Preliminary, not to be quoted

"Understanding the global trade downturn and recovery"[1]
by
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Abstract

This paper aims to shed light on why the downturn in global trade during the intensification of the financial crisis in 2008Q4-2009Q1 was so severe and synchronized across the world, and also examines the subsequent recovery in global trade during 2009Q2-2009Q4. The paper finds that a structural imports function which captures the different and time-varying import-intensities of the components of total final expenditure - consumption, investment, government expenditure, exports, etc – can explain the sharp decline in global imports of goods and services. By contrast, a specification based on aggregate total expenditure can not fully capture the global trade downturn. In particular, panel estimates for a large number of OECD countries based on the individual components of expenditure suggest that the high import-intensity of exports at the country-level can explain a significant proportion of the decline in world imports during the crisis, while declines in the highly import-intensive expenditure category of investment also contributed to the remaining fall in global trade. At the same time, the high and rising import-intensity of exports also reflects and captures the rapid growth in "vertical specialisation", suggesting that widespread global production chains may have amplified the downturn in world trade and partly explains its high-degree of synchronisation across the globe. In addition, the estimates find that stockbuilding, business confidence and credit conditions also played a role in the global trade downturn. Meanwhile, the global trade recovery (2009Q2-2009Q4) can only be partially explained by differential elasticities for the components of demand (although the results confirm that the upturn in OECD imports was also driven by strong export growth and the reactivation of global production chains, as well as fiscal stimulus). This may be partly due to the many policy measures that were implemented to boost global trade at that time and which can not be captured by the specification. The paper is also a pseudo-real time robustness test of the specification in that the first analysis of the global trade downturn is based on the data available at the time (ie, October 2009 vintage), while an updated analysis of the global downturn as well as the trade upturn is based on a more recent dataset (ie, June 2010 vintage). The results for the global downturn remain robust regardless of which vintage of the dataset is used.

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1. Introduction

This paper aims to shed light on why the contraction in global trade during the intensification of the financial crisis in 2008Q4-2009Q1 was so severe and synchronized across the world, and which was particularly pronounced for trade in capital and intermediate goods. Indeed, standard trade equations fail to capture the global trade downturn.[2] Possible explanations for the large scale and highly synchronized nature of the trade downturn and these stylised facts include: problems regarding the cost and availability of trade finance; vertical specialization and the internationalisation of production; and the significant decline in capital expenditure. The paper also examines the subsequent recovery in global trade during 2009Q2-2009Q4.

The prime objective of this paper is to investigate whether part of the explanation for the severity and internationally synchronised fall in world trade, as well as the subsequent recovery in global trade, may depend on the different movements in the components of total final expenditure – ie, consumption, investment, government expenditure, exports, etc - combined with their different import intensities. In addition, the roles played by financial constraints and business confidence regarding the global trade decline and upturn are also examined. The analysis attempts to answer these questions at the global level by using panel estimation techniques for a large number of OECD countries.

The main contribution of this paper is that it uses a systematic approach in order to arrive at an imports specification which reveals the differential effects of individual components of aggregate demand upon imports, and finds that such a specification can explain the sharp decline in global imports of goods and services during the global trade crisis of 2008Q4-2009Q1 (in contrast to trade specifications which use aggregate demand terms which fail to explain the decline in global trade). Meanwhile, the global trade recovery (2009Q2-2009Q4) can only be partially explained by differential elasticities for the components of demand. This may be partly due to the many policy measures that were implemented to boost global trade which corresponded with the trade recovery but can not be captured by the specification.

A key important contribution of the paper is that the time-varying parameter nature of the specification also captures the important role of the high and rising import-intensity of exports

[2] See, for example, Bussiere et al (2009) and Cheung and Guichard (2009).

associated with the rapid growth in "vertical specialisation", suggesting that widespread global production chains may have amplified the downturn as well as the subsequent upturn in world trade and partly explains its high-degree of synchronisation across the globe. The paper is also a pseudo-real time robustness test of the specification in that the first analysis of the global trade downturn is based on the data available at the time (ie, October 2009 vintage), while an updated analysis of the global downturn as well as the trade upturn is based on a more recent dataset (ie, June 2010 vintage). The results for the global downturn remain robust regardless of which vintage of the dataset is used.

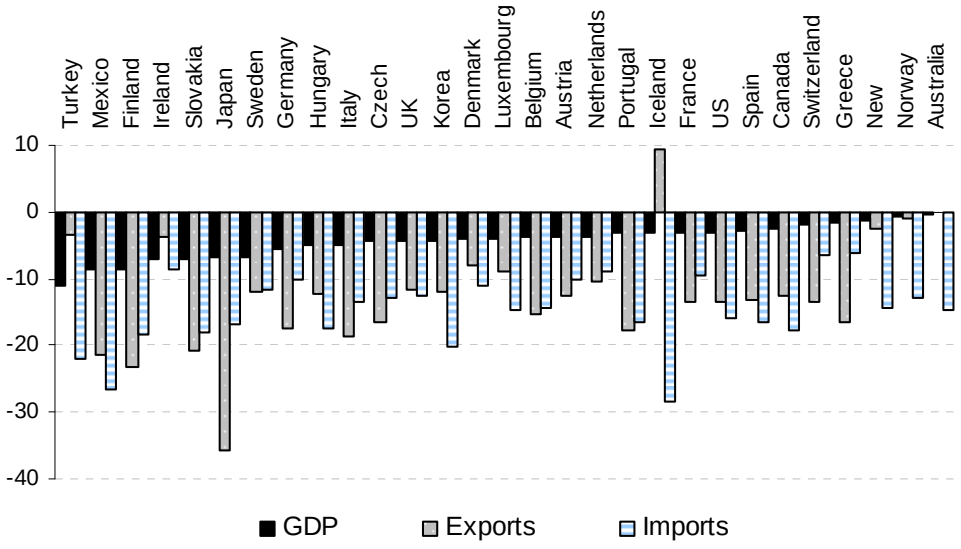
The outline of the paper is as follows. In Section 2, we look at the stylised facts of the global trade contraction during 2008Q4-2009Q1. In Section 3 we briefly examine the various factors that may account for the severity and highly synchronised downturn in global trade over this period. The econometric imports specification is estimated for the global trade downturn (using the October 2009 vintage of the dataset for the period 1995Q1-2009Q1), and the empirical results and their economic interpretation are described in Section 4. Section 5 examines the global trade recovery during 2009Q2-2009Q4 (using the updated June 2010 vintage of the dataset for the period 1995Q1-2009Q4). Finally, Section 6 concludes and highlights some policy implications.

2. Stylised facts of the global trade contraction

As relevant background to the more detailed analysis later, we begin by describing the developments in GDP, trade and other expenditure components across the individual OECD countries during the global trade contraction in 2008Q4-2009Q1 at the height of the financial turmoil. Chart 1 shows the cumulative percentage change in real GDP across the OECD countries as well as export and import volumes of goods and services during 2008Q4-2009Q1 (in descending order of the magnitude of decline in GDP). The series are broadly characterised by substantially larger declines in both exports and imports in comparison to GDP, while exports and imports appear to be highly correlated for many of the individual countries. Turning to Chart 2, we see that the decline in real fixed capital formation during the crisis period also significantly outweighs the decline in GDP for virtually all of the countries in the sample. By contrast, private consumers' expenditure fell significantly *less* than GDP, while government expenditure actually rose in the majority of the OECD countries (Chart 3).

One key message from these stylised facts seems to be that it was especially the import-intensive components of expenditure which experienced particularly marked declines (ie, exports of goods and services and gross fixed capital formation), while the less import-intensive demand categories registered smaller declines or actually increased (ie, private consumers' expenditure and government expenditure).[3]

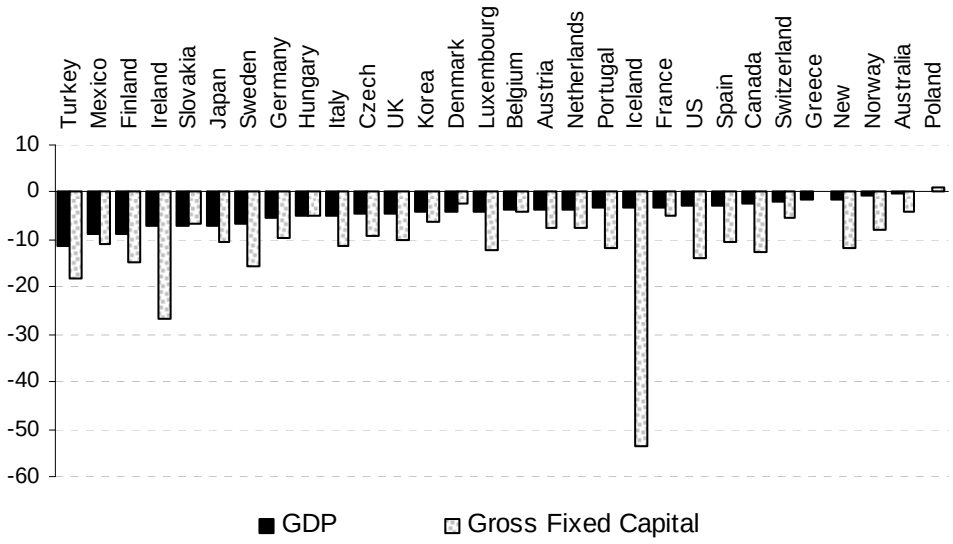
Chart 1: Real GDP and export and import volumes of goods and services. (cumulative percentage change, 2008Q4-2009Q1)



Source: Haver, ECB calculations.

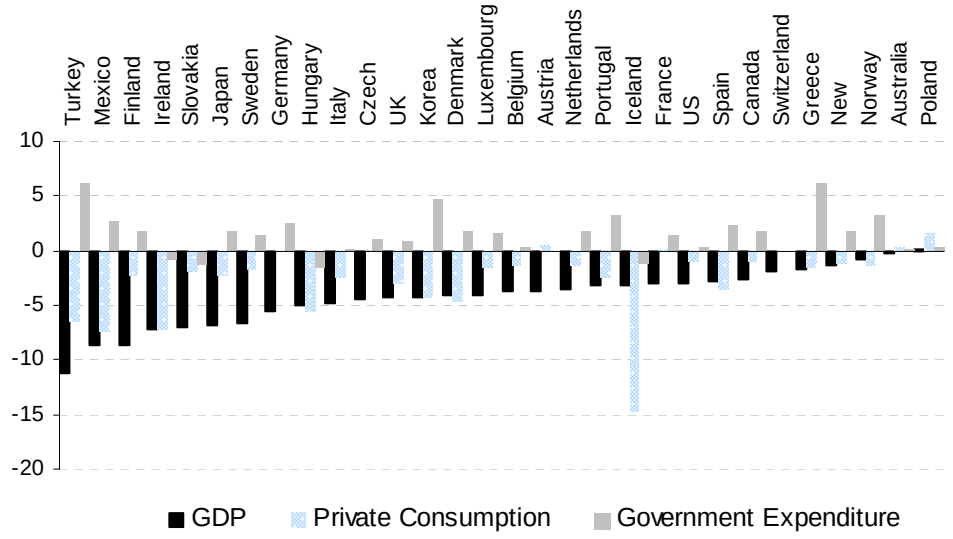
[3] Although somewhat out-of-date, approximations of the import-intensity of the different components of demand can be calculated from input-output tables. For example, based on input-output tables for the year 2000 for five euro area countries, euro area exports have by far the highest import content (44.2%), followed by total investment (29%), while the import content of private consumption and government consumption was much lower at 19.7% and 7.8% respectively. [Source: ESCB, 2005].

Chart 2: Real GDP and fixed capital formation. (cumulative percentage change, 2008Q4-2009Q1)



Source: Haver, ECB calculations.

Chart 3: Real GDP, private consumption and government expenditure. (cumulative percentage change, 2008Q4-2009Q1)



Source: Haver, ECB calculations.

Other key stylised facts relate to the impact of the downturn on specific trade categories across the globe. In particular, it seems that trade in capital and intermediate goods was particularly badly hit, while the impact on trade in consumption goods was somewhat less severe. Another stylised fact at the global level is that international trade in motor vehicles experienced an especially strong decline in 2008Q4-2009Q1.[4]

3. Possible factors explaining the severity and highly synchronised downturn in world trade

A number of factors have been suggested as possibly causing the severity of the downturn, ranging from: vertical specialisation and the internationalisation of production; constraints and costs of trade credit and trade finance; and the decline in global investment. Starting with the *internationalisation of production*, falling costs of transporting not only goods, but also services and information across borders has resulted in an increasing international fragmentation of production. As a result, the export of a single final good or product may now require a number of intermediate stages of production involving the product in numerous crossings of international borders, with each stage counted as both an import and an export. This vertical specialisation, combined with the fact that trade is measured in "gross" terms while GDP is measured on a "net" basis, seems to be part of the reason for the much faster speed of the growth in world trade relative to GDP in recent decades. [5]

The apparent growth in vertical specialisation is therefore consistent with the previously mentioned high and rising import-intensity of exports (Section 2). In other words, each country's exports are becoming more dependent on imports partly due to the rising use of imported intermediate goods, hence the whole global trade chain has become increasingly interconnected. It therefore seems a reasonable hypothesis that the rapid growth in vertical specialisation and widespread global production chains associated with globalisation may have contributed to both the severity and highly synchronised nature of the downturn in global trade during 2008Q4-2009Q1. This hypothesis is also expounded by Yi (2003, 2009) who argues that trade in a world of global supply chains and growing internationalisation of production may result in

[4] The particulary strong declines in trade in capital goods, intermediate goods and motor vehicles during the crisis is well documented in several papers, for example: Freund (2009); European Commission (2009); Brincongne et al (2010); European Central Bank (2010), etc.

[5] See, for example, Hummels et al (2001) who estimates that vertical specialisation is responsible for almost one third of the total growth in world trade over past recent decades. In addition, Amador and Cabral (2009) show that the internationalisation of production has grown rapidly since the early 1990s, a claim that is backed up by Miroudot and Ragoussis (2009) who calculate that vertical specialisation trade is responsible for about a third of trade among OECD and related economies.

amplified and potentially non-linear trade responses to international shocks which are also transmitted more rapidly across countries in a more synchronised manner. Furthermore, Yi (2009) claims that the significantly bigger trade downturn in sectors such as motor vehicles provides additional evidence that global supply chains account for some of the severity and synchronisation of the global trade downturn. Against this background, and as highlighted and described by Cheung and Guichard (2009), Chart 1 reveals that the countries which experienced the larger trade declines during 2008Q4-2009Q1 correspond to those with rapidly growing, or higher proportions, of vertical trade according to the Miroudot and Ragoussis (2009) measure (for example: Mexico, Germany, Finland, Korea, Spain, Portugal, Hungary, Czech Republic, Belgium, etc). Furthermore, the stylised facts highlighted in Section 2 regarding the declines in imports and exports of intermediate goods are also consistent with the idea that the growing importance of vertical specialisation and the international fragmentation of production also played a key role in the synchronisation of the trade downturn.[6]

Another possible reason for the severity of the downturn in global trade has been the apparent increase in the cost, and reduced availability, of *trade finance*. An IMF survey revealed an acceleration in the decline in the value of trade finance during the period October 2008 and January 2009.[7] Nevertheless, the survey also showed that after an initial period, the main reason for the decrease in trade finance was due to a fall in the demand for trade finance rather than constraints in the supply of credit. Auboin (2009) claims that the price of trade finance increased particularly sharply for emerging countries due to scarce liquidity and re-assessment of customer and country-risks ("spreads on 90-day letters of trade credit rose spectacularly during the latter part of 2008, increasing from 10-16 basis points on a normal basis, to 250 to 500 basis points for letters of credit issued by emerging and developing countries").[8]

Of course, trade finance problems may exacerbate the downturn in trade that may be associated with global supply chains and the international fragmentation of production (ie, the failure to obtain trade finance by one producer/trading partner can disrupt the

[6] However, note that the case studies carried out by Anderton and Schultz (1999) show that international outsourcing also uses final goods as well as intermediate goods in the production of exports (hence measures of vertical specialisation based only on intermediate imports do not capture the whole picture).

[7] See IMF Finance and Development, March 2009.

[8] Auboin (2009) – writing in June 2009 – argued that the market gap between the supply and demand for trade credit could be at the lower end of around $25 billion, but was more likely to be above $100 billion and possibly up to $300 billion (out of a global market for trade finance estimated at some $10-12 trillion).

whole global supply chain for a particular product). Similarly, sectors more acutely responsive to credit conditions and most affected by the financial crisis, such as motor vehicle production and capital-expenditure (investment) goods, are also those characterised by a high degree of vertical specialisation from an international trade perspective, and which also experienced strong falls in exports and imports during 2008Q4-2009Q1.

4. Econometric specification

In this section, we derive an imports specification including various variables which may capture the global trade downturn. In addition, we use dummy variables to see which factors may have played a special role during the crisis, and also compare how well an imports specification with differential expenditure component elasticities captures the global trade downturn in comparison to a more traditional specification which uses aggregate total final expenditure.

We begin with a standard import specification expressed in first differences where imports are determined by aggregate demand and relative prices:[9]

$$\Delta \ln impgs_{j,t} = c + \alpha_1 \Delta \ln tfe_{j,t} + \alpha_2 \Delta \ln rpm_{j,t} + \varepsilon_t \quad (1)$$

where: $\Delta \ln impgs_{j,t}$ is the quarterly change in the log of real imports and services for country *j;* $\Delta \ln tfe_{j,t}$ is the quarterly change in the log total final expenditure; $\Delta \ln rpm_{j,t}$ is the quarterly change in the log of relative import prices (defined as the imports deflator divided by the GDP deflator); and a constant (c).[10]

In order to respecify (1) in terms of the separate i components of *tfe*, we can use the following approximation:

$$\Delta \ln(\sum tfe_i) = \sum_i (tfe_i / \sum_i tfe_i) \Delta \ln tfe_i \quad (2)$$

Where the tfe_i components consist of: real consumers'expenditure (*conex*); real government expenditure (*govex*); real gross fixed capital formation (*gfcf*); and real exports of goods and services (*expgs*). To keep the approximation accurate, the

[9] There is a vast empirical and theoretical literature where the main explanatory variables for trade volume equations consist of demand and relative price (or competitiveness) terms. See, for example: Anderton (1999a,b), Landesmann and Snell (1989), Pain et al (2005), while Herve (2001) provides an empirical cross-country survey of parameters estimated using such models.

[10] Most of the data used in this analysis are obtained from the OECD's Main Economic Indicators (See Appendix for further details of data definitions and sources).

weights $tfe_i / \sum_i tfe_i$ should not be constant but moving shares; for example, values as of the most recent past.[11] Denoting the moving shares by λ, we can rewrite (1) as:

$$\Delta \ln impgs_{j,t} = c + \sum_i \alpha_{1i} \lambda_i \Delta \ln tfe_{ij,t} + \alpha_2 \Delta \ln rpm_{j,t} + \varepsilon_t \quad (3)$$

In (3), we have allowed the individual α_{1i} coefficients to be different rather than restricting them to be the same, as (1) implicitly does. In addition, we can see the sorts of specification errors that would occur if a researcher simply respecifies (1) in terms of the components of *tfe* by simply introducing the $\Delta \ln tfe_i$ components (ie, one would be estimating the composite terms $\alpha_{1i}\lambda_i$ rather than α_{1i}).

Although stockbuilding is part of total final expenditure,[12] technical reasons prevent us from including it in the approximation of *tfe* as specified in (2) and we therefore include the change in stocks (*stocks*) as a separate term as shown in equation (4).[13] In addition, we also augment equation (4) with terms which seem to have played a significant role during the recent sharp downturn in trade, namely: the reduced availability and higher cost of trade credit (*credcon*); and business confidence (*bconf*):

$$\Delta \ln impgs_{j,t} = c + \sum_i \alpha_{1i} \lambda_i \Delta \ln tfe_{ij,t} + \alpha_2 \Delta \ln rpm_{j,t} + \alpha_3 bconf_{j,t} + \alpha_4 credcon_{j,t} + \alpha_5 \Delta stocks_{j,t} + \varepsilon_t \quad (4)$$

Trade credit conditions (*credcon*) are approximated by the product of US credit standards and the US high-yield spread (ie, *credcon* rises when credit conditions deteriorate).[14] Business confidence (*bconf*) is proxied by the OECD survey measure and is included partly as a possible leading indicator of movements in demand (ie, *bconf* rises when confidence improves). *A priori*, positive signs are expected for the individual components of demand (tfe_i) as well as business confidence (*bconf*) and

[11] For a similar technique see Anderton and Desai (1988) as well as Stirboeck (2006). Meanwhile, Bussiere, Callegari, Ghironi, and Yamano (2010) also look at the role of the expenditure components in explaining trade movements.

[12] Note that GDP=conex+govex+gfcf+stocks+expgs-impgs, while TFE = GDP+impgs = conex+govex+gfcf+stocks+expgs.

[13] There are computational difficulties in entering stockbuilding as a separate category in the approximation specified in (2), partly related to the fact that stockbuilding accounts for an extremely small share of *tfe* and can not be logged as it frequently registers negative values.

[14] Credcon is based on a similar variable used by the OECD to proxy financial conditions in an equation which explains world trade. See Box 1.2 "The role of financial conditions in driving trade" (OECD, 2009).

the change in stocks (*stocks*), while negative signs are expected for both relative import prices (*rpm*) and credit conditions (*credcon*).

Empirical estimation (based on October 2009 vintage of the dataset)

Panel estimates of equation (4) are obtained by pooling the data across a large number of OECD countries and thereby providing an estimate of the parameters for the OECD as a whole. The estimates are also real time estimates in that they are based on the data available at the time (ie, October 2009 vintage of the dataset). We use a 6-quarter moving average share for the λ_i.[15] In effect, the same slope parameters are imposed across the different countries, but fixed effects allow each country to have a different intercept.[16]

Our estimation strategy is to estimate the imports function as specified in equation (4) using different panel econometric techniques and to compare the results in the following way. First, the LSDV estimator is used. These results are then checked for robustness by estimating the same equation by GMM. Given the rejection of the common slope restriction, we also estimate the equation using the Mean Group estimator, which is the simple arithmetic average of the individual countries' coefficients. Note that, we estimate the equation using only contemporaneous first difference terms for the dependent as well as explanatory variables relating to the components of demand.[17] Further note that all variables used in estimation are of the same order of integration as unit root tests show that all of the components of demand as well as relative import prices are I(1) variables when expressed in logarithms (hence are stationary in first difference form), while *bconf*, *stocks* and *credcon* are all stationary in levels (see Table 5 in the Appendix). All of the explanatory variables are instrumented by their own lagged values in order to avoid simultaneity problems. A

[15] A 6-quarter moving average share for the λ_i has the benefits that it both reduces the volatility of the share of the components of demand while also capturing the most recent movements in the share.

[16] A simple F-test shows that the restriction of equal slope parameters for each country is rejected. However, we note that Baltagi and Griffin (1983) argue that the empirical test of equal slope parameters in panel estimation is frequently rejected despite the fact that there may be a strong economic rationale for imposing common slope parameters.

[17] Given that the sharp downturn in global trade in 2008Q4-2009Q1 seemed to be contemporaneously associated with the fall in global demand, it seems worthwhile to focus on how much of this decline can be explained by the contemporaneous trade/demand relationships. However, experimenting with lags on the explanatory variables did not make any significant difference to the size of the demand parameters, while specifications including lagged dependent variables did not perform so well.

first step is to estimate equation (4) by including as many of the OECD countries for which the bulk of the data are available. However, we initially have to drop the *bconf* and *stocks* terms as these are not available for all OECD countries.

The results for the period 1995Q1-2009Q1 for the LSDV estimator for 29 OECD countries are displayed in the first column of Table 1 and show that all of the variables are statistically significant and have the expected signs (ie, *rpm* and *credcon* have negative signs, while the components of *tfe* are all positively signed). The α_{1i} parameters of the *tfe* components now provide a clear view of the relative importance of imports for the various expenditure components uncontaminated by their differing weights in *tfe*. In particular, exports have the highest import intensity followed by gross fixed capital formation and consumers' expenditure, while government expenditure seems – as expected - to be a low import-intensive activity. Comparing with the other estimation techniques, we see that the GMM and LSDV results are very similar. Although the Mean Group (MG) estimator gives virtually the same results for credit conditions, exports and gross fixed capital formation, the parameter for consumers' expenditure is substantially lower in comparison to the LSDV estimator, while government expenditure is not statistically significant. Nevertheless, the relative size of the expenditure components parameters are in line with the LSDV results and, overall, we can say that the results tend to be similar across the three techniques, with the LSDV and GMM results particularly close. Our strategy is therefore to carry out the rest of the estimation using the LSDV estimator.[18]

[18] In addition, the reason for the weakness of the Mean Group parameters may be partly due to the short sample period. Hence, another argument in favour of the LSDV estimator is that the efficiency gains of pooling the data seem to outweigh the losses from the bias induced from heterogeneity.

Table 1: OECD imports equation;
LSDV GMM and MG results (95Q1-09Q1)

	LSDV	GMM	MG
$\Delta \ln rpm$	-0.263***	-0.195 ***	-0.086 *
	(0.027)	(0.026)	(0.051)
$\lambda \Delta \ln conex$	1.451 ***	1.413 ***	0.759 **
	(0.476)	(0.236)	(0.337)
$\lambda \Delta \ln govex$	1.173 ***	0.960 *	0.409
	(0.349)	(0.398)	(0.491)
$\lambda \Delta \ln gfcf$	1.507 ***	2.189 ***	1.699 ***
	(0.334)	(0.302)	(0.246)
$\lambda \Delta \ln expgs$	1.960 ***	2.097 ***	1.920***
	(0.258)	(0.166)	(0.247)
credcon	-6.22×10^{-7}**	-1.88×10^{-7}	-3.9×10^{-7}**
	(3.09×10^{-7})	(2.07×10^{-7})	(1.5×10^{-7})
C	4.29×10^{-4}	-0.002	0.002**
	(0.003)	(0.001)	(0.001)
R-squared	0.613	0.599	0.824
Durbin-Watson	2.39	2.458	1.871
S.E. of regression	0.023	0.023	0.015
Number of observations	1413	1413	1347

Note: (*) significant at 10 percent level, (**) significant at 5 percent level, (***) significant at 1 percent level; unbalanced panel includes 29 OECD countries; panel estimates based on Least Squares Dummy Variables (LSDV) results estimated by instrumental variables (all variables instrumented by own lagged values); country specific fixed effects included; GMM=Arellano and Bond Generalised Method of Moments; MG=Mean Group Estimator; for the GMM model, the J-test for over-identified restrictions indicates that the instruments are well identified (p-value=0.188).

Table 2 shows the LSDV results for equation (4) for a smaller sample of 21 OECD countries for which the data for all variables in equation (4) are available, hence we can include the *bconf* and *stocks* variables. Column (1) of Table 2 shows business confidence is statistically significant and, as expected, positively signed. The same regression shows that stocks are not statistically significant. However, the relative importance of imports for the various expenditure components are similar to the Table 1 results for 28 OECD countries, with exports and investment expenditure registering the highest import intensities, followed by consumers' expenditure and then government expenditure. Dropping the insignificant stocks term (see column 2 in Table 2) marginally changes the expenditure import intensities with the parameter for consumers'expenditure falling somewhat, while credit conditions (*credcon*) remains correctly signed but is statistically significant only at the 10% level of significance.

Our next step is to test whether any of the parameters of the variables in column (1) in Table 2 change during the crisis. We therefore multiply each variable by an intercept-shift dummy variable for the crisis period 2008Q4-2009Q1 (ie, DUMCRIS8491=1 for

2008Q4-2009Q1, and zero otherwise) and add the interactive dummy variables to the equation in column 1 of Table 2. In addition, we also add DUMCRIS8491 itself to the equation to see if there is a decline in imports that remains unexplained by our equation during 2008Q4-2009Q1. The results are given in column 3 of Table 2 and show that only the stocks interactive dummy is statistically significant (DC8491stocks), with its positive sign revealing that the decline in stocks had a significant negative impact on imports during the crisis period. Meanwhile, the intercept-shift dummy variable DUMCRIS8491 is not statistically significant implying that the equation with differential components of demand elasticities fully explains the severe downturn in trade during the crisis period.

Table 2: OECD imports equation;
LSDV results (95Q1-09Q1)

	(1)	(2)	(3)	(4)
$\Delta \ln rpm$	-0.127***	-0.133 ***	-0.162***	-0.141***
	(0.034)	(0.034)	(0.035)	(0.032)
$\lambda \Delta ln\ conex$	1.653 **	1.297 **	1.561**	
	(0.696)	(0.592)	(0.688)	
$\lambda \Delta ln\ govex$	1.274 **	1.006**	1.236***	
	(0.420)	(0.414)	(0.416)	
$\lambda \Delta ln\ gfcf$	1.806***	1.631 ***	1.506 ***	
	(0.496)	(0.475)	(0.496)	
$\lambda \Delta ln\ expgs$	1.830 ***	1.943 ***	1.807 ***	
	(0.236)	(0.224)	(0.227)	
credcon	-4.3×10^{-7}*	-4.39×10^{-7}*	-3.3×10^{-7}	-4.41×10^{-7}**
	(2.52×10^{-7})	(2.41×10^{-7})	(2.5×10^{-7})	(1.82×10^{-7})
bconf	3.11×10^{-4}***	2.99×10^{-4}***	3.18×10^{-4}***	1.25×10^{-4}***
	(1.04×10^{-4})	(1.03×10^{-4})	(1.04×10^{-4})	(4.59×10^{-5})
stocks	-5.83×10^{-8}		-1.0×10^{-7}*	-1.07×10^{-7}**
	(5.32×10^{-8})		(5.0×10^{-8})	(4.46×10^{-8})
DC8491stocks			1.2×10^{-6}***	1.06×10^{-6}***
			(3.6×10^{-7})	(3.33×10^{-7})
DUMCRIS8491			-0.005	-0.014**
			(0.008)	(0.007)
C	-5.14×10^{-4}	1.15×10^{-4}	1.56×10^{-3}	8.99×10^{-4}
	(0.003)	(0.002)	(0.003)	(7.57×10^{-4})
R-squared	0.565	0.562	0.576	0.061
Durbin-Watson	2.327	2.302	2.321	2.248
S.E. of regression	0.019	0.019	0.019	0.019
Number of observations	908	918	908	908

Note: (*) significant at 10 percent level, (**) significant at 5 percent level, (***) significant at 1 percent level; unbalanced panel includes 21 OECD countries; panel estimates based on Least Squares Dummy Variables (LSDV) results estimated by instrumental variables (all variables instrumented by own lagged values); country specific fixed effects included. Dependent variable is $\Delta \ln impgs_{j,t}$ in columns 1-3, and $\Delta \ln impgs_{j,t} - (\sum_i \alpha_{1i}\lambda_i)\Delta \ln tfe_{j,t}$ in column 4.

Finally, we want to shed light on how well the specification including differential import intensities of the different expenditure components captures the global trade downturn in comparison to a specification using an aggregate total final expenditure (*tfe*) term. We can make an exact comparison by re-estimating the equation reported in column 3 of Table 2 and replacing the expenditure component terms with an aggregate *tfe* term, and also imposing the aggregate parameter for *tfe* implied by the estimated parameters of the individual expenditure components. In other words, we estimate equation (5):[19]

$$\Delta \ln impgs_{j,t} - (\sum_i \alpha_{1i}\lambda_i)\Delta \ln tfe_{j,t} = c + \alpha_2 \Delta \ln rpm_{j,t} + \alpha_3 bconf_{j,t} + \alpha_4 credcon_{j,t} + \alpha_5 stocks_{j,t} + \alpha_6 DC8491stocks + \alpha_7 DUMCRIS8491 + \varepsilon_t \quad (5)$$

Column 4 of Table 3 shows the results for equation (5) and reveals a statistically significant and negative parameter for the dummy variable DUMCRIS8491, thereby demonstrating that movements in aggregate total final expenditure can not fully capture the global trade downturn (whereas DUMCRIS8491 is not statistically significant for the specification including the differential expenditure component terms in column 3 of Table 2). Furthermore, the results in column 4 of Table 3 show that *credcon* and *stocks* also become statistically significant suggesting that these variables have to "take up more of the slack" in explaining the global trade downturn if the individual components of expenditure are replaced by aggregate *tfe* in the imports specification.

Economic interpretation of the results

For an economic interpretation of the results for the differential demand elasticities, we use the parameters of the equations columns 1 and 2 of Table 2, which therefore provide a range of parameter estimates. These weighted elasticities (or import intensities) of the expenditure categories are listed in the first block of Table 3 as the α_{1i} coefficients. To obtain the elasticity with respect to each expenditure component we multiply the α_{1i} coefficients by λ_i. As the λ_i used in constructing the variables are moving averages, the component elasticities are also variable over time. One can use the sample average λ_i for the component shares to obtain mean elasticities for the different expenditure categories, and compare with the start and end period elasticities

[19] Note that the α_{1i} parameters in equation (5) are taken from column 3 in Table 2 (ie, 1.561, 1.236, 1.505 and 1.807 for *conex*, *govex*, *gfcf* and *expgs*, respectively). Hence, when these α_{1i} parameters are multiplied by their respective λ_i and summed together (as in equation (5)), the total gives the implied parameter for *tfe*.

using the corresponding start and end period λ_i's in order to see how the elasticities change over time. The λ_i's are reported in the second block of Table 3 (headed "λ_i"), while the component elasticities are given in the final block of Table 3 (headed "$\lambda_i \alpha_{1i}$"). The final row of Table 3 also gives the total *tfe* elasticity which is the sum of the individual component elasticities.

Table 3:Weighted and component elasticities

	α_{1i}		λ_i			$\lambda\alpha_{1i}$		
	Weighted elasticity		**Start period**	**End period**	**Average weight**	**Component elasticity**		
	(1)	(2)	95Q1 - 96Q2	07Q1 - 08Q2	95Q1 - 09Q1	***Start period***	***End period***	***Average***
conex	1.65	1.30	0.43	0.38	0.41	0.72 - 0.56	0.63 - 0.50	0.67 - 0.53
govex	1.27	1.01	0.16	0.12	0.14	0.20 - 0.16	0.15 - 0.12	0.17 - 0.14
gfcf	1.81	1.63	0.15	0.16	0.16	0.27 - 0.25	0.29 - 0.26	0.28 - 0.26
expgs	1.83	1.94	0.26	0.35	0.30	0.47 - 0.50	0.64 - 0.68	0.55 - 0.59
					tfe =	1.66 - 1.46	1.72 - 1.56	1.68 - 1.50

Note: λ_i is the unweighted average of the 21 OECD countries in the panel esimation.

In general, the component elasticities seem quite sensible as a percentage increase in the largest component of TFE (that is, *conex*) generates a much larger increase of imports of goods and services than, say, an increase in the smallest component (*govex*). The λ_i's in Table 3 also show how the share of exports in *tfe* increases over time, rising from 26% to 35% from the start to the end of the sample resulting in a corresponding increase in the component elasticity for exports. As mentioned previously, the high and rising import-intensity of exports may be partly interpreted as a reflection of the rapid growth of vertical specialisation and the international fragmentation of production whereby the export of a single good or product requires numerous intermediate stages of production involving the product in numerous crossings of international borders, with each stage counted as an import and export.

If we simply multiply the above parameters by the change in the variables over the period 2008Q4-2009Q1 we find that the fall in exports can explain more than half of the decline in world imports, while declines in the highly-import-intensive category of investment also explains a notable proportion of the remaining fall in global trade. Calculations also show that stockbuilding, business confidence and credit conditions

also played a role in the trade downturn, but that these factors had relatively smaller impacts.

5. The global trade recovery

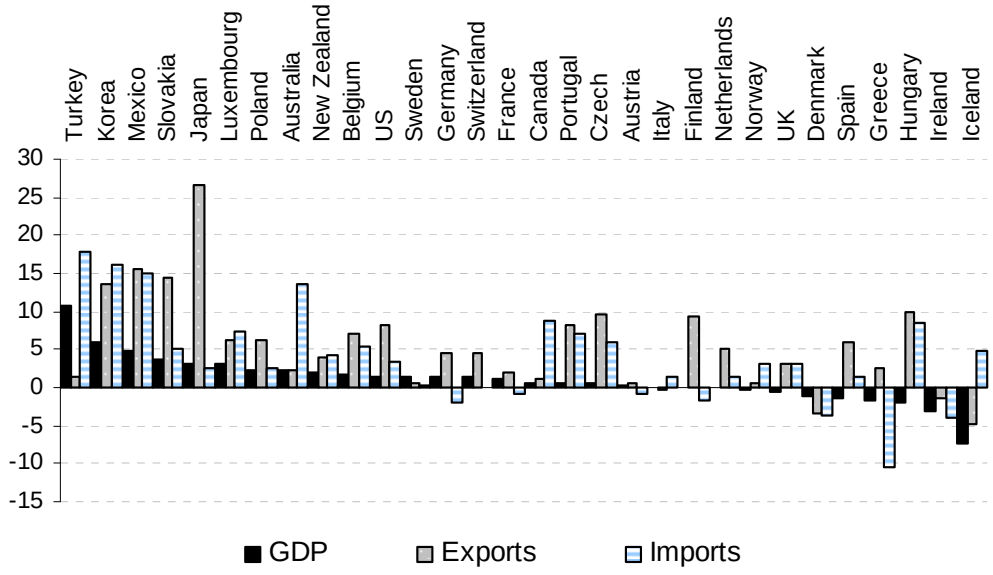
Stylised facts of the recovery

In this section, we update and extend the dataset to 2009Q4 in order to capture the trade recovery which broadly began in 2009Q2.[20] We begin by describing the developments in GDP, trade and other expenditure components across the individual OECD countries during the global upturn in 2009Q2-2009Q4. Chart 4 shows the cumulative percentage change in real GDP across the OECD countries as well as export and import volumes of goods and services during 2009Q2-2009Q4 (in ascending order of the magnitude of the rise in GDP). The series are broadly characterised by substantially larger increases in both exports and imports in comparison to GDP, while exports and imports appear to be highly correlated for many of the individual countries. Turning to Chart 5, we see that despite the recovery in GDP, gross real fixed capital formation continued to significantly decline for many of the countries in the sample. Meanwhile, positive growth in private consumers' expenditure, and particularly government expenditure, contributed to the recovery in many of the OECD countries (Chart 6) and may be related to various fiscal and private expenditure stimulus measures implemented at the time.

One key message from these stylised facts seems to be the different behaviour of the highly import-intensive components of expenditure. In particular, exports of goods and services rose substantially during the recovery period, and were therefore a strong driving force behind the rise in imports, while gross fixed capital formation continued to fall thereby exerting a downward impact on imports.

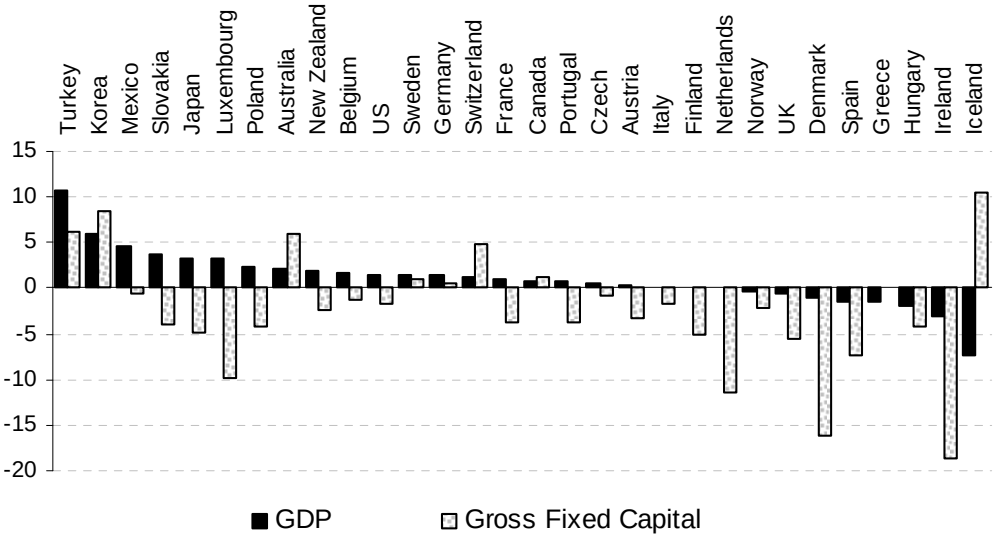
[20] It's debateable as to when the global trade recovery precisely began. The data tell us that the quarterly change in OECD GDP and export volumes of goods and services turned positive in 2009Q2, while the quarterly change in OECD import volumes began rising in 2009Q3. However, the quarterly decline in import volumes was fairly small in 2009Q2 (ie, 1.9%) compared to much larger falls in, say, 2009Q1 (ie, 9.0%). Hence, the base case in this paper is that the OECD trade recovery began in 2009Q2 (although we also compare our results with the case that the recovery began in 2009Q3).

Chart 4: Real GDP and export and import volumes of goods and services. (cumulative percentage change, 2009Q2-2009Q4)



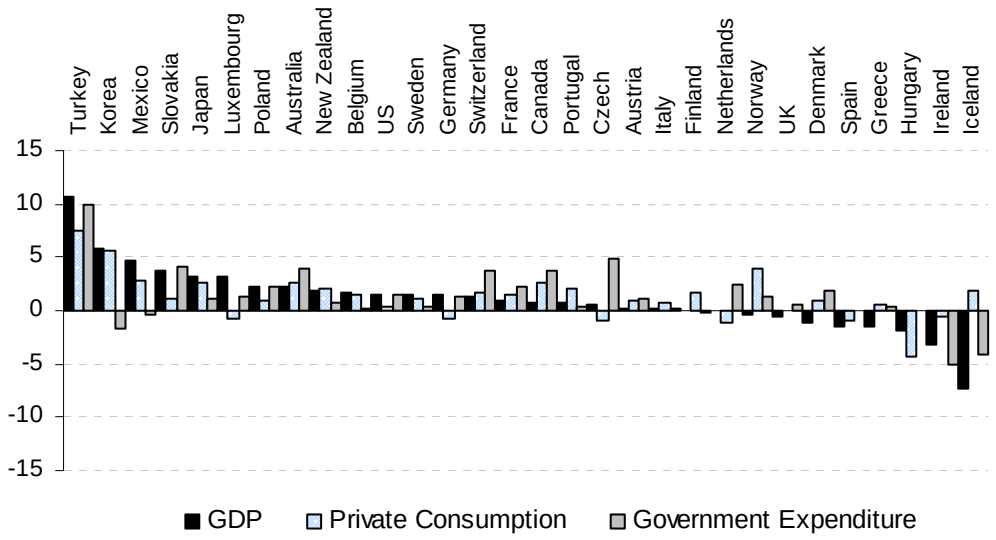
Source: Haver, ECB calculations.

Chart 5: Real GDP and fixed capital formation. (cumulative percentage change, 2009Q2-2009Q4)



Source: Haver, ECB calculations.

Chart 6: Real GDP, private consumption and government expenditure. (cumulative percentage change, 2009Q2-2009Q4)



Source: Haver, ECB calculations.

Econometric results (based on June 2010 vintage of the dataset)

In this section, we use the updated and extended dataset up to 2009Q4 in order to re-estimate our specification and see what it tells us about the trade recovery. We therefore re-estimate column 3 of Table 2 for the period 1995Q1-2009q4 (ie, based on June 2010 vintage of the dataset). In addition, we also add an intercept-shift dummy called DUMRECOV9294 to the equation to see if there is any underlying change in OECD imports that remains unexplained by our equation during the trade recovery period 2009Q2-2009Q4 (ie, DUMRECOV9294=1 for 2009Q2-2009Q4, and zero otherwise).

The results are shown in Column 1 of Table 4. Overall, the equation gives somewhat similar results to the original dataset vintage, notably that the trade *downturn* is explained by the differential components of demand elasticities. In other words, the intercept dummy variable DUMCRIS8491 for the trade downturn is not statistically significant implying that the equation broadly explains the severe downturn in trade during the crisis period. In line with the earlier results in Table 2, only the stocks interactive dummy is statistically significant (DC8491stocks) in Table 4 with its positive sign indicating that the decline in stocks had a significant negative impact on imports during the trade downturn period. This is therefore also a pseudo-real time robustness test of the specification in that the analysis of the global trade downturn in section 4 is based on the data available at the time (ie, October 2009

vintage), while in this section the updated analysis of the global downturn as well as the upturn is based on a more recent dataset (ie, June 2010 vintage). The specification performs well as the results for the global downturn remain robust regardless of which vintage of the dataset is used.

Meanwhile, the intercept shift dummy for the trade recovery period (DUMRECOV9294) is positive and statistically significant, implying that the equation does not fully explain the trade upturn. Another key feature of the results is that the proxy for credit conditions (credcon) is correctly signed and statistically significant (while it was not significant in Table 2), suggesting that the improvement in financial markets helped the trade recovery, while business confidence (bconf) also played a beneficial role. Finally, one difference in comparison to the previous results of Table 2 is that the parameter for consumers' expenditure is not statistically significant. Part of the reason for this may be some instability of the parameter for consumers' expenditure associated with policy measures such as car-scrapping schemes and related measures in many economies which helped to revive the automobile industry.[21] These measures contributed to a sharp increase in international trade in cars, which also implies that consumers' expenditure may have become more import-intensive during the recovery period and may have resulted in some instability of its parameter.

Following the same econometric methodology we applied to the trade downturn, our next step is to multiply each of the main variables by a dummy variable for the recovery period 2009Q2-2009Q4 (ie, DUMRECOV9294=1 for 2009Q2-2009Q4, and zero otherwise) and add these interactive dummy variables to the equation to see if any parameters change over the recovery period. Somewhat in line with the aforementioned possible parameter instability, we find that the interactive dummy for consumers' expenditure is the only one which is statistically significant, albeit at the 10% level of significance (see the parameter for the interactive dummy *dre9294conex* in Column 2 of Table 4). Given that this dummy is likely to be highly correlated with the intercept shift dummy for the recovery, we find that if we drop the intercept dummy DUMRECOV9294 from the equation then *dre9294conex* becomes statistically significant at the 5% level (see column 3 Table 4). These results therefore seem to imply that the import intensity of consumers' expenditure changed during the recovery period (probably associated with various policy measures) and seems to at least partly explain the parameter instability associated with this variable. Nevertheless, one important point of Table 4 is that part of the upturn in trade during 2009Q2-2009Q4 is not explained (ie, the intercept dummy for the recovery - DUMRECOV9294 – is always positively signed and statistically significant). This may be due to the many policy measures

[21] For an overview of the measures to support the car industry, see Haugh et al (2010).

that were implemented to boost global trade at that time and which can not be captured by the equation.[22] By contrast, the equation is directly capturing the positive impacts of specific policies such as the fiscal stimuli implemented by many countries which are included in the government expenditure and fixed capital formation expenditure components in the equation. However, in a similar fashion to the downturn, the results confirm that the upturn in OECD imports was amplified by strong export growth and the reactivation of global production chains.

Finally, we re-estimate the above equations with dummies representing the trade downturn period as 2008Q4-2009Q2, and the trade upturn period as 2009Q3-2009Q4. However, as shown in Table 4a in the Appendix, the results are qualitatively the same as in Table 4. [23]

[22] For example, these measures included: policy measures implemented worldwide to stabilise the financial system (particularly the decision of G20 in April 2009 to make available USD 250 billion for trade finance over 2009-2011); car-scrapping schemes; general fiscal stimulus packages, etc.

[23] As mentioned earlier, it's debateable as to when the global trade recovery precisely began. The data tell us that the quarterly change in OECD GDP and export volumes of goods and services turned positive in 2009Q2, while the quarterly change in OECD import volumes began rising in 2009Q3. However, the quarterly decline in import volumes was fairly small in 2009Q2 (ie, 1.9%) compared to much larger falls in, say, 2009Q1 (ie, 9.0%). Hence, the base case in this paper is that the OECD trade recovery began in 2009Q2 (Table 4), but re-estimating our equations under the assumption that the recovery began in 2009Q3 does not qualitatively change the results (Table 4a).

Table 4: LSDV results (95Q1-09Q4)

	(1)	(2)	(3)
$\Delta \ln rpm$	-0.146***	-0.143***	-0.144***
	(0.034)	(0.034)	(0.034)
$\lambda \Delta conex$	0.809	0.561	0.364
	(0.665)	(0.679)	(0.681)
$\lambda \Delta dre9294conex$		4.062*	4.987**
		(2.311)	(2.250)
$\lambda \Delta govex$	1.113***	1.010***	1.015**
	(0.395)	(0.394)	(0.399)
$\lambda \Delta gfcf$	1.290***	1.366***	1.345***
	(0.417)	(0.418)	(0.424)
$\lambda \Delta expgs$	1.796***	1.786***	1.892***
	(0.209)	(0.208)	(0.208)
credcon	-5.28×10^{-7}**	-5.15×10^{-7}**	-3.29×10^{-7}
	(2.29×10^{-7})	(2.28×10^{-7})	(2.34×10^{-7})
bconf	2.91×10^{-4}***	2.63×10^{-4}***	1.83×10^{-4}*
	(9.79×10^{-5})	(9.90×10^{-5})	(9.52×10^{-5})
stocks	-3.40×10^{-8}	-2.14×10^{-8}	-2.88×10^{-8}
	(4.36×10^{-8})	(4.41×10^{-8})	(4.49×10^{-8})
DC8491stocks	7.63×10^{-7}***	7.06×10^{-7}***	8.03×10^{-7}***
	(2.72×10^{-7})	(2.73×10^{-7})	(2.78×10^{-7})
DUMCRIS8491	-0.001	-0.003	-0.009
	(0.008)	(0.008)	(0.008)
DUMRECOV9294	0.013***	0.010**	
	(0.004)	(0.005)	
C	0.003	0.004	0.003
	(0.002)	(0.002)	(0.002)
R-squared	0.564	0.566	0.554
Durbin-Watson	2.365	2.360	2.345
S.E. of regression	0.019	0.019	0.019
Number of observations	943	943	943

Note: (*) significant at 10 percent level, (**) significant at 5 percent level, (***) significant at 1 percent level; unbalanced panel includes 21 OECD countries; panel estimates based on Least Squares Dummy Variables (LSDV) results estimated by instrumental variables (all variables instrumented by own lagged values); country specific fixed effects included. Dependent variable is $\Delta \ln impgs_{j,t}$.

6. Conclusions

This paper finds that a structural imports function which captures the different and time-varying import-intensities of the components of total final expenditure - consumption, investment, government expenditure, exports, etc – can fully explain the sharp decline in global imports of goods and services during the intensification of the financial crisis in 2008Q4-2009Q1. By contrast, a specification based on aggregate total expenditure can not fully capture the global trade downturn. In particular, panel estimates of an imports function

for a large number of OECD countries based on the individual components of expenditure suggest that the high import-intensity of exports at the country-level (which also captures the increasing role of global production chains) can explain a significant proportion of the recent decline in world imports, while declines in the highly import-intensive expenditure category of investment also significantly contributed to the remaining fall in global trade. The estimates also find that stockbuilding, business confidence and credit conditions also played a significantly smaller role in the global trade downturn.

Meanwhile, the global trade recovery (2009Q2-2009Q4) can only be partially explained by differential elasticities for the components of demand. This may be due to the many policy measures that were implemented to boost global trade at that time and which can not be captured by the equation.

The paper is also a pseudo-real time robustness test of the specification in that the first analysis of the global trade downturn is based on the data available at the time (ie, October 2009 vintage), while an updated analysis of the global downturn as well as the upturn is based on a more recent dataset (ie, June 2010 vintage). The results for the global downturn remain robust regardless of which vintage of the dataset is used.

Overall, the policy implications seem to be that forecasts of trade variables are enhanced if the aggregate demand term is broken down into the various components of expenditure, while policymakers should not be surprised that the increasing prevalence of global production chains may be associated with a greater elasticity of trade with respect to changes in activity in comparison to the past.

Appendix:

Variables and Data sources

The data set uses unbalanced panel data of 29 OECD countries over the period from 1995Q1 to 2009Q1 (October 2009 dataset vintage), and 1995Q1 to 2009Q4 (June 2010 dataset vintage). The GDP expenditure components and deflator data are obtained from the OECD Quarterly National Accounts. All of the GDP expenditure components, including the change in stocks, are expressed in local currency units in constant prices. Relative import prices are calculated as the ratio of the import deflator to the GDP deflator.

Trade credit conditions (*credcon*) are approximated by the product of US credit standards and the US high-yield spread. US credit standards are obtained from the Federal Reserves Senior Loan Officer Survey and approximated by the net percentage of respondents reporting tighter standards for commercial and industrial loans. The US high-yield spread is obtained from Bloomberg and is the difference between the BBB rated 10 year US industrial bond yield and the 10 year US government bond yield.

Business confidence (*bconf*) is proxied by the OECD survey measure for business confidence in manufacturing/industry .

The data are expressed in logarithms in the panel estimates and unit root tests, except for *stocks*, *credcon* and *bconf*.

Unit root tests

Table 5 reports the results of unit root tests for the level as well as the first difference of each variable. We conducted various panel unit root tests on all variables except for the series *credcon*. Given that the values of *credcon* are the same across countries we employed Phillips-Perron, ADF and Kwiatkowski-Phillips-Schmidt-Shin to test for unit roots. For the remaining series we employed Im, Pesaran and Shin W-stat, ADF - Fisher Chi-square and PP - Fisher Chi-square panel root tests. The auxiliary regression for each of the tests includes the individual effect and the individual linear trend. Relative import prices, GDP and its components are stationary in first differences whereas *bconf*, *stocks* and *credcon* are stationary in levels (albeit *credcon* only at the 10% level of significance). Given the strong movements of *credcon* during the financial crisis, we also carried out a unit root test with structural breaks for credcon – but these tests provided conflicting evidence depending upon the exact date of the structural break. Finally, taking the results of the R-squared and Durbin-Watson statistic for the equation results into account, we can conclude that there is no spurious correlation in the panel equation estimates.

Table 5: Panel Unit Root

		Level		First Difference	
Variables	**Method**	**T- Statistic**	**p-value**	**T-Statist**	**p-value**
impgs	(A)	4.74177	1.0000	-39.5563	0.0000
	(B)	40.6314	0.9837	1247.53	0.0000
	(C)	44.0779	0.9587	1293.6	0.0000
expgs	(A)	5.19431	1.0000	-42.5777	0.0000
	(B)	65.7706	0.3477	1283.16	0.0000
	(C)	84.4996	0.0303	1648.99	0.0000
rpm	(A)	-1.45217	0.0732	-37.3135	0.0000
	(B)	76.244	0.1054	1052.24	0.0000
	(C)	59.9038	0.5518	1328.47	0.0000
conex	(A)	4.60324	1.0000	-28.8968	0.0000
	(B)	61.135	0.435	915.108	0.0000
	(C)	48.9829	0.8445	1363.3	0.0000
govex	(A)	-0.44565	0.3279	-50.4912	0.0000
	(B)	78.9519	0.051	1345.91	0.0000
	(C)	88.1431	0.0105	1609.23	0.0000
gfcf	(A)	2.72686	0.9968	-35.8617	0.0000
	(B)	59.1247	0.4342	1020.52	0.0000
	(C)	54.7923	0.5953	1215.01	0.0000
gdp	(A)	7.82167	1.0000	-30.3584	0.0000
	(B)	30.3672	0.9998	1031.85	0.0000
	(C)	55.7447	0.699	1223.65	0.0000
credcon	(D)	-1.85079	0.0615		
	(E)	-1.779592	0.0715		
	(F)	0.30426			
bconf	(A)	-10.1693	0.0000		
	(B)	201.209	0.0000		
	(C)	72.9403	0.0039		
stocks	(A)	-18.5707	0.0000		
	(B)	466.865	0.0000		
	(C)	605.877	0.0000		

Note: The letters (A), (B), (C) respectively refer to Im, Pesaran and Shin W-stat, ADF - Fisher Chi-square and PP - Fisher Chi-square. Exogenous variables: Individual effects and individual linear trends. Automatic lag length selection based on SIC: 0 to 7. Newey-West bandwidth selection using Bartlett Kernel. (D), (E), (F) refer to Phillips-Perron, ADF and Kwiatkowski-Phillips-Schmidt-Shin, respectively. For (F) the critical value at 1%, 5% and 10% level of significance is 0.7390, 0.4630 and 0.3470 respectively. All variables expressed in logarithms except for *credcon*, *bconf* and *stocks*.

Appendix: Modification of Table 4

Table 4a reports the results when the crisis dummy covers the period 2008Q4 to 2009Q2 (DUMCRIS8492) and the recovery dummy refers to the period between 2009Q3 and 2009Q4 (DUMRECOV9394).

Table 4a: LSDV results (95Q1-09Q4)

	(1)	(2)	(3)
$\Delta \ln rpm$	-0.134***	-0.134***	-0.137***
	(0.033)	(0.033)	(0.033)
$\lambda \Delta conex$	0.845	0.811	0.567
	(0.699)	(0.704)	(0.702)
$\lambda \Delta dre9394conex$		-1.460	5.250*
		(4.122)	(2.787)
$\lambda \Delta govex$	1.086***	1.087***	1.056***
	(0.400)	(0.400)	(0.404)
$\lambda \Delta gfcf$	1.489***	1.500***	1.508***
	(0.442)	(0.443)	(0.448)
$\lambda \Delta expgs$	1.861***	1.840***	1.941***
	(0.211)	(0.210)	(0.207)
credcon	-5.34×10^{-7}**	-5.38×10^{-7}**	-5.02×10^{-7}**
	(2.35×10^{-7})	(2.35×10^{-7})	(2.37×10^{-7})
bconf	2.71×10^{-4}***	2.76×10^{-4}***	2.26×10^{-4}**
	(1.01×10^{-4})	(1.01×10^{-4})	(9.97×10^{-5})
stocks	-7.59×10^{-8}	-8.05×10^{-8}	-7.27×10^{-8}
	(5.32×10^{-8})	(5.34×10^{-8})	(5.39×10^{-8})
DC8492stocks	4.78×10^{-7}**	4.75×10^{-7}**	$5.62 \text{ X } 10^{-7}$***
	(2.12×10^{-7})	(2.17×10^{-7})	$(2.15 \text{ X } 10^{-7})$
DUMCRIS8492	0.007	0.006	0.006
	(0.007)	(0.007)	(0.007)
DUMRECOV9394	0.014***	0.016**	
	(0.005)	(0.007)	
C	0.003	0.003	0.003
	(0.002)	(0.002)	(0.002)
R-squared	0.552	0.552	0.542
Durbin-Watson	2.368	2.361	2.354
S.E. of regression	0.019	0.019	0.019
Number of observations	943	943	943

Note: (*) significant at 10 percent level, (**) significant at 5 percent level, (***) significant at 1 percent level; unbalanced panel includes 21 OECD countries; panel estimates based on Least Squares Dummy Variables (LSDV) results estimated by instrumental variables (all variables instrumented by own lagged values); country specific fixed effects included. Dependent variable is $\Delta \ln impgs_{j,t}$.

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