(0.151)
c_{t-6}	0.003	0.006	0.006	0.003	0.006	0.007
	(0.050)	(0.050)	(0.149)	(0.050)	(0.050)	(0.151)
c_{t-7}	0.032	0.034	0.033	0.032	0.034	0.034
	(0.050)	(0.050)	(0.149)	(0.050)	(0.050)	(0.151)
c_{t-8}	-0.007	0.002	0.000	-0.006	0.002	0.002
	(0.052)	(0.052)	(0.155)	(0.052)	(0.052)	(0.157)
	p(F-Test) = 0	p(Hausman) = 0.885		p(F-Test) = 0	p(Hausman) = 0.869	
	$R^2 = 0.988$		$R^2 = 0.888$	$R^2 = 0.988$		$R^2 = 0.885$

*** significant at 1% level – ** significant at 5% level – standard errors in parentheses

Source: Federal Statistical Office of Germany, Eurostat and own calculations

Table 13: Unrestricted estimation results for imports: model 2–4

	Model 2		Model 3		Model 4	
Variable	FE	RE	FE	RE	FE	RE
C	-32.159^{***}	-26.396^{***}	-32.177^{***}	-26.445^{***}	-32.178^{***}	-26.236^{***}
	(7.474)	(7.645)	(7.475)	(7.646)	(7.474)	(7.641)
$\log(y_{it}^*)$	0.463^{***}	0.791^{***}	0.459^{***}	0.790^{***}	0.495^{***}	0.805^{***}
	(0.139)	(0.062)	(0.139)	(0.062)	(0.149)	(0.063)
$\log(y_t^*)$	2.617^{***}	2.380^{***}	2.621^{***}	2.383^{***}	2.594^{***}	2.369^{***}
	(0.579)	(0.573)	(0.579)	(0.573)	(0.580)	(0.572)
t	0.004	0.002	0.004	0.002	0.003	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
eu_{it}	0.079^{***}	0.048	0.079^{***}	0.048	0.077^{***}	0.049
	(0.029)	(0.026)	(0.029)	(0.026)	(0.029)	(0.026)
$\log(D_i)$		-0.863^{***}		-0.861^{***}		-0.885^{***}
		(0.211)		(0.211)		(0.212)
ggd_i		0.248		0.250		0.214
		(0.338)		(0.338)		(0.338)
c_t	0.048	0.043	0.058	0.058	0.069^{**}	0.077^{**}
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
c_{t-1}	-0.041	-0.043	-0.041	-0.044	-0.041	-0.043
	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)
c_{t-2}	0.040	0.041	0.039	0.040	0.039	0.039
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)
c_{t-3}	-0.050	-0.038	-0.056	-0.049	-0.061	-0.059
	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)
c_{t-4}	-0.113^{**}	-0.098	-0.120^{**}	-0.110^{**}	-0.132^{***}	-0.131^{***}
	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)
c_{t-5}	-0.043	-0.040	-0.045	-0.043	-0.046	-0.045
	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)
c_{t-6}	0.030	0.031	0.031	0.031	0.031	0.032
	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)
c_{t-7}	0.046	0.047	0.046	0.047	0.047	0.048
	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)	(0.050)
c_{t-8}	0.090	0.089	0.105^{**}	0.115^{**}	0.126^{**}	0.148^{***}
	(0.049)	(0.049)	(0.049)	(0.049)	(0.050)	(0.049)
	p(F-Test) = 0	p(Hausman) = 0.893	p(F-Test) = 0	p(Hausman) = 0.883	p(F-Test) = 0	p(Hausman) = 0.963
	$R^2 = 0.988$		$R^2 = 0.988$		$R^2 = 0.988$	

*** significant at 1% level – ** significant at 5% level – standard errors in parentheses

Source: Federal Statistical Office of Germany, Eurostat and own calculations

Table 14: Restricted estimation results: exports and imports

(a) Exports

	Model 1a		Model 1b		Model 2		Model 3		Model 4	
Variable	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE
c_t	-0.047^{***}	-0.046^{***}	-0.053^{***}	-0.048^{***}		-0.027^{**}	-0.031^{**}		-0.025^{**}	
	(0.012)	(0.013)	(0.013)	(0.013)		(0.012)	(0.012)		(0.012)	
c_{t-2}	-0.044^{***}	-0.045^{***}	-0.040^{***}	-0.044^{**}	-0.069^{***}					
	(0.017)	(0.018)	(0.018)	(0.018)	(0.015)					
c_{t-3}						-0.088^{***}	-0.083^{***}	-0.108^{***}	-0.087^{***}	-0.108^{***}
						(0.026)	(0.026)	(0.025)	(0.026)	(0.025)
c_{t-4}	-0.133^{***}	-0.146^{***}	-0.111^{***}	-0.142^{***}	-0.135^{***}	-0.139^{***}	-0.133^{***}	-0.138^{***}	-0.161^{***}	-0.160^{***}
	(0.018)	(0.019)	(0.019)	(0.019)	(0.017)	(0.026)	(0.026)	(0.025)	(0.026)	(0.025)

*** significant at 1% level – ** significant at 5% level – standard errors in parentheses

Source: Federal Statistical Office of Germany, Eurostat and own calculations

(b) Imports

	Model 1a		Model 1b		Model 2		Model 3		Model 4	
Variable	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE
c_t	-0.074^{***}	-0.080^{***}	-0.076^{***}	-0.080^{***}						
	(0.021)	(0.021)	(0.021)	(0.021)						
c_{t-2}	0.057^{**}	0.068^{**}	0.060^{**}	0.068^{**}						
	(0.027)	(0.027)	(0.027)	(0.027)						
c_{t-4}					-0.140^{***}	-0.117^{***}	-0.156^{***}	-0.140^{***}	-0.172^{***}	-0.167^{***}
					(0.030)	(0.029)	(0.029)	(0.028)	(0.028)	(0.028)
c_{t-7}					0.092^{***}	0.099^{***}				
					(0.027)	(0.027)				
c_{t-8}							0.101^{***}	0.113^{***}	0.109^{***}	0.127^{***}
							(0.028)	(0.028)	(0.029)	(0.028)

*** significant at 1% level – ** significant at 5% level – standard errors in parentheses

Source: Federal Statistical Office of Germany, Eurostat and own calculations

Table 15: Restricted estimations for direct import effects: sample without Malta

	Model 1a			Model 1b		
Variable	FE	RE		FE	RE	
C	-38.530^{***}	-32.882^{***}	-28.907^{***}	-39.533^{***}	-32.934^{***}	-28.990^{***}
	(4.556)	(4.834)	(4.108)	(4.527)	(4.818)	(4.100)
$\log(y_{it})$	0.461^{***}	0.776^{***}	0.772^{***}	0.474^{***}	0.774^{***}	0.0771^{***}
	(0.115)	(0.062)	(0.056)	(0.115)	(0.062)	(0.056)
$\log(y_t)$	3.133^{***}	2.867^{***}	2.531^{***}	3.177^{***}	2.870^{***}	2.536^{***}
	(0.363)	(0.351)	(0.303)	(0.363)	(0.350)	(0.302)
t	0.000	-0.002	0.000	-0.001	-0.002	0.000
	(0.001)	0.001	(0.001)	(0.001)	(0.001)	(0.001)
eu_{it}	0.114^{***}	0.079^{***}	0.084^{***}	0.117^{***}	0.079^{***}	0.084^{***}
	(0.026)	(0.024)	(0.023)	(0.026)	(0.024)	(0.023)
$\log(ex_{it})$	-0.116	-0.004	-0.010			
	(0.064)	(0.040)	(0.039)			
$\log(D_i)$		-0.823^{***}	-0.761^{***}		-0.821^{***}	-0.761^{***}
		(0.209)	(0.169)		(0.210)	(0.170)
ggd_i		0.273	0.420^{**}		0.277	0.423^{**}
		(0.328)	(0.169)		(0.329)	(0.169)
c_t	-0.070^{***}	-0.077^{***}	-0.060^{***}	-0.072^{***}	-0.077^{***}	-0.060^{***}
	(0.021)	(0.021)	(0.017)	(0.021)	(0.021)	(0.017)
c_{t-2}	0.029	0.043		0.032	0.043	
	(0.026)	(0.026)		(0.026)	(0.026)	
	p(F-Test) $= 0$	p(Hausman) $= 0.040$	p(Hausman) $= 0.048$	p(F-Test) $= 0$	p(Hausman) $= 0.126$	p(Hausman) $= 0.196$
	$R^2 = 0.987$			$R^2 = 0.987$		

*** significant at 1% level – ** significant at 5% level – standard errors in parentheses

Note: Technically, RE estimators are not indisputably adequate for model 1a. But, to create a basis of comparison for crisis responses, RE estimators are employed in case of model 1a too.

Source: Federal Statistical Office of Germany, Eurostat and own calculations