

Unclassified

ECO/WKP(2015)34

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development

07-May-2015

English - Or. English

ECONOMICS DEPARTMENT

ECO/WKP(2015)34
Unclassified

DOES THE POST-CRISIS WEAKNESS OF GLOBAL TRADE SOLELY REFLECT WEAK DEMAND?

ECONOMICS DEPARTMENT WORKING PAPERS No. 1216

By Patrice Ollivaud and Cyrille Schwellnus

OECD Working Papers should not be reported as representing the official views of the OECD or of its member countries. The opinions expressed and arguments employed are those of the author(s).

Authorised for publication by Jean-Luc Schneider, Deputy Director, Policy Studies Branch, Economics Department.

All Economics Department Working Papers are available at www.oecd.org/eco/workingpapers

JT03375871

Complete document available on OLIS in its original format

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

English - Or. English

OECD Working Papers should not be reported as representing the official views of the OECD or of its member countries. The opinions expressed and arguments employed are those of the author(s).

Working Papers describe preliminary results or research in progress by the author(s) and are published to stimulate discussion on a broad range of issues on which the OECD works.

Comments on Working Papers are welcomed, and may be sent to the Economics Department, OECD, 2 rue André-Pascal, 75775 Paris Cedex 16, France, or by e-mail to eco.contact@oecd.org.

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

© OECD (2015)

You can copy, download or print OECD content for your own use, and you can include excerpts from OECD publications, databases and multimedia products in your own documents, presentations, blogs, websites and teaching materials, provided that suitable acknowledgment of OECD as source and copyright owner is given. All requests for commercial use and translation rights should be submitted to rights@oecd.org

ABSTRACT/RÉSUMÉ

Does the Post-Crisis Weakness of Global Trade Solely Reflect Weak Demand?

Global trade growth over the past few years has appeared extraordinarily weak, even in relation to weak global GDP growth. This paper shows that the apparent breakdown in the relationship between global trade and global GDP growth is largely explained by two factors: an inappropriate measurement of global GDP and extraordinary demand weakness in the euro area. As a measure of demand for traded goods, global GDP at market exchange rates is more appropriate than the conventional purchasing power parity-based measure. Moreover, extraordinary demand weakness in the euro area – which is a particularly trade intensive region – has had a substantial negative effect on intra-euro area trade flows, which are commonly counted towards global trade. When global GDP is measured at market exchange rates and intra-euro area flows are removed from the measure of global trade, econometric estimations suggest that over the past 15 years the long-term elasticity of global trade to GDP has been similar to that of the 1990s. Indeed, the overwhelming part of post-crisis trade weakness can be attributed to weak global demand rather than structural changes, according to the econometric estimations in this paper and supporting evidence on changes in global investment, international production fragmentation and protectionism.

JEL classification codes: F10; F17; C53

Keywords: Global trade, trade elasticity, forecasting

La faiblesse du commerce mondiale après la crise reflète-t-elle seulement une faible demande?

La croissance du commerce mondial a été particulièrement faible ces dernières années, même relativement à la croissance du PIB mondial. Ce papier montre que cette apparente rupture dans la relation entre croissance du commerce mondial et du PIB mondial est due dans une large mesure à deux facteurs : une mesure inappropriée du PIB mondial et une faiblesse exceptionnelle de la demande dans la zone euro. Pour mesurer la demande en biens échangeables, le PIB mondial agrégé avec des taux de change du marché est plus adapté que la mesure conventionnelle basée sur des conversions en parité de pouvoir d'achat. De plus, la faiblesse exceptionnelle de la demande dans la zone euro (où l'intensité du commerce est particulièrement forte) a eu un effet négatif substantiel sur les flux intra-zones, qui sont habituellement comptabilisés dans le commerce mondial. Une fois que le PIB mondial est agrégé avec des taux de change de marché et que l'on soustrait les flux intra-zone-euro au commerce mondial, les estimations économétriques suggèrent ainsi que sur les 15 dernières années, l'élasticité de long-terme du commerce au PIB mondial a été similaire à celle des années 90. En effet, la faiblesse du commerce mondial après la crise est essentiellement due à une faiblesse de la demande mondiale plutôt qu'à un changement structurel. Cela est montré par les estimations économétriques de ce papier et également confirmé par l'observation des évolutions de l'investissement mondial, de la fragmentation de la production internationale et du protectionnisme.

Classification JEL: F10; F17; C53

Mots-Clés: Commerce mondial, élasticité du commerce, prévision

TABLE OF CONTENTS

DOES THE POST-CRISIS WEAKNESS OF GLOBAL TRADE SOLELY REFLECT WEAK DEMAND?.....	7
1. Introduction.....	7
2. The relation between global trade and global GDP over the past three decades	9
3. Can weak demand account for the weakness of post-crisis global trade growth?	14
3.1. Econometric estimation of the long-term global trade elasticity.....	16
3.2. Trends in investment, production fragmentation and protectionism.....	21
Investment	21
International production fragmentation.....	22
Protectionism.....	23
4. Implications for projecting trade when GDP projections are known.....	23
REFERENCES	24
Annex 1: Details on global GDP volume at market exchange rates and intra-euro area trade	26
Annex 2: Details on estimation results based on quarterly data	28
Annex 3: Properties of the model in growth rates	30
Annex 4: Additional tables and figures.....	32

Tables

1. Estimation results for Equation (1) based on annual data	17
A2.1. Estimation results for equation (1) based on quarterly data	28
A2.2. Cointegration tests based on quarterly data	29
A3.1. Tests for breaks in the parameters of the model in growth rates	31
A4.1. Detailed estimation results for Equation (1) based on annual data	33
A4.2. Tests for breaks in the long-term import-to-GDP relation	34
A4.3. Detailed estimation results for Equation (2) based on annual data	35

Figures

1. The apparent elasticity of global trade declined in the wake of the crisis.....	9
2. The global trade elasticity is biased when GDP is aggregated at purchasing power parities	11
3. Global trade intensity has deviated from its pre-crisis trend.....	12
4. Post-crisis trade growth has been close to the rates predicted by GDP growth	13
5. Global investment intensity is pro-cyclical.....	15
6. The break in the cointegrating relation between trade and GDP coincides with the global crisis....	18
7. The ratio of global trade to GDP growth typically declines following global downturns	19
8. In-sample fit of the model in growth rates without structural break	20
9. The ratio of global investment volume to GDP volume has been weak in the wake of the crisis	21
10. The decline in international production fragmentation in 2009 is consistent with GDP developments	22

A1.1.	Real global GDP growth at PPPs and market exchange rates	26
A1.2.	Intra-euro area import volume	27
A1.3.	The ratio of intra-euro imports to euro area GDP has deviated from its pre-crisis trend	27
A2.1.	Long-term elasticity estimated over 7-year windows using quarterly data	29
A3.1.	Apparent elasticity implied by the model in growth rates in equation (2)	30
A4.1.	The apparent global trade elasticity using alternative aggregation methods	32

Boxes

Box 1.	Which is the appropriate measure of global GDP in the context of global trade analysis?	10
Box 2.	Measuring the structural relation between global trade and GDP	14

DOES THE POST-CRISIS WEAKNESS OF GLOBAL TRADE SOLELY REFLECT WEAK DEMAND?

By Patrice Ollivaud and Cyrille Schwellnus¹

1. Introduction

1. The anaemic recovery of global trade following the collapse of 2009 raises the question of whether recent trade weakness mainly reflects cyclical factors or signals a structural break in the process of globalisation that may have implications for long-run global GDP growth. While over the two decades that preceded the crisis global trade grew on average at more than twice the rate of purchasing power parity (PPP) based global GDP, global trade growth over the period 2008-14 was slightly below this conventional measure of global GDP growth. In other words, the long-term elasticity of global trade to GDP appears to have declined from around 2 in the two decades preceding the crisis to around 1 thereafter.

2. Empirical studies suggest that the collapse of world trade during the global crisis of 2008-09 mainly reflected a sharp decline in import-intensive components of demand such as investment and durable goods consumption, implying that the reversal of cyclical composition effects would lead to a rebound of global trade growth.² However, the fact that there may be less scope for further trade liberalisation than over past decades – especially in large emerging market economies – and less scope for further declines in international trade costs suggests that recent weakness in global trade may in part also reflect longer-term structural changes (Krugman, 2013).³

3. The main conclusion of this paper is that most of the post-crisis weakness of global trade can be attributed to weak global demand rather than structural changes. This conclusion is based on a number of empirical findings:

- The decline in the long-term elasticity of global trade to GDP coincides with the onset of the global crisis of 2008-09, suggesting that the decline may at least partly reflect demand developments rather than longer-term structural developments.
- Post-crisis global demand growth has been weaker than suggested by conventional measures of global GDP growth based on purchasing power parities (PPPs) which overestimate growth of demand for traded goods by unduly putting more weight on emerging market economies than measures of global GDP growth at market exchange rates.

1. The authors are members of the Economics Department of the OECD. They would like to thank Jens Arnold, Sebastian Barnes, Jérôme Brézillon, Thomas Chalaux, Jean-Marc Fournier, Catherine Mann, Mauro Pisu, Jean-Luc Schneider and Dave Turner for helpful comments and Inés Gómez-Palacio for assistance in preparing the document.

2. Based on an extensive review of empirical studies Bems et al. (2013) suggest that 65-80% of the trade collapse of 2009 can be attributed to declines in expenditure and shifts in its composition, with the remaining fall in global trade attributable to inventory adjustments and credit shocks. By contrast, tariff increases and antidumping duties contributed at most 0.4 percentage points to the 24 per cent decrease in merchandise trade in 2009.

3. Anecdotal evidence suggests that the global crisis triggered an increase in the number of “murky” protectionist measures by G20 countries (Evenett, 2013).

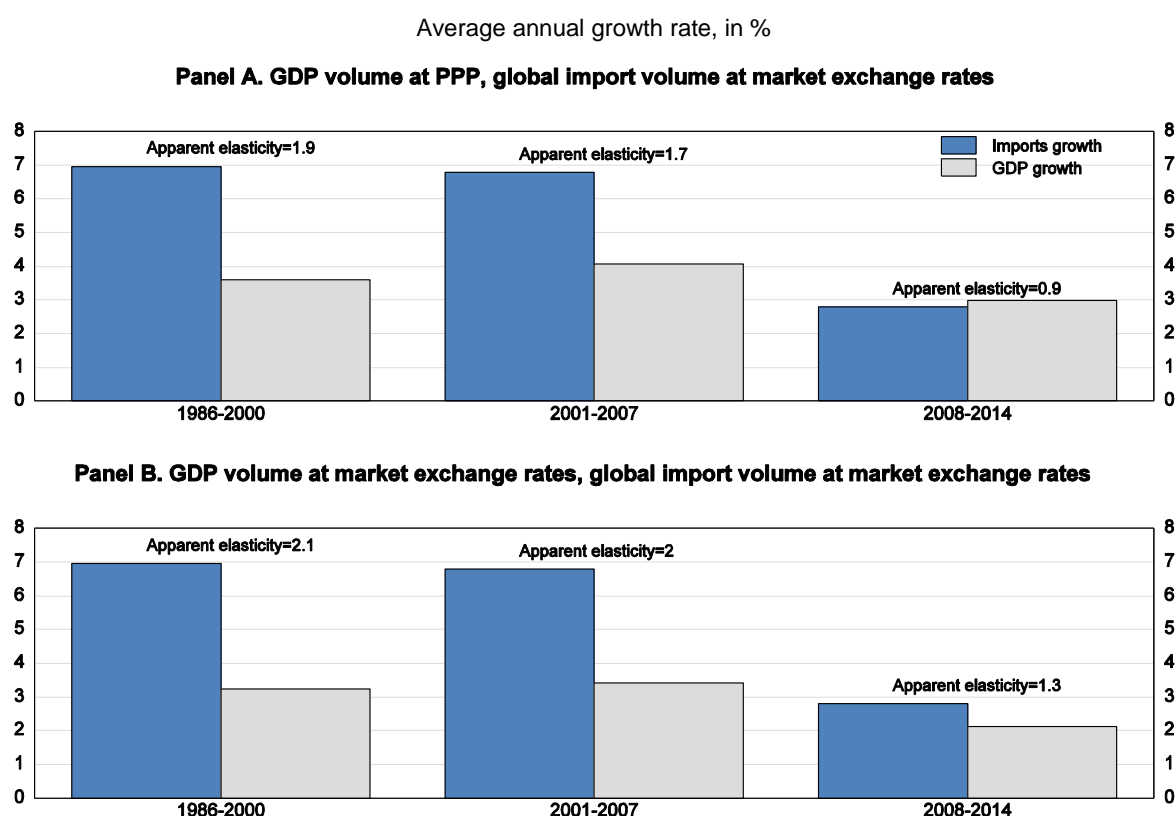
- Weak euro area demand explains a large part of the post-crisis weakness of global trade relative to global GDP, especially over 2010-12, as trade among highly trade-intensive euro area countries has been hit particularly hard.
- Once global GDP is calculated at market exchange rates and intra-euro area trade is removed from the measure of global trade, there is only a limited decline in the long-run elasticity of global trade to GDP over the past 15 years.
- The limited decline in the long-run global trade elasticity over the past 15 years entirely reflects post-crisis developments, with the post-crisis decline in the ratio of global trade to global GDP growth – the apparent global trade elasticity – being similar to that following past global downturns.
- A model that includes only growth rates of global trade and GDP allows for the empirical regularity of a pro-cyclical apparent global trade elasticity and tracks post-crisis trade developments fairly accurately without assuming any structural change in the trade-GDP relation, suggesting that about 85% of the post-crisis trade weakness is explained by global demand weakness.
- The pro-cyclical nature of the apparent global trade elasticity partly reflects the pro-cyclical nature of global investment intensity; as global investment has remained subdued in the wake of the crisis, global GDP has become less import-intensive.
- The pro-cyclical nature of the apparent global trade elasticity is also related to the empirical regularity that the pace of international production fragmentation increases with global GDP growth; the apparent slowdown in international production fragmentation during the crisis therefore reflects at least partly cyclical demand developments rather than a structural break.
- Despite the limited over-predictions of the model in growth rates for the years 2012-2013 and possibly 2014 – which are, however, well within the model's error margin – the most likely scenario for global trade growth in the medium term is thus a rate of about twice that of global GDP growth at market exchange rates as cyclical effects fade.
- Based on the current projections of global GDP growth of 3.3% at market exchange rates (3.9% at PPPs) for 2016 in *OECD Economic Outlook* (November 2014), the model in growth rates developed in this paper predicts a recovery of global trade growth to about 7%.

4. The remainder of the paper is structured as follows. Section 2 describes post-crisis trade developments, emphasising that global GDP measured in PPP terms overestimates demand addressed at exports. It further shows that most of the deviation of global trade intensity from its pre-crisis trend appears to be driven by trade weakness in the euro area. Section 3 assesses whether there is evidence for a structural decline in the long-term global trade elasticity preceding the global crisis of 2008-09, with the results suggesting that the long-term global trade elasticity has been stable over the period 1986-2007. The decline thereafter appears to be largely driven by cyclical effects rather than longer-term structural developments, as suggested by the accurate in-sample fit of a model in growth rates that explains global trade growth exclusively by cyclical GDP developments without assuming a change in the long-term trade-to-GDP relation. A brief discussion of trends in investment, international production fragmentation and protectionism further supports the hypothesis that the post-crisis slowdown in global trade growth mainly reflects global demand developments rather than structural change. Section 4 briefly discusses the implications of the empirical results for the OECD forecasting process and the future evolution of global trade.

2. The relation between global trade and global GDP over the past three decades

5. The apparent long-term elasticity of global trade measured at market exchange rates to GDP at purchasing power parities (the ratio of growth rates) remained at around 2 up until the global crisis of 2008-09 and started to decline only thereafter, suggesting that there is little empirical support for the view that there has been a gradual decline over the past 15 years (Figure 1, Panel A). As observed by Constantinescu et al. (2015) the apparent long-term elasticity of global trade to GDP declined from around 2 in the 1990s around to below 1½ thereafter, but the decline reflects an abrupt change around the onset of the global crisis rather than gradual developments over the past 15 years, suggesting that it may, at least partly, reflect cyclical developments.

Figure 1. The apparent elasticity of global trade declined in the wake of the crisis



Note: The apparent elasticity of global trade to GDP is computed as the average annual growth rate of global import volumes to the average annual growth rate of global GDP volumes. Global import volume and GDP volume at market exchange rates are measured in 2010 USD. Values for 2014 are partly based on projections in *OECD Economic Outlook* (November 2014).

Source: OECD Economic Outlook 96 database; and OECD calculations.

6. The decline in the apparent global trade-to-GDP elasticity is less pronounced when both global trade and GDP are measured at market exchange rates instead of measuring global trade at market exchange rates and global GDP at purchasing power parities as done by Davies (2013) or Constantinescu et al., (2015) (Figure 1, Panel B).⁴ Global trade volumes are conventionally measured at market exchange rates, reflecting the presumption that arbitrage should limit price differences across countries. It therefore seems natural to measure global demand for tradable goods at market exchange rates rather than PPPs; while a country with a low relative price of non-tradable goods may have the same real income as a country with a high relative price of non-tradable goods even at a lower GDP at market exchange rates, it will nonetheless contribute less to global demand for tradable goods. For instance, a country experiencing a large currency depreciation may experience only a marginal decline in GDP measured at purchasing power parities as the relative price of non-tradable goods to tradable goods declines, but reflecting the decline in GDP at market exchange rates its purchasing power for tradable goods would nonetheless decline substantially. Mismeasurement of global demand for tradable goods when using global GDP at purchasing power parities can introduce a substantial downward bias into estimates of the global trade elasticity, which becomes especially pronounced when the growth differential between low-income and high-income countries increases or when global GDP growth declines, as was the case in the wake of the global crisis of 2008-09 (Box 1).⁵

Box 1. Which is the appropriate measure of global GDP in the context of global trade analysis?

This box shows that measuring global trade volumes at market exchange rates while measuring global GDP at PPPs introduces a bias into estimates of global trade elasticities.

For illustrative purposes, consider a global economy consisting of two countries with equal and constant import intensities (defined as ratios of national import volumes to national GDP volumes in constant national currency). A logical requirement is that in this economy the global trade elasticity be 1 irrespective of real growth differentials across countries; equal import intensities imply that the composition of GDP growth is irrelevant for global trade growth while constant import intensities imply that import volumes grow at the same rate as GDP volumes.

Formally, the global trade elasticity is defined as:

$$\sigma^W \equiv \frac{w_M^1 \cdot g_M^1 + w_M^2 \cdot g_M^2}{w_Y^1 \cdot g_Y^1 + w_Y^2 \cdot g_Y^2},$$

where superscripts denote countries 1 and 2, g_M and g_Y are growth rates of imports and GDP, and w_M and w_Y are shares in global imports and GDP. Note that irrespective of the currency of aggregation the assumption of constant import intensities implies that import volumes grow at the same rate as GDP volumes, *i.e.* $g_M = g_Y$.

If imports and GDP are aggregated in the same currency – for instance, in US dollars at market exchange rates as in this paper -- the assumption of equal import intensities across countries implies that country shares in global imports and global GDP are identical, *i.e.* $w_M^i = w_Y^i$. In this case, the global trade elasticity indeed collapses to 1:

$$\sigma^W = \frac{w_Y^1 \cdot g_Y^1 + w_Y^2 \cdot g_Y^2}{w_Y^1 \cdot g_Y^1 + w_Y^2 \cdot g_Y^2} = 1.$$

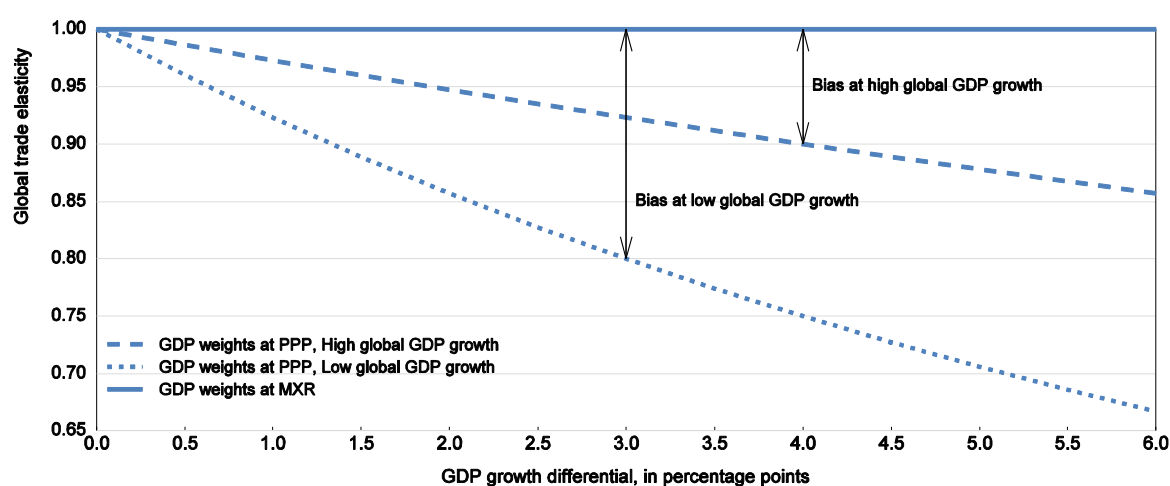
4. Although Constantinescu et al. (2015) does not explicitly disclose the precise measure of global GDP used in their study, the similarity of their estimation results with those based on global GDP at PPPs reported in Table 1 below suggests that Constantinescu et al. (2015) is based on the PPP measure. Given that the long-term component of global trade growth in Constantinescu et al. (2015, Figure 6) is obtained by multiplying the assumed long-term elasticity of 1.3 with global GDP growth, the fact that the long-term component is close to 0 for 2009 while global GDP growth at market exchange rates was around -2% also appears to suggest that Constantinescu et al. (2015) is based on global GDP at PPPs.
5. The growth differential between G7 countries and the BRICS countries increased from around 4½ percentage points over the period 1986-2007 to 5½ percentage points over the period 2008-14 while global growth slowed by around 1 percentage point (from 3.3% to 2.1% at market exchange rates).

By contrast, if imports are aggregated at market exchange rates and GDP is aggregated at PPPs, the assumption of equal import intensities across countries no longer implies that country shares in global imports and global GDP are identical; depending on the direction of the purchasing power correction a country's weight in global GDP at PPPs may be larger or smaller than its weight in global imports at market exchange rates:

$$\sigma^w = \frac{w_M^1 g_Y^1 + w_M^2 g_Y^2}{w_Y^1 g_Y^1 + w_Y^2 g_Y^2}$$

Assuming that the purchasing power correction reduces country 1's share in global GDP, *i.e.* $w_Y^1 < w_M^1$ and $w_Y^2 > w_M^2$, and that GDP growth in country 2 is higher than in country 1 (country 1 can be thought of as an advanced economy and country 2 as an emerging market economy), it follows immediately that the bias *(i)* is negative, *(ii)* increases in absolute terms with the growth differential between the two countries and *(iii)* increases in absolute terms as global GDP growth declines (Figure 2).¹

Figure 2. **The global trade elasticity is biased when GDP is aggregated at purchasing power parities**



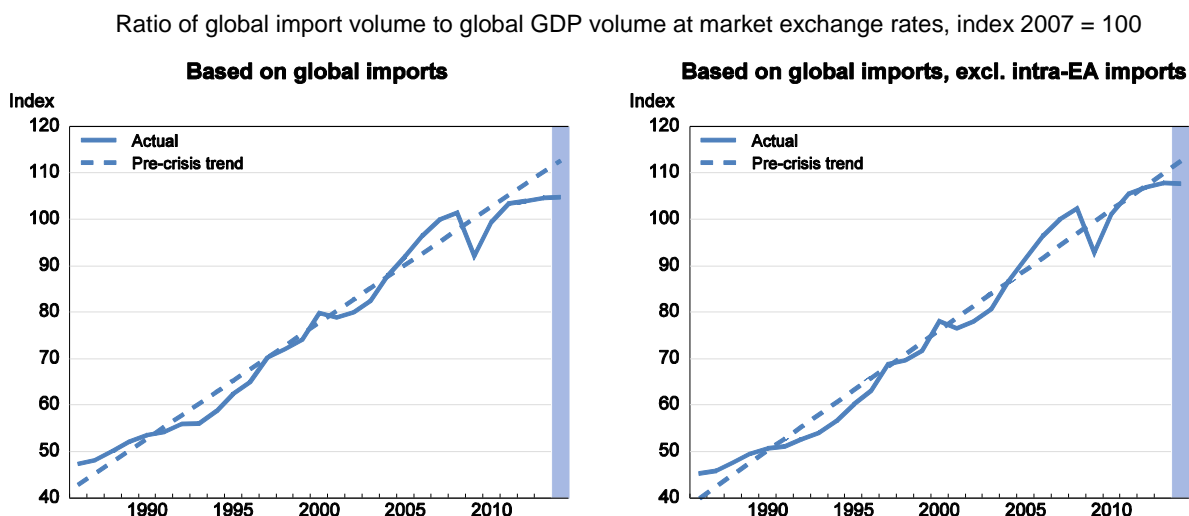
Note: GDP growth differential denotes the difference in GDP growth between country 2 and country 1. The chart assumes equal trade weights; equal GDP weights at market exchange rates (MXR); and GDP weights of 1/3 for country 1 and 2/3 for country 2 at PPPs. High global GDP growth assumes global GDP growth (at market exchange rates) of 6% while low global GDP growth assumes a rate of 2%.

Source: OECD calculations.

Note:

1. It should be noted that the global trade elasticity is not sensitive to the precise currency in which trade and GDP are aggregated so long as both are aggregated in the same currency; for instance, aggregating both trade and GDP at purchasing power parities or aggregating both trade and GDP at current rather than constant exchange rates (as in this paper) yields similar apparent elasticities (see Figure A4.1).

7. Developments in global trade intensity – here defined as the ratio of global trade volume to global GDP volume – further support the view that the global trade-to-GDP relation was fairly stable over 1986-2007 (Figure 3, Panel A). Over 2001-2007 global trade intensity was close to its pre-crisis trend over the period 1986-2007, but it started to deviate abruptly in 2009. Despite the trade rebound of 2010 global trade intensity remains well below its pre-crisis trend.

Figure 3. **Global trade intensity has deviated from its pre-crisis trend**

Note: Global import volume and GDP volume at market exchange rates are measured in 2010 USD. The trend line represents the pre-crisis trend 1986-2007. Values for 2014 are partly based on projections in *OECD Economic Outlook* (November 2014).

Source: OECD Economic Outlook 96 database; and OECD calculations.

8. The post-crisis deviation of global trade intensity from its pre-crisis trend is partly driven by the post-crisis weakness of intra-euro area trade. If intra-euro area trade – which was hit particularly hard by demand weakness in the euro area – is excluded from the measure of global trade, post-crisis global trade intensity is only marginally below its pre-crisis trend (Figure 3, Panel B).⁶ By statistical convention intra-euro area trade – which accounts for around 10% of global trade and is similar to intra-national trade along several dimensions as it is not subject to tariffs or currency risk and transport costs among geographically proximate countries are low – is included in the measure of global trade. Consequently, a shock to euro area demand may have a disproportional effect on global trade as it reduces both intra-euro area imports among highly integrated member countries and imports from outside the euro.⁷ By contrast, a shock to US demand reduces both inter-state imports and imports from outside the United States, but only the reduction in extra-US imports is accounted for in the conventional measure of global trade.⁸ To some extent, the deviation of global trade intensity from its pre-crisis trend therefore appears to reflect a statistical convention – which may reverse once demand in euro area countries picks up – rather than a structural development.

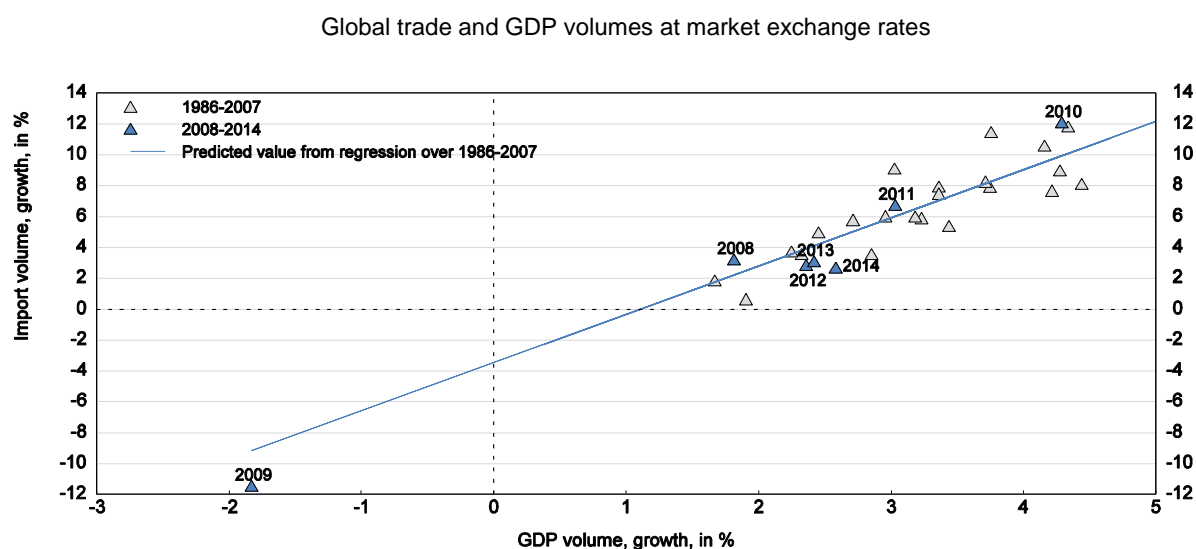
6. See Annex 1 for details on the construction of intra-euro area import volumes and Figure A1.2 for post-crisis growth in intra-euro area import volumes.

7. Note that the negative effect of euro area trade on the global trade intensity reflects both weak euro area demand and a decline in the apparent elasticity of intra-euro area trade to euro area GDP, with intra-euro area trade intensity well below its pre-crisis trend (Figure A1.3).

8. The share in global GDP of the United States is slightly higher than that of the euro area (23% versus 18% in 2010), but the share in global trade is only around half that of the euro area (12.5% versus 24% in 2010). Assuming similar import elasticities – which is consistent with the results in Bussière et al. (2013) and Morin and Schweltnus (2014) – the effect on global imports of a similar decline in demand across the two zones would be about twice as large for the euro area as for the United States.

9. Annual growth rates of global trade (including intra-euro area trade) in the wake of the crisis are well explained by annual growth rates of global GDP, leaving little room for structural explanations of global trade weakness (Figure 4). Even for the years 2011-14 – which are conventionally viewed as highlighting a structural break in the trade-GDP relationship (Constantinescu et al., 2015; Davies, 2014) – annual global trade growth is close to the predicted values from the linear regression of trade on GDP growth over the pre-crisis period (1986-2007). A noteworthy feature of the linear trend line in Figure 4 is that it is consistent with a decline in the apparent elasticity of global trade to GDP without assuming a change in the long-term trade-to-GDP relation; at the average GDP growth rate over 1986-2007 of 3.3% the linear trend line predicts trade growth of 6.7%, implying an apparent elasticity of 2.1, while at the average GDP growth rate over 2008-14 of 2.1%, the equation predicts trade growth of 3.1%, implying an apparent elasticity of 1.5.⁹ The pro-cyclicality of the apparent global trade elasticity appears to be – at least partly – related to the pro-cyclicality of global investment intensity (Box 2). Other possible explanations include the larger pro-cyclicality of the goods sector, which constitutes the bulk of trade, relative to the services sector, which constitutes the bulk of GDP, and the pro-cyclicality of international production fragmentation (Freund, 2009).

Figure 4. Post-crisis trade growth has been close to the rates predicted by GDP growth



Note: Values for 2014 are partly based on projections in *OECD Economic Outlook* (November 2014). Global import volume and GDP volume at market exchange rates are measured in 2010 USD.

Source: OECD Economic Outlook 96 database; and OECD calculations.

10. Summing up, the decline in the apparent elasticity of global trade to GDP does not appear to pre-date the global crisis of 2008-09, suggesting that the abrupt change thereafter may at least partly reflect demand developments. The decline in the apparent elasticity is partly related to the weakness of intra-euro area trade and post-crisis growth of global trade appears to be well explained by global GDP growth,

9. The regression of global trade growth on global GDP growth $\Delta \ln(\text{imports}_t) = \alpha + \beta \Delta \ln(\text{gdp}_t) + \varepsilon_t$ corresponds to a short-run model that does not restrict the long-term elasticity of global trade to GDP. More specifically, if $\alpha \neq 0$ the long-term elasticity implied by this model $\Delta \ln(\text{imports}) / \Delta \ln(\text{gdp}) = \beta + \alpha / \Delta \ln(\text{gdp})$ depends on long-term GDP growth. For the coefficients estimated over 1986-2007 ($\alpha = -3.5$ and $\beta = 3.1$), GDP growth of 3.3% (average 1986-2007) implies a long-term elasticity of 2.1 while GDP growth of 2.1% (average 2008-14) implies an elasticity of 1.5.

further supporting the hypothesis that global trade weakness may at least partly reflect demand developments.

3. Can weak demand account for the weakness of post-crisis global trade growth?

11. Based on a more formal econometric analysis and the description of recent trends in investment, international production fragmentation and protectionism, this section further investigates whether post-crisis trade developments may reflect a structural break in the relation between global trade and GDP or whether demand developments alone are sufficient to explain post-crisis global trade weakness. A standard error correction model is estimated over different sub-periods to detect structural breaks in the long-run trade elasticity. This model suggests that the long-run relation between global trade and GDP was stable over 1986-2007, with a structural break around the year 2008. However, the error correction model constrains the apparent trade elasticity to be constant irrespective of medium-term GDP growth, which is inconsistent with the stylised fact that the apparent elasticity declines in the wake of global downturns. Consequently, the error correction model attributes a decline in the apparent elasticity to a structural break in the long-run trade elasticity. It is shown that a less restrictive model that does not constrain the long-term elasticity to be constant can account for the post-crisis decline in the apparent elasticity and accurately tracks post-crisis trade developments without any structural change in the trade-GDP relation. Details on the different methods to assess the stability of the trade-GDP relation are described in Box 2.

Box 2. Measuring the structural relation between global trade and GDP

This box shows that over short sample periods the apparent long-term elasticity of global trade to GDP may fluctuate even though the structural relation between global trade and GDP is stable.

The ratio of global trade growth to global GDP growth over short sample periods is directly observable and is denoted as the **apparent global trade elasticity** in this paper. Fluctuations in the apparent elasticity may reflect either changes in the long-term structural relation between global trade and GDP or cyclical effects related to the expenditure composition of global GDP as highlighted, for instance, by Bussière et al. (2013).

The **structural long-term global trade elasticity** is not directly observable in real time, but under the assumption that a stable long-term structural relation between global trade and GDP exists over sufficiently long sample periods it can be estimated as the coefficient β in the (logarithmic) level equation

$$\ln(\text{trade}_t) = \alpha^{LT} + \beta^{LT} \cdot \ln(\text{gdp}_t) + \varepsilon_t$$

or as the coefficient $-\delta/\gamma$ in the error correction equation

$$\Delta \ln(\text{trade}_t) = \alpha^{ECM} + \beta^{ST} \cdot \Delta \ln(\text{gdp}_t) + \gamma \ln(\text{trade}_{t-1}) + \delta \ln(\text{gdp}_{t-1}) + \varepsilon_t.$$

It should be noted that over short sample periods both methods yield unreliable estimates of the underlying long-term structural long-term global trade elasticity. The coefficient β in the level equation typically declines in the wake of global downturns, suggesting that over short sample periods the estimated β depends on the global business cycle. Over short sample periods, the $-\delta/\gamma$ coefficient in the error correction equation is highly unstable (see Figure A2.1), as the error correction model fails to distinguish between the short-term dynamics and the long-term structural relation between global trade and GDP.

The **short-term global trade elasticity** measures the percentage point change in global trade growth for every percentage point change in global GDP growth and can be estimated as the coefficient β^{ST} in the equation in first differences

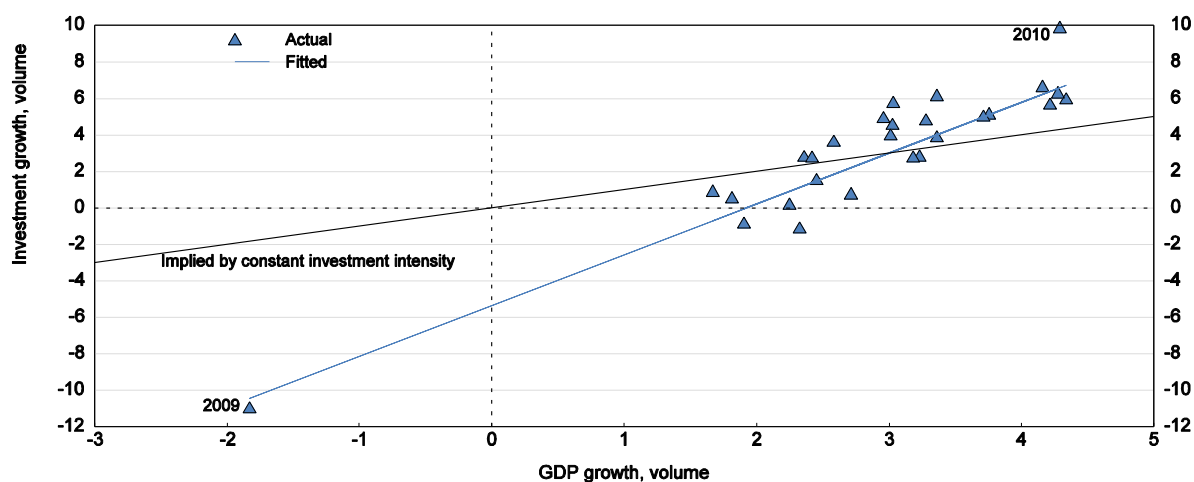
$$\Delta \ln(\text{trade}_t) = \alpha^{ST} + \beta^{ST} \cdot \Delta \ln(\text{gdp}_t) + \varepsilon_t.$$

The equation in first differences does not constrain the apparent long-term global trade elasticity to be constant even at a stable structural relation between global trade and GDP; at stable coefficients α^{ST} and β^{ST} the elasticity is defined as

$\sigma \equiv \Delta \ln(\text{trade}_t) / \Delta \ln(\text{gdp}_t) = \beta^{ST} + \alpha^{ST} / \Delta \ln(\text{gdp}_t)$. Given an estimated intercept term α^{ST} over the period 1986-2014 of around -3.5 and a short-term elasticity of around 3, the equation in first differences implies that over sample periods of 5-6 years the apparent long-term global trade elasticity increases with GDP growth.¹

The negative intercept α^{ST} and the implied pro-cyclicality of the apparent trade elasticity over short sample periods in the model in first differences is consistent with the pro-cyclicality of global investment intensity; at above-average global GDP growth, global investment intensity tends to increase while it tends to decrease at below-average global GDP growth (Figure 5). In fact, the estimated relation between global GDP growth and global investment growth implies that at 0 global GDP growth global investment growth is negative, suggesting that predicted negative global trade growth at 0 global GDP growth may be related to the predicted decline in global investment.

Figure 5. Global investment intensity is pro-cyclical



Source: OECD Economic Outlook 96 database; and OECD calculations.

The model in first differences that assumes the short-term global trade elasticity to be constant but that does not constrain the long-term elasticity can replicate the stylised fact that the apparent elasticity declines during periods of low global GDP growth – which may reflect a level shift in potential global GDP – without assuming a structural change in the underlying model parameters. By contrast, the error correction model that constrains the long-term elasticity to be constant can account for the persistent low apparent trade elasticity in the wake of the crisis only by assuming a structural decline in the long-term global trade elasticity.²

The model in first differences implies that the apparent global trade elasticity returns to its pre-crisis average only if GDP growth returns to its pre-crisis average. Over the short sample 2008-14, the model is consistent with a lower apparent global trade elasticity as average post-crisis GDP growth has been lower than global GDP growth over 1986-2007. However, the model in first differences implies that the apparent global trade elasticity returns to its pre-crisis average of around 2 if global GDP growth returns to its pre-crisis average which is the baseline projection of all major international organisations.³

Notes:

1. Over sample periods of 5 years global GDP growth at market exchange rates has ranged from 2% to 4%.
2. The error correction model assuming no structural change in model parameters implies that the apparent global trade elasticity returns to its pre-crisis average irrespective of global GDP growth.
3. *OECD Economic Outlook* (November 2014) projects 3.3% global GDP growth at market exchange rates for 2016; the *World Bank Global Economic Prospects* (January 2015) projects 3.3%; and the *IMF World Economic Outlook* (October 2014) projects 3.4%. Global GDP growth at market exchange rates over the period 1986-2007 was 3.3%.

3.1. Econometric estimation of the long-term global trade elasticity

12. A standard error correction model framework is used to estimate the long-term elasticity of global trade to GDP over different time periods (Irwin, 2002; Constantinescu et al., 2015). This framework assumes that a stable cointegration relation between global trade and GDP exists within sub-periods, but that this relation may change across time periods as exogenous factors such as trends in trade liberalisation, transport costs or international production fragmentation change. Following the notation of Constantinescu et al. (2015) to facilitate direct comparison of estimation results, the estimated equation takes the form:

$$\Delta \ln m_t = \alpha + \beta \Delta \ln y_t + \gamma \ln m_{t-1} + \delta \ln y_{t-1} + \varepsilon_t \quad (1)$$

where Δ denotes first differences, m_t denotes global import volume and y_t global GDP volume at time t , α is the regression intercept and ε_t is the error term. The short-run elasticity of global trade to GDP is β while the speed of adjustment to the long-run equilibrium is $-\gamma$. The long-run elasticity of global trade to GDP is given by $-\delta/\gamma$.

13. Estimation of equation (1) based on a PPP-based measure of global GDP would imply that the long-term global trade elasticity has declined to around 1.3 around the year 2000 (Table 1, Model 1), which would be consistent with the conventional view that the long-term trade-GDP relation changed around the turn of the century (Constantinescu et al., 2015). According to this view, the years 1986-2000 would appear as a period of exceptionally high trade growth, with an estimated long-term global trade elasticity of 2.3, while the decline to around 1.3 at the turn of the century would indicate the return to the pre-1986 norm.

14. Based on global GDP at market exchange rates – which is a more accurate gauge of global demand for traded goods than global GDP at PPPs – the estimated long-term trade elasticity has remained around 2 over the past 15 years (Table 1, Model 2). While the estimates suggest a significant decline at the turn of the century, the estimated long-term elasticity has remained well above the pre-1986 norm.¹⁰ Moreover, the estimated long-term elasticity has declined only marginally from 2.3 to around 2 once intra-euro area flows are excluded from the measure of global trade (Table 1, Model 3). Given that estimates of long-run elasticities obtained over short samples such as 2001-14 may be affected by cyclical factors and that removing intra-euro area flows only removes part of the cyclical effects of the global crisis, these results cast considerable doubt on the hypothesis that the long-run trade elasticity declined around the year 2000.

10. It should be noted that the differences between sub-periods in Table 1 are statistically significant at the 5% level (see Table A4.1).

Table 1. Estimation results for Equation (1) based on annual data

		Long-run elasticity ^{1,2}		
Model	Definition of long-run elasticity	1970-85	1986-2000	2001-14
(1)	Global import volume at 2010 USD to global GDP volume at PPP	1.3***	2.3***	1.3***
(2)	Global import volume at 2010 USD to global GDP volume at 2010 USD	1.3***	2.4***	1.8***
(3)	Global import volume ex. intra-EA imports at 2010 USD to global GDP volume at 2010 USD	1.3***	2.3***	2.0***

Notes:

1. Based on the estimation of the following equation:

$$\begin{aligned} \ln(\text{imports})_t = & \alpha_1 + \beta_1 * \ln(\text{gdp})_t * DV_1 + \gamma_1 * \ln(\text{imports})_{t-1} * DV_1 + \delta_1 * \ln(\text{gdp})_{t-1} * DV_1 + \alpha_2 + \beta_2 * \ln(\text{gdp})_t * DV_2 + \gamma_2 \\ & * \ln(\text{imports})_{t-1} * DV_2 + \delta_2 * \ln(\text{gdp})_{t-1} * DV_2 + \alpha_3 + \beta_3 * \ln(\text{gdp})_t * DV_3 + \gamma_3 * \ln(\text{imports})_{t-1} * DV_3 + \delta_3 \\ & * \ln(\text{gdp})_{t-1} * DV_3 + \varepsilon_t \end{aligned}$$

where gdp is global GDP volume; imports is global imports of goods and services; DV1, DV2 and DV3 are dummy variables for the periods 1970-85, 1986-2000 and 2001-14 respectively; and ε_t is the error term.

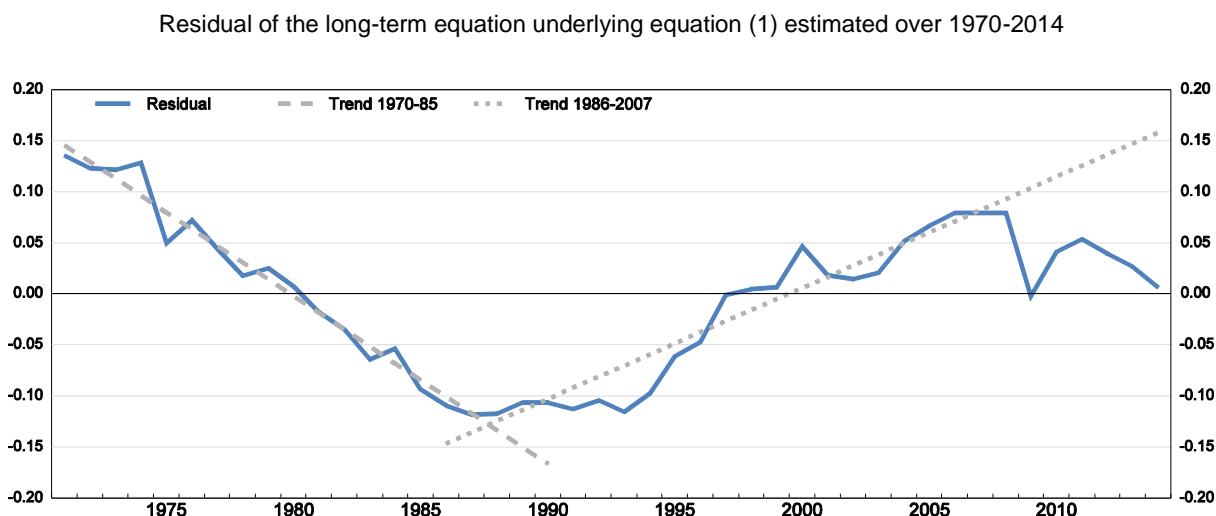
2. The long-term elasticities for the sub-periods 1970-85, 1986-2000 and 2001-14 are given by $-\delta_1/\gamma_1$, $-\delta_2/\gamma_2$ and $-\delta_3/\gamma_3$, respectively. Statistical significance is established using a non-linear Wald test. *** indicates a significance level of 1%.

Source: OECD Economic Outlook 96 database; and OECD calculations.

15. The limited decline in the long-term elasticity of global trade to GDP (measured at market exchange rates in the remainder of the paper) over 2001-14 appears to be driven by post-2007 developments rather than structural changes preceding the crisis (Figure 6). The residual of the long-term cointegrating relation between global trade and GDP underlying the error correction model in equation (1) – estimated over the period 1970-2014 using GDP – is trending down over 1970-85 and trending up over 1986-2007. The break in the long-run elasticity of global trade to GDP around the late 1980s partly reflects the acceleration in the process of globalisation, especially trade liberalisation in a number of large emerging market economies, such as China, India and the former Soviet economies, as well as the implementation or deepening of major regional trade agreements such as the North American Free Trade Agreement or the Single European Market, which triggered the international fragmentation of production chains. Instead of producing predominantly in a single country, multinational firms increasingly fragmented the production chain across several countries to take advantage of cost differences, implying that value added increasingly crossed borders several times before being shipped to the final consumer. The post-2008 deviation of the residuals from the pre-crisis trend reflects the decline in the apparent global trade elasticity in the wake of the crisis, but in the context of the severity and the length of the crisis the limited number of post-crisis observations suggests caution in interpreting this as a structural break.¹¹

11. Formal tests for structural breaks detect statistically significant changes in the long-term relation between global trade and GDP in the late 1980s and around the onset of the global crisis in 2008-09 but no change around the year 2000, suggesting that the break in the global trade elasticity did not pre-date the global crisis (Table A4.2). The cointegration test of Gregory and Hansen (1996) allowing for a structural break in the cointegration relation yields 2007 as the break date for the sample period 1986-2014. Moreover, it suggests a broadly stable cointegration relation between global trade and GDP from the late-1980s to 2007. The Gregory and Hansen (1996) test narrowly fails to reject the null hypothesis of no cointegration when allowing for a break in 2007, but it is well known that formal tests of cointegration have low power in small samples (Hakkio and Rush, 1991). The error-correction based cointegration test of Banerjee et al. (1996) which has generally more power when cointegration exists, rejects the null hypothesis of no cointegration over the period 1986-2007.

Figure 6. The break in the cointegrating relation between trade and GDP coincides with the global crisis



Note: Residual based on the estimation over 1970-2014 of the long-term equation implicitly underlying the error correction model in equation (1): $\ln(\text{imports})_t = \alpha + \beta * \ln(\text{gdp})_t + \varepsilon_t$. Global import volume and GDP volume at market exchange rates are measured in 2010 USD.

Source: OECD Economic Outlook 96 database; and OECD calculations.

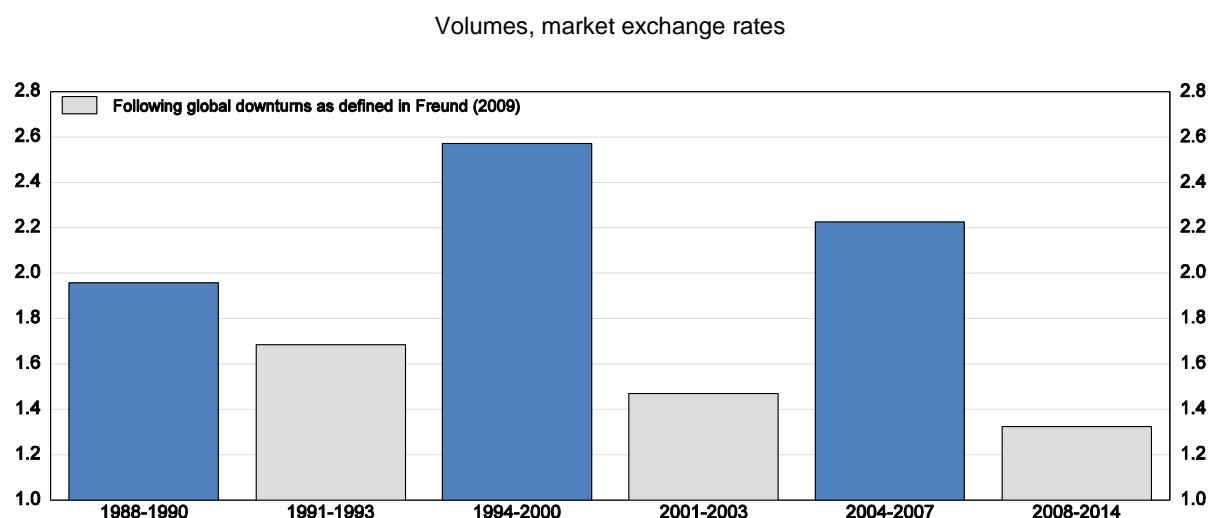
16. While it is tempting to interpret the decline in the apparent elasticity and the break in the long-term residuals around the crisis as reflecting a structural slowdown in the process of globalisation, the fact that this decline coincides with the onset of the global crisis suggests that it may at least partly be driven by demand developments.¹² In the very long-term there is no reason for the global trade elasticity to remain above 1 as the potential for further transport cost reductions and trade liberalisation declines (Krugman, 2013).¹³ However, it appears unlikely that the transition from a long-term elasticity of well above 2 to around 1 would occur as abruptly as suggested by Figures 1 and 4.

17. Even at a stable long-run elasticity of global trade to GDP, over short sample periods the ratio of global trade growth to global GDP growth – the apparent elasticity – can vary for cyclical reasons (Figure 7). Econometric tests typically suggest a stable long-term relation between global trade and GDP from the late 1980s to 2007 (as represented by a stable δ/γ in equation 1), but in the wake of global downturns identified by the statistical filtering method of Freund (2009) the apparent elasticity was typically well below the stable long-term elasticity. Against the background of the severity of the global crisis of 2008-09, the decline in the apparent elasticity over 2009-14 does not appear as particularly striking.

12. Note that the residuals of the long-term equation and the statistical tests for structural breaks in the long-term cointegrating relation between global trade and GDP are based on the long-term equation in (logarithmic) levels which assumes a constant apparent global trade elasticity irrespective of global demand growth (see Box 2). The statistical tests therefore mechanically attribute a decline in the apparent global trade elasticity to a change in the structural long-term global trade elasticity.

13. Gruber et al. (2011) constrain the long-run global trade elasticity to 1 but allow for an exogenous globalisation trend meant to capture the effect of transport cost declines, trade liberalisation or the lengthening of global value chains on the global trade growth.

Figure 7. The ratio of global trade to GDP growth typically declines following global downturns



Note: Global import volume and GDP volume at market exchange rates are measured in 2010 USD. Values for 2014 are partly based on projections in *OECD Economic Outlook* (November 2014).

Source: OECD Economic Outlook 96 database; and OECD calculations.

18. A model that includes only growth rates of global trade and GDP tracks post-crisis trade developments fairly accurately without assuming any structural break in the parameters over the period 1986-2014, suggesting that about 85% of the post-crisis weakness in global trade can be explained by global demand developments.¹⁴ By constraining the long-term global trade elasticity to be constant even at persistently low GDP growth, the error correction model in Equation 1 can account for the post-crisis decline in the apparent elasticity only by assuming a structural break in the long-term elasticity. By contrast, the model in growth rates can account for the stylised fact that the global trade elasticity declines in the wake of global downturns without assuming any structural break in the trade-GDP relation (see Box 2). The remainder of the paper focuses on the following model in growth rates:

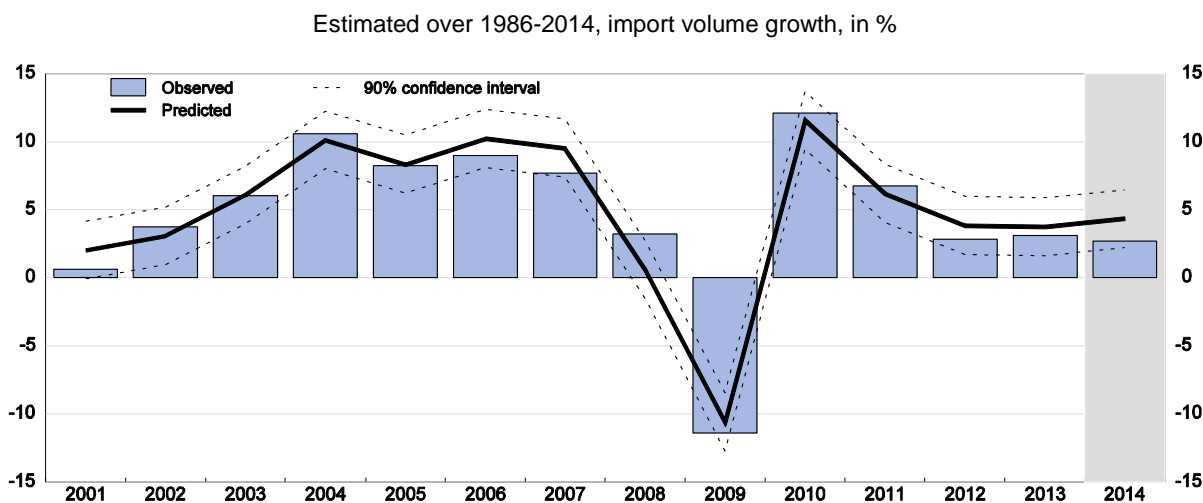
$$\Delta \ln m_t = \alpha + \beta_1 \Delta \ln m_{t-1} + \beta_2 \Delta \ln y_t + \beta_3 \Delta \ln y_{t-1} + \varepsilon_t, \quad (2)$$

where Δ denotes first differences, m_t denotes global import volume and y_t global GDP volume at time t , α is the regression intercept and ε_t is the error term. Formal tests suggest that the parameters of this model are stable over the estimation period 1986-2014 (Table A3.1) and the in-sample fit is accurate even for the post-crisis period (Figure 8).¹⁵

14. Global trade growth declined from 6.9% over 1986-2007 to 2.8% over 2008-14, with the model estimated over 1986-2007 explaining 3½ percentage points of the overall decline.

15. The detailed estimation results are reported in Table A4.3. The parameter stability in the model in growth rates implies that predicted global trade grows at about twice the rate of global GDP once cyclical effects fade, *i.e.* at average GDP growth over the period 1986-2014 the short term model implies an apparent global trade elasticity of about 2 (see Annex 3 for the properties of the model in growth rates).

Figure 8. In-sample fit of the model in growth rates without structural break



Note: The predicted value of global import volume growth is based on the estimation of equation (2) over the period 1986-2014. Values for 2014 are partly based on projections in *OECD Economic Outlook* (November 2014). Global import volume and GDP volume at market exchange rates are measured in 2010 USD.

Source: OECD Economic Outlook 96 database; and OECD calculations.

19. For the years 2012-13 and possibly 2014, the model in growth rates slightly over-predicts global trade growth but the error is well within the model's error margin and likely to reflect a number of special factors rather than major structural developments. The over-prediction for 2012 and 2013, for instance, partly reflects the extraordinary demand weakness of the highly trade-intensive euro area, for which imports declined by 1% in 2012 and grew by only around 1% in 2013. Projected trade weakness for 2014 appears to mainly reflect developments in non-OECD Asia, including China, rather than euro area developments. A structural explanation for recent trade weakness can therefore not fully be ruled out. However, it would be premature to conclude from a single year of unexpectedly low trade growth that there is a structural break in the long-term trade-GDP relation.¹⁶

20. Estimations based on quarterly data confirm the results based on annual data in the sense that the estimated long-term global trade elasticity over the period 2001-14 is around 2 (Table A2.1) and that the limited decline with respect to the 1990s reflects post-crisis developments (Table A2.2). Although higher-frequency data allow a more precise estimation of the dynamics of the trade-GDP relation, quarterly data cannot resolve the fundamental issue that over periods of 7 years estimates of the long-term elasticity are highly unstable and can be perturbed by cyclical effects.¹⁷ Testing the long-run relation between trade and GDP with 30 quarterly observations is conceptually no different from testing it with 7 yearly observations (Hakkio and Rush, 1991). Rather than using quarterly data to estimate the long-term elasticity over short sample periods, this paper therefore applies standard econometric methods to test for the existence of a stable cointegration relation between global trade and GDP over the period 1986-2014. These tests suggest that the cointegration relation was broadly stable over 1986-2008, implying that quarterly data also reject the hypothesis that the decline in the global trade elasticity pre-dated the crisis.

16. The possible over-prediction for 2014 is similar in size to the one for 2001 after which trade resumed growth similar to the rate predicted by the model in growth rates.

17. Rolling regressions over 7-year windows over 1986-2014 based on equation (1) show that the estimated long-term global trade elasticity is highly unstable (Figure A2.1).

21. Summing up, the econometric analysis suggests that the most likely scenario for global trade growth over the next 2-3 years is a rate of about twice that of global GDP growth at market exchange rates as cyclical effects fade and GDP growth picks up as to around its pre-crisis average, as projected by all major international organisations. While the limited number of post-crisis observations precludes a definitive rejection of the hypothesis that structural changes in the global trade-GDP relation may have contributed to recent trade weakness, the econometric analysis rejects the hypothesis that the limited decline in the long-term global trade elasticity reflects structural developments pre-dating the crisis of 2008-09 (Constantinescu et al., 2015). Based on a model in growth rates that does not constrain the elasticity of global trade to GDP to be constant, post-crisis trade developments are well explained by GDP developments alone, suggesting that the decline in the apparent global trade elasticity after 2008 mainly reflects cyclical factors rather than a structural break in the process of globalisation.

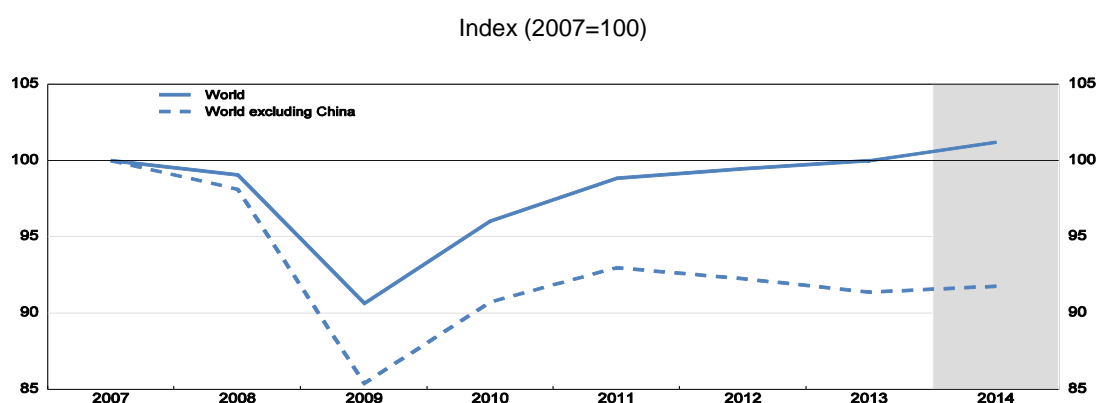
3.2. Trends in investment, production fragmentation and protectionism

22. This sub-section assesses whether recent developments in global investment, international production fragmentation and protectionism are consistent with the results from the econometric analysis. It is first analysed whether in the wake of the crisis the composition of global demand shifted away from import-intensive investment, a development that may at least partly reverse as the global recovery strengthens over the next years. It is further analysed whether post-crisis developments in international production fragmentation signal a structural break or whether the slowdown is consistent with typical cyclical developments and whether there is any evidence for changes in trade protection.

Investment

23. Global investment has been weak in the wake of the crisis, suggesting that the shift in the composition of global GDP towards less import-intensive components such as government consumption or private non-durables consumption has contributed to the post-crisis weakness of global trade. The apparent rebound of global investment intensity in the wake of the crisis has largely been driven by developments in China, for which the post-crisis investment boom largely reflects infrastructure investment (OECD, 2013) whose import content is low (Figure 9). For the remaining countries investment has been exceptionally weak in the wake of the crisis, further supporting the notion that trade may rebound strongly if investment intensity, especially in OECD countries, rebounds.

Figure 9. The ratio of global investment volume to GDP volume has been weak in the wake of the crisis



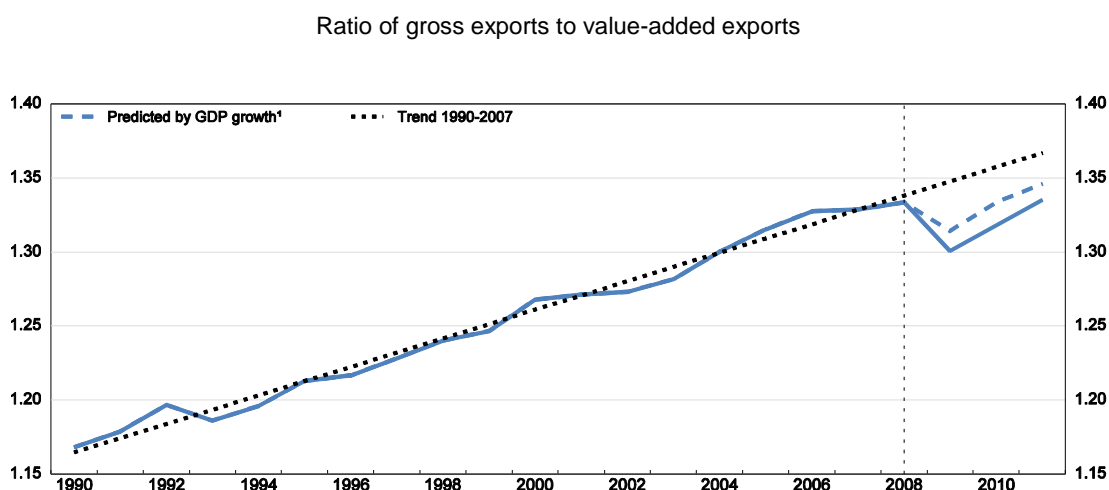
Note: Global investment and GDP volumes measured at market exchange rates. The value for 2014 is partly based on projections in *OECD Economic Outlook* (November 2014).

Source: OECD Economic Outlook 96 database; and OECD calculations.

International production fragmentation

24. There is no evidence for a slowdown in international production fragmentation – the process of slicing up the production process into stages located in different countries – in the run-up to the global crisis and the decline for 2009 is broadly consistent with global GDP developments, suggesting that there is thus far no evidence for a structural break. A common measure of international production fragmentation is the ratio of gross exports to value added exports, which can be interpreted as the average number of border crossings for each unit of imported final good (Fally, 2012). This measure started to increase along a linear trend in the late 1980s up to 2008, thereby raising gross exports and the global trade elasticity. It started to deviate from trend only at the onset of the global crisis (Figure 10). Regression analysis suggests that international production fragmentation is pro-cyclical in the sense that international production fragmentation accelerates when global GDP growth is high and decelerates during global downturns. The pro-cyclicality may reflect the fact that during global recessions the composition of global trade shifts toward products with shorter value chains (Ferrantino and Taglioni, 2014) or the fact that multinational companies postpone investment projects related to international outsourcing. Based on the estimated semi-elasticity of international production fragmentation to global GDP, post-crisis developments in international production fragmentation are largely explained by GDP developments, with international production fragmentation declining in 2009 and rebounding over 2010-11 (Figure 10).

Figure 10. **The decline in international production fragmentation in 2009 is consistent with GDP developments**



Note: Between OECD-WTO reference years (1995, 2000, 2005, 2008 and 2009) the gross exports to value added exports ratio is interpolated using the ratio in Johnson and Noguera (2012). The OECD-WTO reference year 2011 is based on preliminary data.

1. Predicted value for 2009 and 2011 based on the estimation over 1990-2008 of $\Delta GVAX_t = \alpha + \beta * \Delta \ln(gdp)_t + \varepsilon_t$, where $GVAX_t$ is the ratio of gross to value-added exports.

Source: OECD-WTO Trade in Value Added (TiVA); Johnson and Noguera (2012).

Protectionism

25. Increases in protectionism appear to have played at best a marginal role in the slowdown of global trade following the crisis. While circumstantial evidence suggests an increase in the number of “murky” protectionist measures taken by G20 governments (Evenett, 2013) – including subsidies to domestic industries, anti-dumping actions or discriminatory regulation – WTO (2014) concludes that “the share of world trade affected by restrictive trade measures is not high” and that the rise in trade-restrictive measures has to be seen in the context of offsetting trade liberalising measures, especially in lower-income G20 countries. For instance, the share of world trade covered by trade-restrictive measures introduced by G20 countries in 2012 was similar to the share covered by trade-liberalising measures (around 1% of world trade).¹⁸

4. Implications for projecting trade when GDP projections are known

26. Models linking global trade and GDP are routinely used in the OECD Economics Department to assess the consistency of the global trade and GDP projections. The results reported in this paper imply that in the near term consistency checks should be conducted based on the relation between global trade growth and GDP growth since around the late 1980s, as the relation has been fairly stable thereafter with no evidence for a structural break in the equation in growth rates (equation 2) in the wake of the global crisis of 2008-09.¹⁹ Based on the estimation of equation 2 over 1986-2013 that has tracked global trade growth fairly accurately over 1990-2013, the most recent global GDP projections for 2016 of 3.3% at market exchange rates (3.9% at PPPs) in *OECD Economic Outlook* (November 2014) imply that global trade growth should pick up to around 7%.

18. The share of world trade covered by trade-restrictive and trade-liberalising measures is a crude indicator for the trade effects of protection as trade effects depend on the type and the size of the measures and import demand elasticities.

19. In the medium term, it is likely that the apparent elasticity of global trade to GDP returns to a level well below 2 as trade liberalisation and declines in transport costs are likely to proceed at a slower pace than over the past two decades.

REFERENCES

- Bai, J. and P. Perron (2003), “Computation and Analysis of Multiple Structural Change Models”, *Journal of Applied Econometrics* 18 (1): 1–22.
- Banerjee, A., J. Dolado and R. Mestre (1998), “Error-correction tests for cointegration in a single-equation framework”, *Journal of Time Series Analysis* 19(3): 267-283.
- Bems R., R. Johnson and K.-M. Yi (2013), “The Great Trade Collapse”, *Annual Review of Economics* 5(1): 375-400.
- Bussière, M., G. Callegari, F. Ghironi, G. Sestieri and M. Yamano (2013), “Estimating trade elasticities: Demand elasticities and the trade collapse of 2008-09”, *American Economic Journal: Macroeconomics* 5(3):118–151.
- Clements, M. and D. Hendry (2002), “An overview of economic forecasting”, in: M. Clements and D. Hendry (eds.), *A Companion to Economic Forecasting*, pp. 1-18, Blackwell Publishing.
- Constantinescu, C., A. Mattoo and M. Ruta (2015), “The global trade slowdown. Cyclical or structural?” *Policy Research Working Paper No. 7158*, World Bank.
- Davies, G. (2013), “Why world trade growth has lost its mojo”, <http://blogs.ft.com/gavyndavies/2013/09/29/why-world-trade-growth-has-lost-its-moj/>
- Evenett, S. (2013), “Five More Years of the G20 Standstill on Protectionism?”, voxeu.org.
- Fally, T. (2012), “Production staging: Measurement and facts”, mimeograph, University of Colorado-Boulder.
- Ferrantino and Taglioni (2014), “Global Value Chains in the current trade slowdown”, *Economic Premise* No. 137 (March 2014), World Bank.
- Freund, C. (2009). “The trade response to global downturns: Historical evidence”, *World Bank Policy Research Working Paper*, No. 5015, The World Bank.
- Gregory, A. and B. Hansen (1996), “Residual-based tests for cointegration in models with regime shifts”, *Journal of Econometrics*, No. 70: 99-126.
- Gruber, J., F. di Mauro, B. Schnatz and N. Zorell (2011), “Where are global and U.S. trade heading in the aftermath of the trade collapse: Issues and alternative scenarios”, *Board of Governors of the Federal Reserve System International Finance Discussion Papers*, No. 1017.
- Hakkio, C. and M. Rush (1991), “Cointegration – How short is the long run?” *Journal of International Money and Finance* 10: 571-581.
- Irwin, D. (2002), “Long-run trends in world trade and income”, *World Trade Review* 1(1): 89-100.
- Johnson, R. and G. Noguera (2012), “Accounting for intermediates: Production sharing and trade in value added”, *Journal of International Economics*, Vol. 86: 224-236.
- Krugman, P. (2013), “Should slowing trade growth worry us?” http://krugman.blogs.nytimes.com/2013/09/30/should-slowing-trade-growth-worry-us/?_php=true&_type=blogs&_r=0

Morin, M. and C. Schwellnus (2014), “An update of the OECD international trade equations”, *OECD Economics Department Working Paper* No. 1129, OECD Publishing, Paris.

OECD (2013), *OECD Economic Surveys: China*, OECD Publishing, Paris.

WTO (2014), *World Trade Report 2014*, World Trade Organization, Geneva.

Annex 1: Details on global GDP volume at market exchange rates and intra-euro area trade

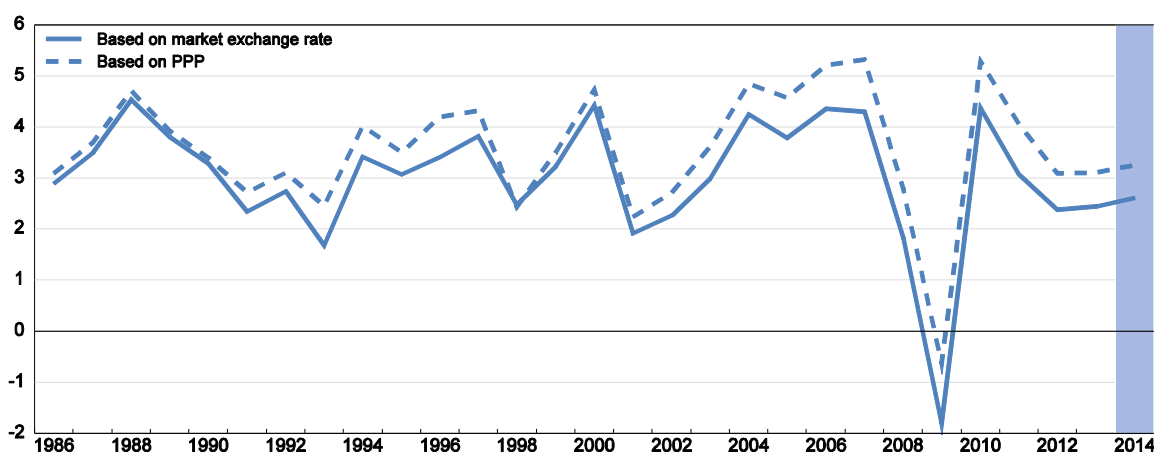
27. Global GDP growth at market exchange rates is computed as the weighted sum of country-specific real GDP growth rates, where the weights are shares in global GDP at market exchange rates defined as follows:

$$w_{i,t} = \frac{(gdp_{i,t} * e_{i,2010})}{\sum_i (gdp_{i,t} * e_{i,2010})}$$

where $gdp_{i,t}$ denotes real GDP of country i at date t (in constant domestic currency for the base year 2010) and $e_{i,2010}$ the value of the bilateral exchange rate of country i with the US dollar in 2010.²⁰ Note that global import volumes are computed at market exchange rates using the same aggregation procedure. Post-crisis growth of global GDP at market exchange rates has been around 1 percentage point below the growth rate of the conventional measure of global GDP at PPPs which is directly available in OECD Economic Outlook (November 2014) database (Figure A1.1).

Figure A1.1. Real global GDP growth at PPPs and market exchange rates

Percentage change



Note: The value for 2014 is partly based on projections in *OECD Economic Outlook* (November 2014).

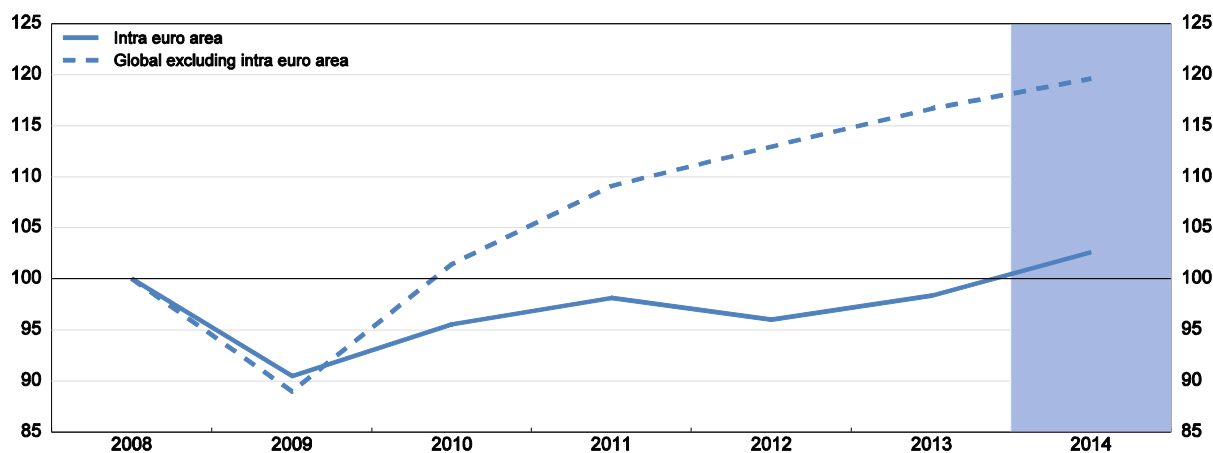
Source: OECD Economic Outlook 96 database; and OECD calculations.

28. Intra-euro area imports of goods and services are constructed using the share of intra-euro area imports reported by Eurostat (merchandise only) and multiplying it by the measure of total euro area import volumes (goods and services) in the OECD Economic Outlook No. 96 database. Eurostat does not report intra-euro area imports before 1999 so that IMF Direction of Trade Statistics are used to compute the share of intra-euro area imports in total euro area imports before that date. Over the post-crisis period intra-euro area imports have been a significant drag on global import volume growth (Figure A1.2). Moreover, the elasticity of intra-euro area trade to euro area GDP appears to have declined in the wake of the crisis, as illustrated by the deviation of the ratio of intra-euro area imports to euro GDP from its pre-crisis trend (Figure A1.3).

20. The level of global GDP volume at 2010 market exchange rates can be obtained by constructing an index of global GDP volume and applying it to nominal global GDP in US dollars in 2010.

Figure A1.2. **Intra-euro area import volume**

Index (2008=100)

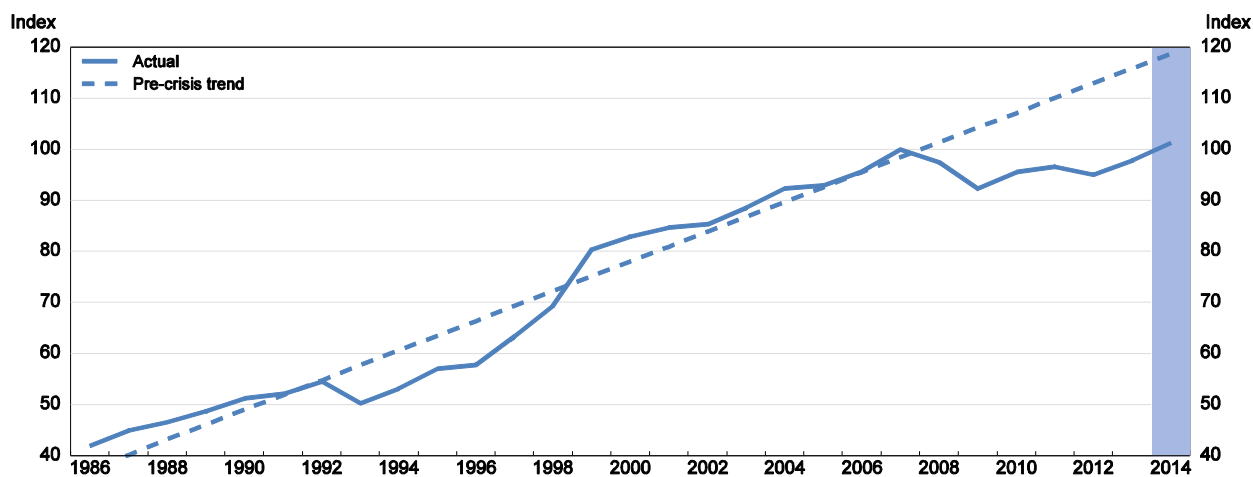


Note: The value for 2014 is partly based on projections in *OECD Economic Outlook* (November 2014).

Source: Eurostat; OECD Economic Outlook 96 database; and OECD calculations.

Figure A1.3. **The ratio of intra-euro imports to euro area GDP has deviated from its pre-crisis trend**

Index (2007 = 100)



Note: The value for 2014 is partly based on projections in *OECD Economic Outlook* (November 2014).

Source: OECD Economic Outlook 96 database; and OECD calculations.

Annex 2: Details on estimation results based on quarterly data

29. The estimation results for the sample periods 1986-2000 and 2001-14 based on quarterly data are similar to those based on annual data in the sense that there is a limited decline in the long-term global trade elasticity over the second sub-sample, with the long-term elasticity nonetheless remaining close to 2 (Table A2.1).

Table A2.1. **Estimation results for equation (1) based on quarterly data**

Dependent variable	$\Delta \ln(\text{imports})_t$	
	1986-2000	2001-14
constant (α)	-2.4 (1.8)	-1.4 (1.2)
$\Delta \ln(\text{gdp})_t$ (β)	2.0*** (0.4)	3.5*** (0.2)
$\ln(\text{imports})_{t-1}$ (γ)	-0.05 (0.04)	-0.05 (0.04)
$\ln(\text{gdp})_{t-1}$ (δ)	0.1 (0.1)	0.1 (0.1)
Long-term elasticity $(-\delta/\gamma)^1$	2.6***	1.9***
Statistical difference with previous period ²		0.7
Adjusted R-squared	0.74	0.74
Sample size ³	116	116

Note: Statistical significance based on unadjusted t-statistics at the 1, 5 and 10% level is denoted by ***, **, and *, respectively; standard errors in parenthesis. Based on the estimation of the following equation:

$$d\ln(\text{imports})_t = \alpha_2 + \beta_2 * d\ln(\text{gdp})_t * DV_2 + \gamma_2 * \ln(\text{imports})_{t-1} * DV_2 + \delta_2 * \ln(\text{gdp})_{t-1} * DV_2 + \alpha_3 + \beta_3 * d\ln(\text{gdp})_t * DV_3 + \gamma_3 * \ln(\text{imports})_{t-1} * DV_3 + \delta_3 * \ln(\text{gdp})_{t-1} * DV_3 + \epsilon_t,$$

where gdp is global GDP volume; imports is global imports of goods and services; DV2 and DV3 are dummy variables for the periods 1986-2000 and 2001-14 respectively; and ϵ_t is the error term.

1. The long-term elasticities for the sub-periods 1986-2000 and 2001-14 are given by $-\delta_2/\gamma_2$ and $-\delta_3/\gamma_3$, respectively. Statistical significance is established using a non-linear Wald test.

2. F-statistic based on a nonlinear using a nonlinear Wald test.

3. To allow direct comparison with Constantinescu et al. (2015) the overall sample size is reported although the effective sample size for the identification of the relevant coefficients is equal to size of the sub-samples.

Source: OECD Economic Outlook 96 database; and OECD calculations.

30. The Gregory and Hansen (1996) cointegration test over the period 1986-2014 indicates 2008Q1 as a break date and broadly stable cointegration before, suggesting that the decline in the long-term global trade elasticity over the period 2001-14 compared to 1986-2000 is driven by post-2007 developments.

Table A2.2. **Cointegration tests based on quarterly data**

	Null hypothesis	Test statistic	5% critical value	10% critical value	Break date
Gregory-Hansen ¹ (1986-2014)	no cointegration	-4.5	-5.0	-4.7	2008Q1

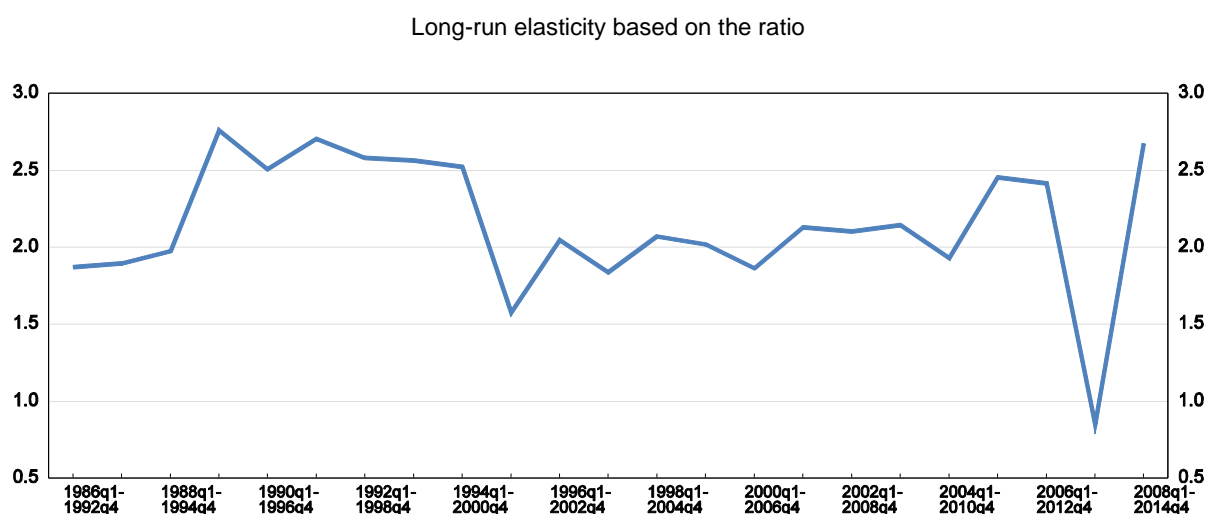
Note: Tests based on the long-term equation using quarterly data: $\ln(\text{imports}_t) = c + \beta * \ln(\text{gdp}_t) + \varepsilon_t$

1. Gregory-Hansen (1996) cointegration test allowing for a break (constant and slope) with 10% trimming.

Source: OECD Economic Outlook 96 database; and OECD calculations.

31. Estimating long-term relations over 6-7 year horizons would be misguided as higher-frequency data do not help to estimate the long-term relation between global trade and GDP. As noted by Hakkio and Rush (1991), the gain in degrees of freedom is more apparent than real as identifying a long-term property of the data with 30 quarterly observations is essentially equivalent to identifying it with 7 yearly observations. Moreover, estimates of the long-term elasticity over 7-year windows are highly unstable, implying that they are highly dependent on the chosen sample dates (Figure A2.1)

Figure A2.1. **Long-term elasticity estimated over 7-year windows using quarterly data**



Note: Based on equation (1).

Source: OECD Economic Outlook 96 database; and OECD calculations.

Annex 3: Properties of the model in growth rates

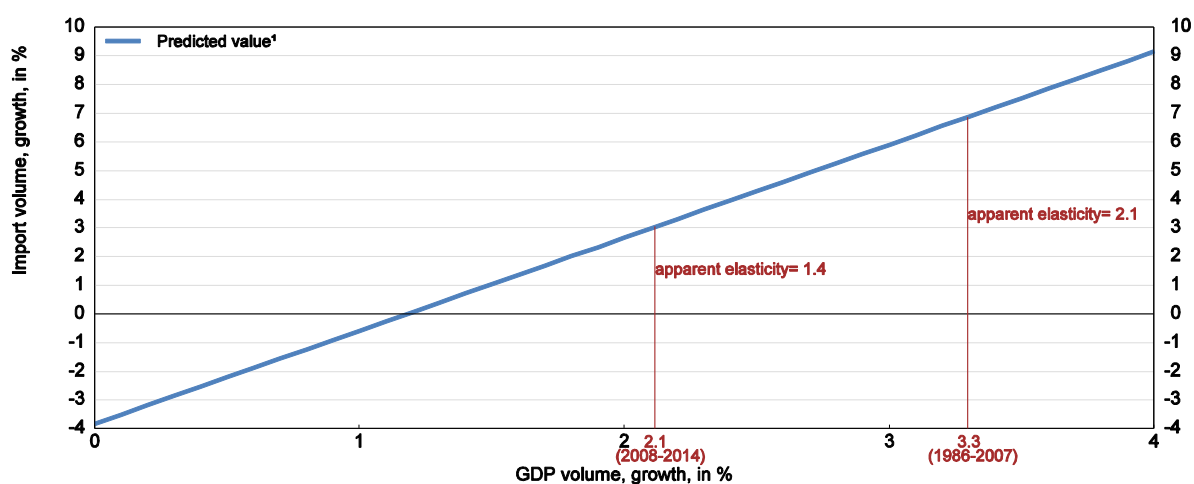
32. The model in growth rates in equation (2) implies a non-constant apparent elasticity of global trade to GDP, with the apparent elasticity given by:

$$\frac{\Delta \ln(\text{imports}_t)}{\Delta \ln(\text{gdp}_t)} = \frac{\alpha}{(1 - \beta_1) \cdot \Delta \ln(\text{gdp}_t)} + \frac{\beta_2 + \beta_3}{1 - \beta_1}$$

At the parameter values estimated over the period 1986-2014 (Table A4.3) and positive global GDP growth, the apparent global trade elasticity is pro-cyclical, which is consistent with the stylised fact that the apparent elasticity typically declines in the wake of global downturns (see Figure 7).

33. Reflecting the pro-cyclicity of the apparent global trade elasticity, the model in growth rates in equation (2) does not require assuming a structural break in model parameters to replicate global trade developments in the wake of the crisis. As noted by Clements and Hendry (2002), forecasting performance of models in first differences are less sensitive than error correction models to persistent changes in means of stationary variables, such as the persistent decline in the mean of global GDP growth in the wake of the crisis. Even without assuming a structural break in the parameters estimated over the period 1986-2014, the short term model thus predicts global trade growth of 3% at the average rate of global GDP growth of 2.1% over 2008-14 (apparent elasticity of 1.4) and global trade growth of around 7% at the average rate of global GDP growth of 3.3% over the period 1986-2007 (apparent elasticity of 2.1, Figure A3.1).

Figure A3.1. Apparent elasticity implied by the model in growth rates in equation (2)



Note: Average growth rate are reported in red for the periods 1986-2007 and 2008-2014.

1. Based on equation (2) assuming steady-state growth of trade and GDP volumes.

Source: OECD Economic Outlook 96 database; and OECD calculations.

34. The stability in the parameters of the model in growth rates in equation (1), which is confirmed by formal tests of structural breaks (Table A3.1), suggests that going forward global trade is likely to grow at twice the rate of global GDP as cyclical effects fade. At an average GDP growth rate of 3.3% as over 1986-2007, the model in growth rates is consistent with a long-term global trade elasticity of slightly above 2 (see Figure A3.1).

Table A3.1. **Tests for breaks in the parameters of the model in growth rates**

	Null hypothesis	Test statistic	5% critical value	10% critical value	Break date
Bai-Perron ¹ (1986-2014)	no break	5.1	14.0	12.1	-

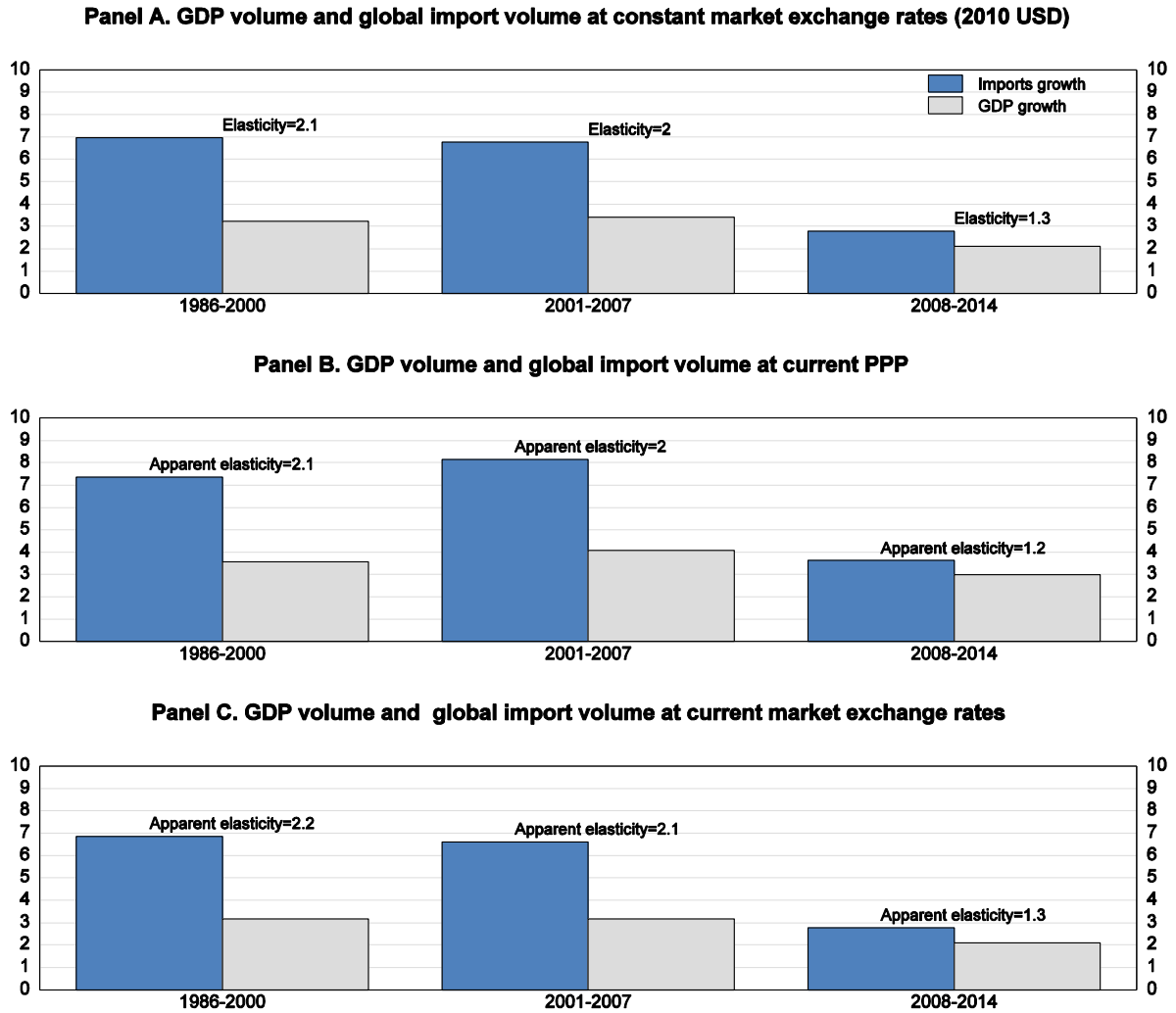
Note: Tests based on equation (2).

Source: OECD Economic Outlook 96 database; and OECD calculations.

Annex 4: Additional tables and figures

Figure A4.1. The apparent global trade elasticity using alternative aggregation methods

Average annual growth rate, volume, in %



Source: OECD Economic Outlook 96 database; and OECD calculations.

Table A4.1. Detailed estimation results for Equation (1) based on annual data

Panel A: Global GDP volume at PPPs

Dependent variable	$\Delta \ln(\text{imports})_t$		
	1970-85	1986-2000	2001-14
constant (α)	-6.1** (2.4)	-6.5 (5.7)	-2.9 (2.2)
$\Delta \ln(\text{gdp})_t$ (β)	1.9*** (0.3)	3.1*** (0.6)	3.4*** (0.3)
$\ln(\text{imports})_{t-1}$ (γ)	-0.6*** (0.2)	-0.2 (0.2)	-0.2* (0.1)
$\ln(\text{gdp})_{t-1}$ (δ)	0.7*** (0.2)	0.4 (0.4)	0.3* (0.2)
Long-term elasticity ($-\delta/\gamma$) ¹	1.3***	2.3***	1.3***
Statistical difference with previous period ²		3.3*	2.9*
Adjusted R-squared	0.87	0.87	0.87
Sample size ³	45	45	45

Panel B: Global GDP volume at market exchange rates

Dependent variable	$\Delta \ln(\text{imports})_t$		
	1970-85	1986-2000	2001-14
constant (α)	-7.0*** (2.5)	-11.8** (5.7)	-5.9 (5.2)
$\Delta \ln(\text{gdp})_t$ (β)	1.9*** (0.3)	3.3*** (0.6)	3.4*** (0.3)
$\ln(\text{imports})_{t-1}$ (γ)	-0.6*** (0.2)	-0.3 (0.2)	-0.2 (0.2)
$\ln(\text{gdp})_{t-1}$ (δ)	0.8*** (0.2)	0.6* (0.3)	0.4 (0.3)
Long-term elasticity ($-\delta/\gamma$) ¹	1.3***	2.4***	1.8***
Statistical difference with previous period ²		20.9***	4.5**
Adjusted R-squared	0.89	0.89	0.89
Sample size ³	45	45	45

Panel C: Global GDP volume at market exchange rates, excluding intra-EA imports

Dependent variable	$\Delta \ln(\text{imports})_t$		
	1970-85	1986-2000	2001-14
constant (α)	-11.1*** (3.6)	-16.9*** (5.7)	-9.9 (7.5)
$\Delta \ln(\text{gdp})_t$ (β)	1.6*** (0.4)	3.3*** (0.7)	3.5*** (0.4)
$\ln(\text{imports})_{t-1}$ (γ)	-0.9*** (0.3)	-0.4** (0.2)	-0.3 (0.2)
$\ln(\text{gdp})_{t-1}$ (δ)	1.2*** (0.4)	0.9*** (0.3)	0.6 (0.4)
Long-term elasticity ($-\delta/\gamma$) ¹	1.3***	2.3***	2.0***
Statistical difference with previous period ²		20.9***	4.5**
Adjusted R-squared	0.85	0.85	0.85
Sample size ³	45	45	45

Note: Statistical significance based on unadjusted t-statistics at the 1, 5 and 10% level is denoted by ***, **, and *, respectively; standard errors in parenthesis. Based on the estimation of the following equation:

$$d\ln(\text{imports})_t = \alpha_1 + \beta_1 * d\ln(\text{gdp})_t * DV_1 + \gamma_1 * \ln(\text{imports})_{t-1} * DV_1 + \delta_1 * \ln(\text{gdp})_{t-1} * DV_1 + \alpha_2 + \beta_2 * d\ln(\text{gdp})_t * DV_2 + \gamma_2 * \ln(\text{imports})_{t-1} * DV_2 + \delta_2 * \ln(\text{gdp})_{t-1} * DV_2 + \alpha_3 + \beta_3 * d\ln(\text{gdp})_t * DV_3 + \gamma_3 * \ln(\text{imports})_{t-1} * DV_3 + \delta_3 * \ln(\text{gdp})_{t-1} * DV_3 + \epsilon_t,$$

where gdp is global GDP volume; imports is global imports of goods and services; DV1, DV2 and DV3 are dummy variables for the periods 1970-85, 1986-2000 and 2001-14 respectively; and ϵ_t is the error term.

1. The long-term elasticities for the sub-periods 1970-85, 1986-2000 and 2001-14 are given by $-\delta_1/\gamma_1$, $-\delta_2/\gamma_2$ and $-\delta_3/\gamma_3$, respectively. Statistical significance is established using a non-linear Wald test.

2. F-statistic based on a nonlinear Wald test.

3. To allow direct comparison with Constantinescu et al. (2015) the overall sample size is reported although the effective sample size for the identification of the relevant coefficients is equal to size of the sub-samples.

Source: OECD Economic Outlook 96 database; and OECD calculations.

Table A4.2. Tests for breaks in the long-term import-to-GDP relation

	Null hypothesis	Test statistic	5% critical value	10% critical value	Break date
Bai-Perron ¹ (1970-2014)	0 break (vs 1)	233.9	12.3	10.4	1988
	1 break (vs 2)	50.3	13.8	12.2	2009
	2 breaks (vs 3)	14.1	14.7	13.2	1995
Gregory-Hansen ² (1989-2014)	no cointegration	-4.4	-5.0	-4.7	2007
Banerjee et al. ³ (1986-2007)	no cointegration	-3.3	3.4	3.0	-

Note: Tests based on the long-term equation $\ln(\text{imports}_t) = c + \beta * \ln(\text{gdp}_t) + \epsilon_t$

1. Bai-Perron (2003) test of multiple breaks (constant and slope) with 10% trimming.

2. Gregory-Hansen (1996) cointegration test allowing for a break (constant and slope) with 10% trimming.

3. Banerjee et al. (1996) cointegration test.

Source: OECD Economic Outlook 96 database; and OECD calculations.

Table A4.3. Detailed estimation results for Equation (2) based on annual data

1986-2014

Dependent variable	$\Delta \ln(\text{imports})_t$
constant (α)	-0.03** (0.01)
$\Delta \ln(\text{imports})_{t-1}$ (β_1)	0.3* (0.15)
$\Delta \ln(\text{gdp})_t$ (β_2)	3.6*** (0.22)
$\Delta \ln(\text{gdp})_{t-1}$ (β_3)	-1.3** (0.55)
Adjusted R ²	0.90
Sample size	29

Note: Import and GDP volumes are measured at constant market exchange rates. Statistical significance at the 1, 5 and 10% level is denoted by ***, **, and *, respectively; standard errors in parenthesis.

Source: OECD Economic Outlook 96 database; and OECD calculations.

WORKING PAPERS

The full series of Economics Department Working Papers can be consulted at www.oecd.org/eco/workingpapers

1215. *Estonia: raising productivity and benefitting more from openness*
(April 2015) by Andreas Kappeler
1214. *Estonia: making the most of human capital*
(April 2015) by Andrés Fuentes Hutfilter
1213. *The Czech labour market: documenting structural change and remaining challenges*
(April 2015) by Sónia Araújo and Petr Malecek
1212. *Reforming the Slovak public sector*
(April 2015) by Lilas Demmou and Robert Price
1211. *Spurring growth in lagging regions in the Slovak Republic*
(April 2015) by Lilas Demmou, Gabriel Machlica and Martin Haluš
1210. *Skill mismatch and public policy in OECD countries*
(April 2015) by Müge Adalet McGowan and Dan Andrews
1209. *Labour market mismatch and labour productivity: evidence from PIAAC data*
(April 2015) by Müge Adalet McGowan and Dan Andrews
1208. *Maintaining an efficient and equitable housing market in Belgium*
(April 2015) by Sanne Zwart
1207. *Determinants of the low female labour force participation in India*
(April 2015) by Piritta Sorsa, Jan Mares, Mathilde Didier, Caio Guimaraes, Marie Rabate, Gen Tang and Annamaria Tuske
1206. *Strengthening skill use and school-to-work transitions in the Czech Republic*
(April 2015) by Sónia Araújo and Petr Malecek
1205. *Reforming the tax on immovable property: taking care of the unloved*
(April 2015) by Hansjörg Blöchliger
1204. *Taxation and investment in Colombia*
(April 2015) by Sarah Perret and Bert Brys
1203. *Efficiency and contestability in the Colombian banking system*
(April 2015) by Christian Daude and Julien Pascal
1202. *Fiscal decentralisation in Colombia: new evidence regarding sustainability, risk sharing and “fiscal fatigue”*
(April 2015) by Guillaume Bousquet, Christian Daude and Christine de la Maisonneuve

1201. *Effects of economic policies on microeconomic stability*
(April 2015) by Boris Cournède, Paula Garda and Volker Ziemann
1200. *The 2013 update of the OECD's database on product market regulation – policy insights for OECD and non-OECD countries*
(April 2015) by Isabell Koske, Isabelle Wanner, Rosamaria Bitetti and Omar Barbiero
1199. *Improving taxes and transfers in Australia*
(April 2015) by Philip Hemmings and Annamaria Tuske
1198. *Federal-state relations in Australia*
(April 2015) by Vassiliki Koutsogeorgopoulou and Annamaria Tuske
1197. *Sharing the fruits of growth with all Mexicans*
(April 2015) by Eduardo Olaberriá and Valéry Dugain
1196. *What makes Mexicans happy?*
(April 2015) by Valéry Dugain and Eduardo Olaberriá
1195. *Improving the labour market integration of immigrants in Belgium*
(March 2015) by Álvaro Pina, Vincent Corluy and Gerlinde Verbist
1194. *Raising the potential of the domestically oriented sector in Germany*
(March 2015) by André Eid and Andrés Hutfilter
1193. *Improving transport infrastructure in Russia*
(March 2015) by Alexander Kolik, Artur Radziwill and Natalia Turdyeva
1192. *Improving the business climate in Russia*
(March 2015) by Arthur Radziwill and Yana Vaziakova
1191. *Determinants of female entrepreneurship in India*
(March 2015) by Arnaud Daymard
1190. *The changing role of the exchange rate for macroeconomic adjustment*
(March 2015) by Patrice Ollivaud, Elena Rusticelli and Cyrille Schweltnus
1189. *Boosting productivity in Russia: skills, education and innovation*
(March 2015) by Lilas Demmou and Andreas Wörgötter
1188. *Boosting growth and reducing informality in Mexico*
(March 2015) by Sean Dougherty
1187. *The conduct of monetary policy in the future: instrument use*
(March 2015) by Kei-Ichiro Inaba, Rory O'Farrell, Łukasz Rawdanowicz and Ane Kathrine Christensen
1186. *A constant market share analysis of Spanish goods*
(February 2015) by Alberto Gonzalez Pandiella