WP/16/139

IMF Working Paper

6½ Decades of Global Trade and Income: "New Normal" or "Back to Normal" after GTC and GFC?

by Sanjay Kalra

INTERNATIONAL MONETARY FUND

 WP/16/139

IMF Working Paper

Secretary's Department

6½ Decades of Global Trade and Income:
"New Normal" or "Back to Normal" after GTC and GFC?

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July 2016

Abstract

Global merchandise trade expanded rapidly over the last 6½ decades and its relationship with global income has seen ebbs and flows. This paper examines the shifts in this relationship using time series data over 1950-2014 and situates it in the current and longer term context. The conjunctural context comes from, among other things, the "great trade collapse" (GTC) and the global financial crisis (GFC) in 2009, and developments since then. The longer term context comes from the relative role of "globalization" and "technology" shocks in accounting for the short and long run variance of global exports and income. The paper estimates trade and income elasticities using ADL models taking account of structural breaks, and impulse response functions from structural VARs. The estimated SVAR model provides a lens to ask whether global trade and income are in a "new normal' or only "back to (an old) normal" after the GTC and GFC.

JEL Classification Numbers: C3, F14
Keywords: Global Trade and Income, Elasticities, SVAR, Globalization, Technology shocks, Structural breaks
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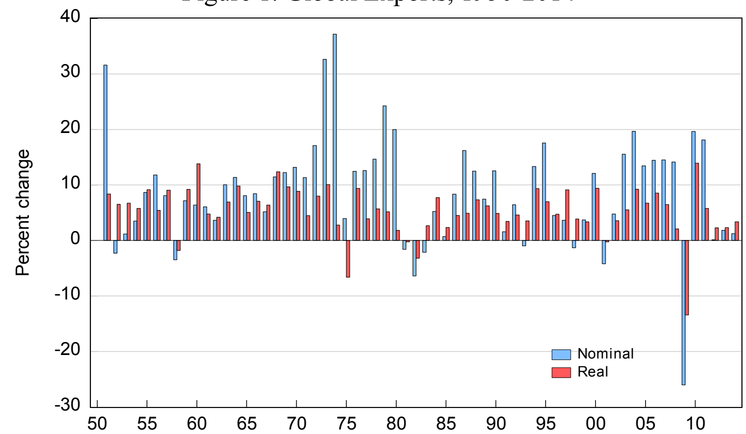
I. Motivation

The co-movement of global trade and income has regained prominence in the context of the "great trade collapse" (GTC) in 2009 following the global financial crisis (GFC) in 2008Q4 and the sluggish recovery since then. In 2009, nominal and real global exports fell by 26 and 13 percent, respectively. Export values and volumes recovered quickly in 2010 to surpass the pre-crisis level. However, the average growth rate during 2011-14 has been only 5¼ and 3¼ percent, respectively. During the same period, global growth averaged a little over 2 percent. From a longer term perspective, global exports expanded rapidly during the past 6½ decades (1951-2014). Nominal and real merchandise exports grew at annual average rates of nearly 9½ percent and 5½ percent, respectively (Figure 1). Over the same period, global real GDP (income) grew at an average annual rate of 3½ percent (Table 1).[1]

Figure 1. Global Exports, 1950-2014



The long run relative growth rates have generated a "rule of thumb" that the rate of growth of real exports is double the growth rate of real income, i.e., the elasticity of global exports to income—a measure that is often taken to summarily represent the relationship between the two variables—is 2. Notwithstanding this "rule of thumb", there is variation in the literature on the elasticity of global trade to income. A part of the variation across the studies comes from differences in data sources, sample period, specification of the estimated equation, and whether the reference is to short term or long term elasticity.

Table 1. Global Exports and Income: Growth Rates
(Average annual percent change, 1951-2014)

Exports	Nominal	Real
Total	9.5	5.6
Agricultural products	6.8	3.3
Fuels and mining products	9.3	3.4
Manufactures	10.3	6.9
Income	--	3.5

Sources: WTO (2015) and author's calculations.

Against the backdrop of the slowdown in the growth of global exports, especially compared to the 2000s and prior to the GFC, the relationship between global trade and income has generated significant comment.[2] The commentary had varied from concern

[1] The paper uses real GDP to represent real income, as in Irwin (2002).

[2] The growth of global export and income during 2001-08 was 5.1 percent and 2.8 percent, respectively.

over whether the trade slowdown reflects lost “mojo” (Davies, 2013) to the argument that there is no *a priori* reason to expect that the relationship should remain invariant (and with a high elasticity) in all time spans (Krugman, 2013).

This paper revisits this discussion in a tractable, dynamic framework with extended time series data. In particular, the extended time span helps to put the current discussion in historical perspective and ask how large the GTC and GFC were relative to previous shocks. The longer time span also allows a look at the episode from a “forecast” perspective: what would have been expected during 2009-14 from various time points if the past had continued into the future? For example, what would the forecast for global exports and income have been in 1990, 2000 and 2008? In addition, such an analysis is useful to ask which of the effects mentioned in the literature is significant, over which time periods, and with what relative importance. The remainder of the paper is organized as follows. Section II sets the stage, with a brief selected literature review, for the estimation framework of Section III. The empirical results are also presented in Section III. Section IV interprets the GTC and GFC with an estimated SVAR model.

II. SELECTED LITERATURE SURVEY

Irwin (2002) estimates the trade elasticity for three sample periods: pre-World War I (1870-1913), interwar period (1920-38) and post-World War II (1950-2000).[3] It also provides estimates of the elasticities over subsamples, identified by structural breaks in the data. The paper concludes that trade grew slightly more rapidly than income in the late nineteenth century, with little structural change in the trade-income relationship. However, during the interwar and post-war periods, there were structural breaks. These breaks—for the post-war period—are identified in 1974 and 1985. With these structural breaks, the estimated elasticities for the three subsamples imply that since the mid-1980s trade was more responsive to income than in any of the other periods (short and long-term elasticities of 1.55 and 3.39, respectively), although the results cannot directly determine the reasons for the increased sensitivity of trade to income. As backdrop, the trade policy regime differed across periods, from the bilateral treaty network in the late nineteenth century to interwar protectionism to post-war GATT-WTO liberalization. The commodity composition of trade had also shifted from primary commodities to manufactured goods.[4] While providing these clues, the paper does not empirically estimate the contribution of these factors.

Several studies revive the determinants of trade growth noted by Irwin (2002). Most recently, Constantinescu et. al. (2016) notes turbulence in global trade in 2015 and suggests that China’s rebalancing and transition to a new growth path are already contributing to trade volatility and would continue to shape developments in the foreseeable future. Other studies have also noted the role of China in shaping global trade developments, especially in emerging markets through input demand and other channels. Developments in China may, of course, not be the only factor shaping global

[3] The paper employs an AR(1) single equation model in log levels to compute the elasticities.
[4] The share of manufacturing in (real) total global exports surpassed 50 percent in the mid-1970s.

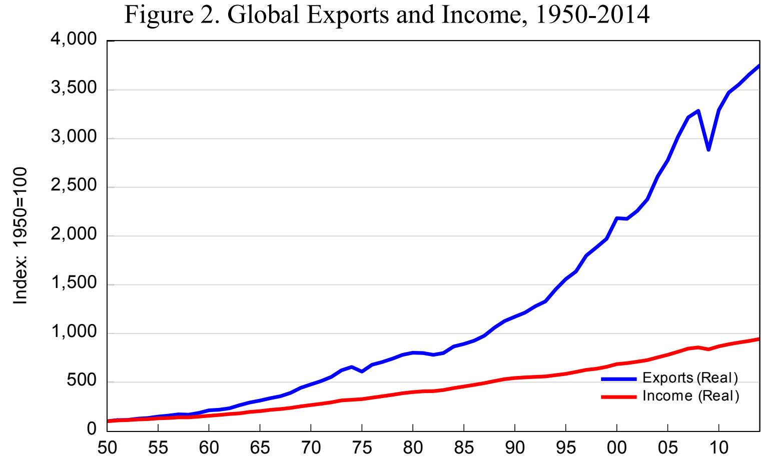
trade. From a conjunctural standpoint, there is now an extensive literature which examines factors that may have contributed to the oversized decline in global trade in 2009. These studies, which include Altomonte et. al. (2012), Baldwin (2009), Bems et. al. (2010, 2011, 2013), Buono (2013), Levchenko et. al. (2010), Bussiere et. al. (2013), Ferrantino and Taglioni (2014), and Abiad et. al. (2014), attribute the collapse variously to a sharp contraction in aggregate demand (income), concentrated on trade-intensive components, aggravated by inventory effects and trade financing constraints. Constantinescu et. al. (2015) and Bems et. al. (2010, 2011, 2013), for example, examine the role of the commodity composition of trade and vertical specialization while Freund (2009) and several studies in Hoekem (2015) point to the role of cyclical factors.[5] Other studies in Hoekem (2015) attribute the slowdown to structural factors, including the composition of trade, the end of the integration of central/eastern Europe and China into the global trading system, and limits of vertical integration in global value chains (GVC).[6] The policy implications of the role of cyclical versus structural factors in the trade slowdown are, of course, quite different.

At the same time, Irwin (2002) acknowledges—as is the case with many of the studies referred to above—the possible endogeneity of exports consistent with the notion of trade as an "engine of growth". Indeed, Irwin and Terviö (2002) shows that more trade has led to higher income throughout the 20th century, with the exception of the interwar period. From an estimation standpoint, incorporating this bi-directional relationship requires the use of a simultaneous equation model. For purposes of this paper, the strong presumption from these studies is that the relationship of trade and income is bi-directional and that it has varied over different time spans.

III. Global Trade and Income over 6½ Decades

Consistent with the discussion of Section II, we examine the relationship between global exports and income over 1950-2014 using several empirical specifications. In what follows, we first estimate single equations models and then multivariate equation models of global exports and income. The data for the empirical

Figure 2. Global Exports and Income, 1950-2014



[5] Studies in Hoekem (2015) which emphasize the role of cyclical factors in the global trade slowdown include Boz et. al., Bussiere & Marsilli, Ollivaud & Schwellnus, Gangnes et. al., and Veenendall et. al.
[6] Constantinescu et. al., Gaulier et. al., Escaith & Miroudot, Crozet et. al., Bark, Ito & Wakasugi, Thorbecke, Chinn, and Pei et. al.

estimation (Figure 2) is taken from WTO (2015) which shows the exponential increase of global exports over 6½ decades as global income rose tenfold.

A. Income as Determinant of Exports

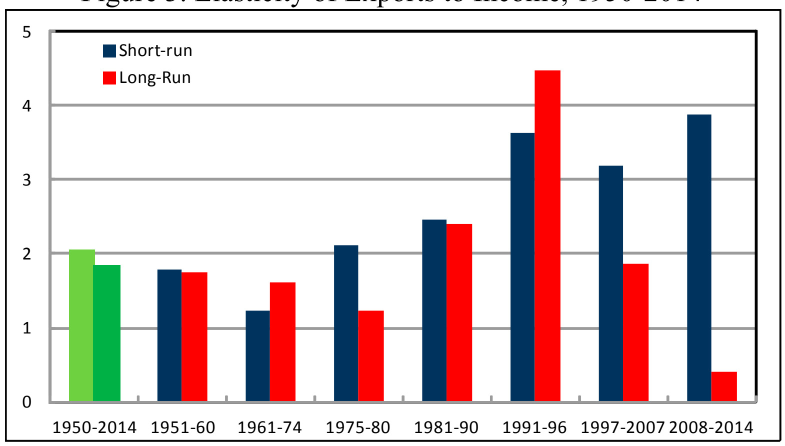
Specification and estimation

We start with a single equation autoregessive distributed lag (ADL) specification. The estimated equation is:

$$x_t = \beta_0 + \beta_1 y_t + \beta_2 y_{t-1} + \beta_3 x_{t-1} + \varepsilon_{xt} \quad (1)$$

where *x* and *y* are global exports and income, respectively, and $\varepsilon_x \sim N[0, \sigma_x^2]$ is the error term.[7] Both the variables are in logs, real, and indexed at 2005=100, as shown in Figure 1. In this specification, the short-term elasticity of exports to income (θ_S) is β_1 and the long-term elasticity (θ_L) is $\frac{\beta_1+\beta_2}{1-\beta_3}$. The results of this benchmark equation for the full sample periods are shown in Table 2. θ_S and θ_L are estimated at 2.1 and 1.8, respectively.

Figure 3. Elasticity of Exports to Income, 1950-2014



Structural breaks

With a changing relationship over the long time span, there were likely structural breaks in the estimated equation. The Bai and Perron (2003) test of unknown number of structural breaks suggests six structural breaks in the estimated equation (1961, 1975, 1981, 1991, 1997 and 2008). The estimated structural breaks are reported in Table 3. The breakpoints identified by the test appear to be associated with well-defined events. The breaks in 1975 and 1981 reflect the two oil price shocks. 1991 can be associated with the breakup of the former Soviet Union and rise in trade due to the integration of the central/eastern European countries. 1997 reflects the effects of the Asian Crisis. Finally, 2008 picks up the GTC.

The implied short and long run elasticities for the full sample and seven subsamples are collected in Figure 3. The changes in the elasticities are revealing, with ebbs and flows

[7] In the estimated equations in the tables, LX_T is the log of real exports and DLX_T is the first difference of logs (or the growth rates of exports). Similarly, LY and DLY are log and growth rate of income, respectively.

over the subsamples. First, the short and long run elasticities do not rise and fall in tandem, with a large range around the values for the full sample. Second, the oil price shocks of the 1970s dampened the impact of income growth on exports, possibly reflecting supply side shocks. Third, the highest estimated elasticities (both short and long run) are in the first half of the 1990s, and declined thereafter suggesting that the Asian crisis may have dampened trade and was not fully offset by the rising share of China in global trade, the long rise in global income during the 2000s and the GVCs. The rise in the short run elasticity during 2008-14 picks up the oversized decline in global exports (and the subsequent larger recovery) in 2009. At the same time, the decline in the long run elasticity could be suggestive of a slowdown since 2010.These estimates corroborate Irwin (2002) where the long-run elasticity of exports was the highest during 1985-2000. In Figure 3, the highest elasticity is during the first half of the 1990s, a period during which the incorporation of central/eastern European and former Soviet Union countries into global trade led to a reclassification of internal trade into international trade.

Stationarity and cointegration

Unit root tests suggest that the order of integration for y_t is I(0) while the null hypothesis that x_t is a unit root process is not rejected at the 5 percent level of significance (Table 4).[8] The null hypothesis that Δx_t is a unit root process is not accepted at the 5 percent level of significance implying that x_t is an I(1) process. With this, and to ensure all variables in the equation are stationary, we re-specify and estimate (1) as an error correction specification:

$$\Delta x_t = \beta_0 + \beta_1 \Delta y_t + \rho_x (x_{t-1} - \gamma_x y_{t-1}) + \varepsilon_{xt} \quad (2)$$

where $(x_{t-1} - \gamma y_{t-1})$ is the long run cointegrating relationship between x and y, $\theta_S = \beta_1$, $\theta_L = \gamma_x$ and ρ_x is the speed of adjustment to the long run co-integrating vector. The Johansen test confirms the existence of a co-integrating vector. The estimated equation for (2) in Table 5 implies, as before, short and long run elasticities of 2.1 and 1.8, respectively. In addition, we have an estimate of $\rho_x = -4.7$.

B. Exports as an "Engine of Growth"

In this subsection we estimate a specification, along the lines of (2), to capture the notion that trade is a determinant of income following studies such as Irwin and Terviö (2002).

Specification and estimation

We specify, as in (2), an ECM model for global income with exports and lagged income as explanatory variables:

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta x_t + \rho_y (y_{t-1} - \gamma_y x_{t-1}) + \varepsilon_{yt} \quad (3)$$

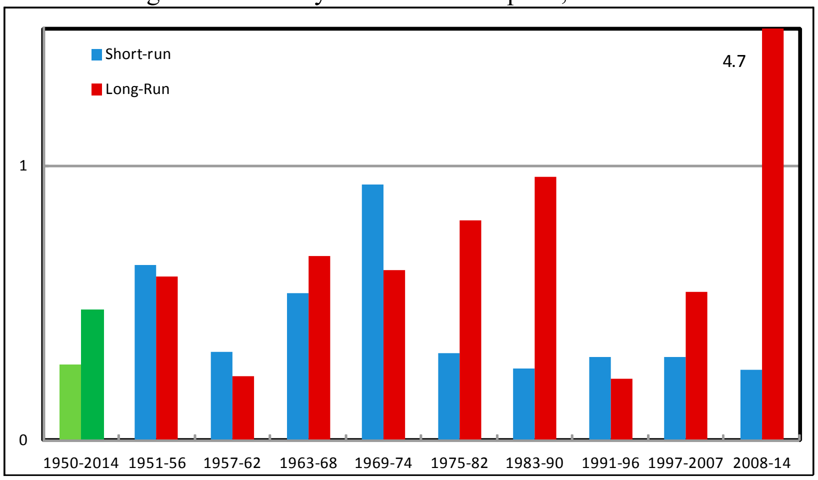
[8] We use the Phillips-Perron unit root tests.

Using the co-integration results from the previous section, we estimate (3). From the estimated equation (Table 6), the estimated short- and long-run elasticities of income to exports ($\delta_s = \alpha_1$ and $\delta_L = \gamma_y$, respectively) are 0.3 and 0.5, respectively. The estimated coefficient confirms the positive impact of exports on income, both in the short and long run. The estimated speed of adjustment to the long-run co-integrating vector (ρ_y) is −4.

Structural breaks

Once again, with changes in the relationship likely over such a long time span, we use the Bai and Perron (2003) test of an unknown number of structural breaks (using an ADL specification). The test now suggests eight breaks in the estimated equation at 1957, 1963, 1969, 1975, 1983, 1991, 1997 and 2008 (Table 7). While some of these structural breaks mirror the ones estimated above, there are clearly differences in both number and timing. The estimated short and long run elasticities for the full sample and nine subsamples are shown in Figure 4. As in the earlier section, the effect of exports on income varies, both in the short and long run over the various sample periods. In some ways, these effects, by definition, are inverses of the elasticities of income to exports, although the different structural breaks points provide a point of departure.

Figure 4. Elasticity of Income to Exports, 1950-2014



C. Global Exports and Income: Feedback Loops and Common Shocks

Given that income and exports are related and may indeed be co-determined by each other and other factors, there is a clear possibility of feedback loops. To account for this bi-directional relationship and the possibility of common shocks, we turn to a VAR specification. We first postulate a bivariate structural VAR (SVAR) in global exports and income. We interpret the structural innovations to exports as “globalization” shocks and those to income as “technology” shocks. The “globalization” shocks may be seen as reflecting a variety of developments in global trade, including liberalization and the process of countries joining the WTO. On the negative side, these shocks may come from protectionism, disruptions to financial sector, or wars and other conflicts. We interpret the “technology” shocks partly in a standard macroeconomic fashion as coming from technological change and the resulting increases in total factor productivity, although there could be other plausible interpretations as well including the large balance sheet effects of the type now associated with the GFC.

We first estimate an unstructured VAR (UVAR) from which we retrieve the SVAR by imposing identifying restriction. We estimate the SVAR under the long-run restriction that the cumulative impact of "globalization" shocks on income is zero.[9] In the short-run, therefore, both shocks affect global exports and income. We use the SVAR specification to retrieve the impulse response functions and the variance decompositions to examine quantify the impact of shocks on the endogenous variables. To extract short- and long-run elasticities and speeds of adjustment, we estimate a vector error correction (VEC) representation of the SVAR.

A Structural VAR (SVAR)

Specification and identification

We propose a bivariate SVAR in first difference in exports and income as follows:

(4)
$$\Delta x_t = \beta_{x0} + \sum_{j=1}^{n} \beta_{xxj} \Delta x_{t-j} + \sum_{j=0}^{n} \beta_{xyj} \Delta y_{t-j} + \mathrm{b_{xx}} \omega_{xt}$$
$$\Delta y_t = \beta_{y0} + \sum_{j=0}^{n} \beta_{yxj} \Delta x_{t-j} + \sum_{j=1}^{n} \beta_{yyj} \Delta y_{t-j} + b_{yy} \omega_{yt}$$

where *j* are lagged values, *n* is the lag length of the VAR and the vector of error terms $[\omega_{xt}, \omega_{yt}]$ has an identity variance-covariance matrix Ω, with the interpretation that ω_{xt} and ω_{yt} are exogenous, structural "globalization" and "technology" shocks, respectively. Both shocks are assumed to follow an *N(0,1)* distribution and are serially and cross uncorrelated. The lag length *n* for the VAR is chosen using information criteria. The Schwartz criterion suggests a lag length of two for the UVAR.

In matrix form, (4) can be written as follows:

(5)
$$A \Delta z_t = A_0 + \sum_{j=1}^{n} A_j \Delta \mathrm{z}_{t-j} + B \omega_t$$

where Δz_t= $[\Delta \mathrm{x}_t, \Delta \mathrm{y_t}]$ is the vector of endogenous variables:

The UVAR representation of (5) is:

(6)
$$\Delta z_t = B_0 + \sum_{j=1}^{n} B_j \Delta \mathrm{z}_{t-j} + e_t$$

where $B_0=A^{-1}A_0$, $B_j=A^{-1}A_j$ and $Ae_t= B\omega_t$. The identifying restriction that the cumulative impact of "globalization" shocks on income is zero translates into the restriction that the cumulative long-run impact of ω_x on Δy is zero. The parameter estimates of the UVAR and estimates of the SVAR restrictions are shown in Table 8 and Table 9, respectively.

[9] We could alternatively achieve identification of the SVAR under the restriction that the "technology' shocks do not have a long run impact on global exports, which seems rather implausible. We need only one restriction for the SVAR to be just-identified.

Innovation Accounting: Variance Decomposition and Impulse Response Functions

As regards variance decompositions (Figure 5), globalization and technology shocks account for 60 and 40 percent, respectively, of the variation in global exports while technology shocks account for the bulk of the variation in global income (90 percent over all horizons). The impulse response functions (IRF) and cumulative IRFs for the SVAR are shown in Figure 6. By construction, the long-run cumulative impact of globalization shocks on income is zero. However, both in the short and long run, the globalization and technology shocks have a measurable impact, especially on exports. For example, a one standard deviation (positive) globalization shock raises global exports by a peak effect of 3½ percent contemporaneously; the cumulative impact declines to around 2¾ percent in year 5. At the same time, globalization shocks do have an impact on income in the short run as well (½ percent), but the impact peters out over subsequent years. Technology shocks have a noticeable impact on global income, with 1¾ percent of the total long run impact of a little under 4 percent coming in the first year. These results complement and enrich the understanding of the relationship between global exports and income that come from elasticity estimates and speed of adjustment to the long run relationship to which we now turn.

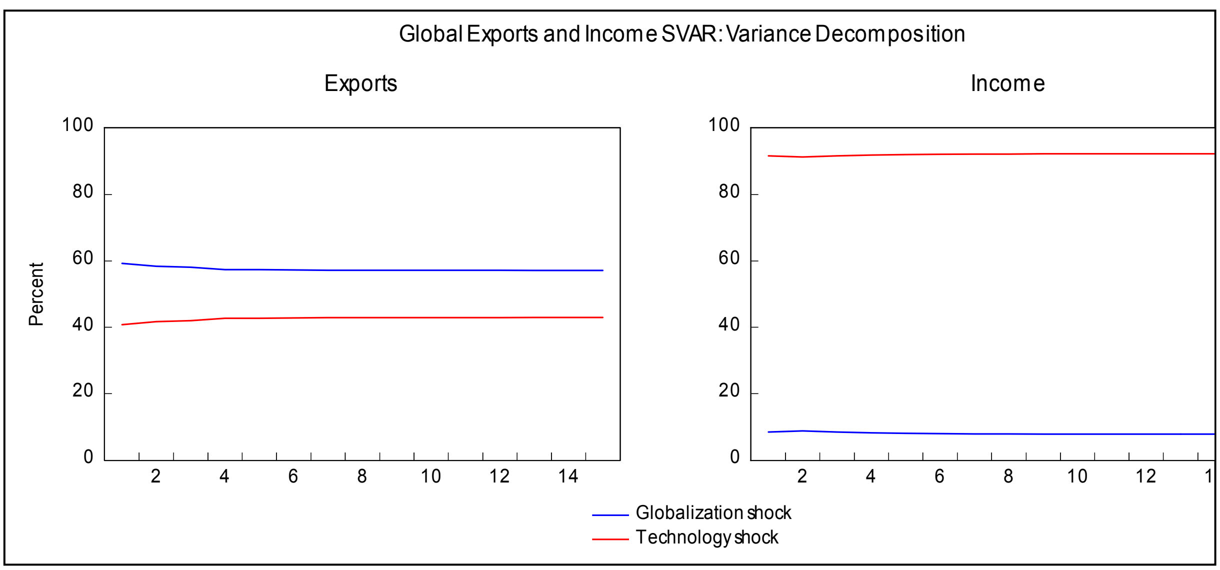
Vector Error Correction Representation: Elasticities and Speed of Adjustment

The Vector Error Correction Model (VECM) representation of (6) can be written as:

(7)
$$\Delta x_t = \gamma_1 \Delta x_{t-1} + \gamma_2 \Delta y_{t-1} + \rho_x (x_{t-1} - \gamma y_{t-1}) + \omega_{xt}$$
$$\Delta y_t = \lambda_1 \Delta y_{t-1} + \lambda_2 \Delta x_{t-1} + \rho_y (x_{t-1} - \gamma y_{t-1}) + \omega_{yt}$$

With this alternative specifications, the cointegrating vector $(x_{t-1} - \gamma y_{t-1})$ provides the long-run elasticity of exports to income γ and of income to exports (1/γ); the speeds of adjustment of exports and income to long run equilibrium are ρ_x and ρ_y, respectively.

Figure 5. SVAR Innovation Accounting: Variance Decomposition



The (contemporaneous) short-run elasticities are provided by the IRFs. The IRFs provide, in addition, the lagged impact of shocks on the endogenous variables at other horizons as well. The estimated VECM is shown in Table 10. The estimated long-run elasticity γ is 2.4; ρ_x and ρ_y are estimated at 0.03 and 0.02, respectively. While the long-run elasticity is of an order of magnitude similar to the univariate ECMs, the speed of adjustment is significantly smaller suggesting that, following shocks, there could well be extended periods of adjustment to the long run equilibrium of the sort that the global economy experienced after the oil price shock, the break-up of the Soviet Union, the Asian Crisis and most recently the GFC.

IV. The "Great Trade Collapse" and "Back to the Past"?

Using the SVAR to forecast exports and income for various forward looking spans generates an interesting account of expectations that may have been built up during the 1990s and 2000s, until the GFC in 2009. Using the model to generate dynamic stochastic forecasts of exports and income in 1990 (for 1991-2014), 2000 (for 2001-14) and in 2008 (for 2009-14) we arrive at Figure 7.

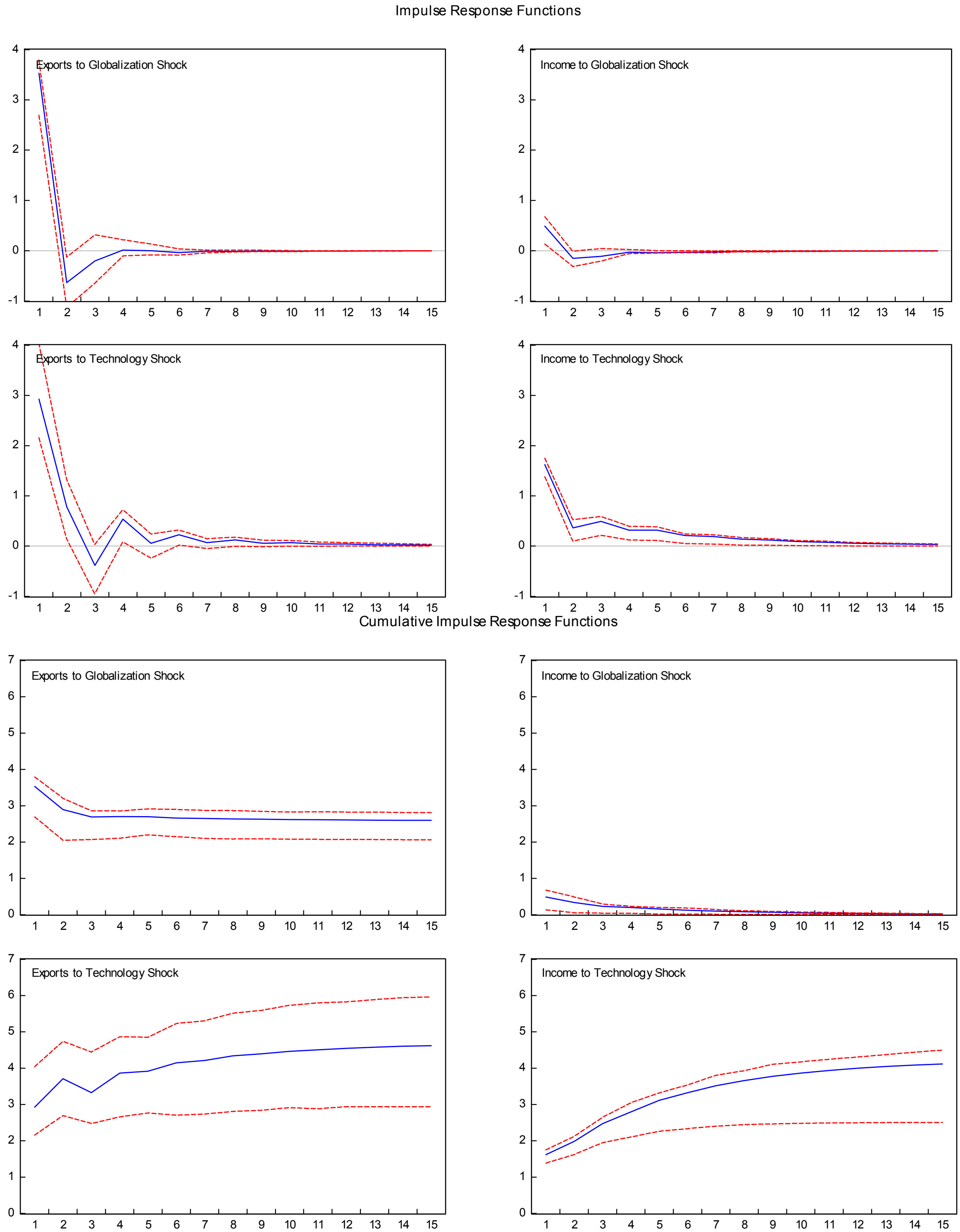
Using the 1990 forecast, the (actual) growth rate of exports surpassed the expected rate as former central/eastern Europe and Soviet Union countries joined the global trading system. This may, however, have been partly a statistical artifact which translated internal trade into international trade. After the temporary, shallow setback of the 2000-01 dotcom bust, China and the rise of the GVCs (which again may have changed some internal trade into international trade or rerouted existing international trade) contributed to the higher than expected growth of global exports, even by the higher standard of the 1990s, although incorporating the higher base of the 1990s meant that the "overperformace" was smaller (middle panel). All of the remarkable growth of exports appears to have taken place when global income was either underperforming (in the 1990s and in the first half of the 2000s, top panel) or broadly "on track" in the first half of the 2000s (middle panel). Only during the second half of the 2000s do both global exports and income appear to be "overperforming", a time of easy monetary and financial conditions in advanced economies which culminated in the GFC in 2008Q3. However, even the ostensible "trend" performance of global income in this forecast does not necessarily imply the nonexistence of imbalances across regions and countries. Yet another factor that may have contributed to the slowdown in global trade more recently may be the on-shoring of production processes in China as it has moved up the value chain, displacing imports from relatively more advanced economies, in what seems like an "internalization" process (compared to the "externalization") at the time of the breakup of the former Soviet Union (IMF, 2016).

The growth of global exports and income appears to be below the expected mean when the 1990-2008 experience, especially the "overperformance" of the second half of the 2000s, is factored into forecast (bottom panel). The step decline in 2009 is, of course, rather evident, and there appears to be a decline in the growth rates as well. Whether this decline in the growth rate is temporary, long-lasting or permanent is be hard to tell, especially given that the VECM suggests that the speed of adjustment to shocks is rather small. The decline in the growth rate may also be reflecting that, with the special factors of the 1990s and 2000s no longer in play, global income and trade may not necessarily be depressed from a long term standpoint, but only back to an old "normal" of the pre-1990s. Furthermore, even if the levels and growth rate are below expected means, they have recovered within a reasonable confidence interval around the (higher) expected mean.

Such an interpretation of the GTC and GFC raises broader questions of what might be needed to restore the "mojo" of both global exports and income, a subject of intense discussion at global policy making institutions and at the individual country level (WEO, 2016). A part of the discussion relates to whether the levers of macroeconomic policy can restore global aggregate demand in the short run into a self-sustaining cycle or deeper structural reform are needed which will have both supply and demand side effects. In the absence of adequate policy action or the next set of positive shocks, would the global economy have to wait longer to return to a higher growth path? In this context, it would be of interest to investigate whether the Trans-Pacific Partnership (TPP) provides the opportunity to kick-start global export growth, with salutary effects on global income.

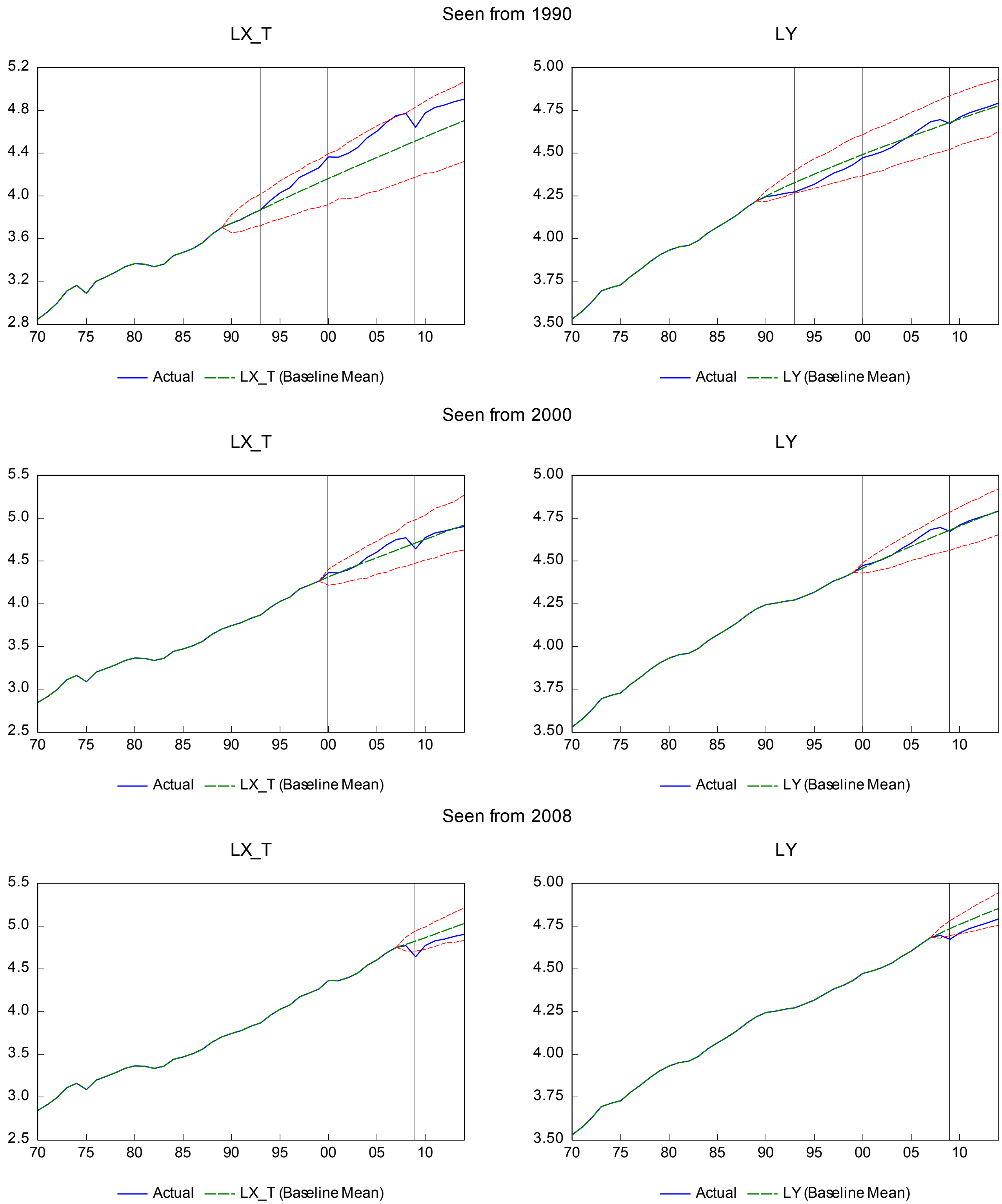
Several of the hypotheses noted above and in the literature can be further examined in expanded versions of the model. For one, the paper does not address the issue of exogeneity. It is presumed that there is a bi-directional relationship between global exports and income. Granger causality tests and other tests could be employed to explore this issue. Global growth can be broken down into the contribution of the main blocs to see the relative contribution of advanced and emerging economies (including China) to global exports and growth. Similarly, global exports can be decomposed into the main categories—agricultural, fuels and mining products, and manufacturing to assess relative sectoral contributions, and relatedly the impact of GVCs. From an empirical standpoint, the parameter estimates for the forecasting model estimated in Section III are for the full sample 1950-2014. A part of this could be addressed by re-estimating the SVAR over shorter sample periods, although this may strain the data and could be partly addressed by a shift to Bayesian estimation. It would also be instructive to construct a time-varying SVAR to generate the forecasts, although the main contours of argument would likely remain unchanged.

Figure 6. SVAR Innovation Accounting: Impulse Response Functions



Source: Authors' computations.
Note: 66 percent confidence interval (using Monte Carlo bootstrap procedure).

Figure 7. The "Great Trade Collapse" or "Back to the Past"?



Sources: WTO (2015) and author's calculations.

Table 2. Income as Determinant of Exports: ADL model—OLS (no structural breaks)

Dependent Variable: LX_T
Method: Least Squares
Date: 04/08/16 Time: 18:09
Sample (adjusted): 1951 2014
Included observations: 64 after adjustments
HAC standard errors & covariance (Quadratic-Spectral kernel, Andrews bandwidth = 1.0154)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.20	0.12	-1.68	0.10
LY	2.14	0.32	6.78	0.00
LY(-1)	-2.05	0.30	-6.91	0.00
LX_T(-1)	0.95	0.04	25.07	0.00

R-squared	1.00	Mean dependent var	3.35
Adjusted R-squared	1.00	S.D. dependent var	1.04
S.E. of regression	0.03	Akaike info criterion	-4.19
Sum squared resid	0.05	Schwarz criterion	-4.06
Log likelihood	138.16	Hannan-Quinn criter.	-4.14
F-statistic	27281.06	Durbin-Watson stat	2.10
Prob(F-statistic)	0.00	Wald F-statistic	29885.84
Prob(Wald F-statistic)	0.00		

Sources: WTO (2015) and author's calculations.

Table 3. Income as Determinant of Exports: Structural breaks

Breakpoint Specification
Description of the breakpoint specification used in estimati...
Equation: FIX_BLS_X_T_ALL_ADL
Date: 04/08/16 Time: 18:03

Summary

Estimated number of breaks: 6
Method: Bai-Perron tests of L+1 vs. L globally determined breaks
Maximum number of breaks: 6
Breaks: 1961, 1975, 1981, 1991, 1997, 2008

Current breakpoint calculations:

Multiple breakpoint tests
Bai-Perron tests of L+1 vs. L globally determined breaks
Date: 04/08/16 Time: 18:03
Sample: 1951 2014
Included observations: 64
Breaking variables: C LY LY(-1) LX_T(-1)
Break test options: Trimming 0.10, Max. breaks 6, Sig. leve... 0.05
Test statistics employ HAC covariances (Quadratic -Spectral kernel, Andrews bandwidth)
Allow heterogeneous error distributions across breaks

Sequential F-statistic determined breaks:	6
Significant F-statistic largest breaks:	6

Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	19.74538	78.98150	16.76
1 vs. 2 *	13.34149	53.36595	18.56
2 vs. 3 *	130.2230	520.8920	19.53
3 vs. 4 *	130.2230	520.8920	20.24
4 vs. 5 *	130.2230	520.8920	20.72
5 vs. 6 *	8.952162	35.80865	21.13

* Significant at the 0.05 level
** Bai-Perron (Econometric Journal, 2003) critical values.

Estimated break dates:
1: 1975
2: 1975, 1991
3: 1961, 1975, 1991
4: 1961, 1975, 1981, 1991
5: 1961, 1975, 1981, 1991, 1997
6: 1961, 1975, 1981, 1991, 1997, 2008

Sources: WTO (2015) and author’s calculations.

Table 4. Unit Root Tests for Global Exports and Income

Null Hypothesis: LX_T has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.665155	0.0857
Test critical values:	1% level	-3.536587	
	5% level	-2.907660	
	10% level	-2.591396	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LX_T) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.859557	0.0000
Test critical values:	1% level	-3.538362	
	5% level	-2.908420	
	10% level	-2.591799	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LY has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.873341	0.0001
Test critical values:	1% level	-3.536587	
	5% level	-2.907660	
	10% level	-2.591396	

*MacKinnon (1996) one-sided p-values.

Sources: WTO (2015) and author's calculations.

Table 5. Income as Determinant of Exports: ECM—OLS (no structural breaks)

Dependent Variable: DLX_T
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 04/01/16 Time: 16:32
Sample (adjusted): 1951 2014
Included observations: 64 after adjustments
Convergence achieved after 7 iterations
HAC standard errors & covariance using outer product of gradients
(Quadratic-Spectral kernel, Andrews bandwidth = 0.9851)
DLX_T=C(1)+C(2)*DLY+C(3)*(LX_T(-1)-C(4)*LY(-1))

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-20.49	12.14	-1.69	0.10
C(2)	2.14	0.31	6.82	0.00
C(3)	-4.85	3.77	-1.29	0.20
C(4)	1.86	0.22	8.31	0.00

R-squared	0.62	Mean dependent var	5.66
Adjusted R-squared	0.60	S.D. dependent var	4.59
S.E. of regression	2.89	Akaike info criterion	5.02
Sum squared resid	499.68	Schwarz criterion	5.15
Log likelihood	-156.57	Hannan-Quinn criter.	5.07
F-statistic	33.16	Durbin-Watson stat	2.10
Prob(F-statistic)	0.00		

Sources: WTO (2015) and author's calculations.

Table 6. Exports as "Engine of Growth": ECM—OLS (no structural breaks)

Dependent Variable: DLY
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 04/01/16 Time: 16:33
Sample (adjusted): 1951 2014
Included observations: 64 after adjustments
Convergence achieved after 5 iterations
HAC standard errors & covariance using outer product of gradients
(Quadratic-Spectral kernel, Andrews bandwidth = 3.0538)
DLY=C(1)+C(2)*DLX_T+C(3)*(LY(-1)-C(4)*LX_T(-1))

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	11.03	6.09	1.81	0.08
C(2)	0.28	0.03	9.44	0.00
C(3)	-3.97	3.33	-1.19	0.24
C(4)	0.47	0.12	3.87	0.00

R-squared	0.71	Mean dependent var	3.51
Adjusted R-squared	0.70	S.D. dependent var	1.89
S.E. of regression	1.04	Akaike info criterion	2.97
Sum squared resid	64.38	Schwarz criterion	3.10
Log likelihood	-91.00	Hannan-Quinn criter.	3.02
F-statistic	49.86	Durbin-Watson stat	1.88
Prob(F-statistic)	0.00		

Sources: WTO (2015) and author's calculations.

Table 7. Exports as "Engine of Growth": Structural breaks

Breakpoint Specification
Description of the breakpoint specification used in estimati...
Equation: FIX_BLS_Y_ALL_ADL
Date: 04/08/16 Time: 18:12

Summary

Estimated number of breaks: 8
Method: Bai-Perron tests of L+1 vs. L globally determined breaks
Maximum number of breaks: 8
Breaks: 1957, 1963, 1969, 1975, 1983, 1991, 1997, 2008

Current breakpoint calculations:

Multiple breakpoint tests
Bai-Perron tests of L+1 vs. L globally determined breaks
Date: 04/08/16 Time: 18:12
Sample: 1951 2014
Included observations: 64
Breaking variables: C LX_T LX_T(-1) LY(-1)
Break test options: Trimming 0.10, Max. breaks 8, Sig. leve... 0.05
Test statistics employ HAC covariances (Quadratic -Spectral kernel, Andrews bandwidth)
Allow heterogeneous error distributions across breaks

Sequential F-statistic determined breaks: 8
Significant F-statistic largest breaks: 8

Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	21.63081	86.52323	16.76
1 vs. 2 *	15.24611	60.98443	18.56
2 vs. 3 *	111.7775	447.1102	19.53
3 vs. 4 *	111.7775	447.1102	20.24
4 vs. 5 *	111.7775	447.1102	20.72
5 vs. 6 *	111.7775	447.1102	21.13
6 vs. 7 *	111.7775	447.1102	21.55
7 vs. 8 *	14.80989	59.23956	21.83

* Significant at the 0.05 level
** Bai-Perron (Econometric Journal, 2003) critical values.

Estimated break dates:
1: 1961
2: 1961, 1991
3: 1962, 1975, 1991
4: 1962, 1968, 1975, 1991
5: 1957, 1963, 1969, 1975, 1991
6: 1957, 1963, 1969, 1975, 1983, 1991
7: 1957, 1963, 1969, 1975, 1983, 1991, 1997
8: 1957, 1963, 1969, 1975, 1983, 1991, 1997, 2008

Sources: WTO (2015) and author's calculations.

Table 8. Global Exports and Income: VAR Specification

Vector Autoregression Estimates
Date: 04/05/16 Time: 17:09
Sample (adjusted): 1953 2014
Included observations: 62 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DLX_T	DLY
DLX_T(-1)	-0.33	-0.10
	(0.20)	(0.07)
	[-1.64]	[-1.33]
DLX_T(-2)	-0.04	-0.09
	(0.20)	(0.07)
	[-0.18]	[-1.23]
DLY(-1)	1.08	0.40
	(0.52)	(0.19)
	[2.06]	[2.09]
DLY(-2)	-0.25	0.42
	(0.51)	(0.19)
	[-0.50]	[2.27]
C	4.87	1.63
	(1.50)	(0.55)
	[3.25]	[2.94]
R-squared	0.07	0.22
Adj. R-squared	0.01	0.16
Sum sq. resids	1199.35	163.28
S.E. equation	4.59	1.69
F-statistic	1.13	3.91
Log likelihood	-179.81	-117.99
Akaike AIC	5.96	3.97
Schwarz SC	6.13	4.14
Mean dependent	5.64	3.45
S.D. dependent	4.61	1.85
Determinant resid covariance (dof adj.)		18.39
Determinant resid covariance		15.54
Log likelihood		-260.99
Akaike information criterion		8.74
Schwarz criterion		9.08

Sources: WTO (2015) and author's calculations.

Table 9. Global Exports and Income: SVAR Specification

Structural VAR Estimates
Date: 04/07/16 Time: 13:03
Sample (adjusted): 1953 2014
Included observations: 62 after adjustments
Estimation method: method of scoring (analytic derivatives)
Convergence achieved after 6 iterations
Structural VAR is just-identified

Model: Ae = Bu where E[uu']=I
Restriction Type: long-run pattern matrix
Long-run response pattern:

C(1)	C(2)
0	C(3)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	2.59	0.23	11.14	0.00
C(2)	4.70	0.53	8.79	0.00
C(3)	4.23	0.38	11.14	0.00

Log likelihood -266.21

Estimated A matrix:

1.00	0.00
0.00	1.00

Estimated B matrix:

3.53	2.93
0.49	1.62

Sources: WTO (2015) and author's calculations.

Table 10. Global Exports and Income: VECM Specification

Vector Error Correction Estimates
Date: 04/05/16 Time: 17:23
Sample (adjusted): 1953 2014
Included observations: 62 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:
B(1,1)=1
Convergence achieved after 1 iterations.
Restrictions identify all cointegrating vectors
Restrictions are not binding (LR test not available)

Cointegrating Eq:	CointEq1	
LX_T(-1)	1.00	
LY(-1)	-2.40	
	(0.28)	
	[-8.56]	
C	5.98	
Error Correction:	D(LX_T)	D(LY)
CointEq1	0.03	0.02
	(0.01)	(0.01)
	[2.40]	[2.95]
D(LX_T(-1))	-0.26	-0.07
	(0.20)	(0.07)
	[-1.32]	[-0.95]
D(LX_T(-2))	0.04	-0.06
	(0.19)	(0.07)
	[0.21]	[-0.80]
D(LY(-1))	0.58	0.18
	(0.54)	(0.20)
	[1.07]	[0.93]
D(LY(-2))	-0.78	0.19
	(0.54)	(0.19)
	[-1.46]	[0.99]
C	0.08	0.03
	(0.02)	(0.01)
	[4.15]	[4.29]
R-squared	0.16	0.32
Adj. R-squared	0.08	0.26
Sum sq. resids	0.11	0.01
S.E. equation	0.04	0.02
F-statistic	2.13	5.30
Log likelihood	108.75	172.01
Akaike AIC	-3.31	-5.36
Schwarz SC	-3.11	-5.15
Mean dependent	0.06	0.03
S.D. dependent	0.05	0.02
Determinant resid covariance (dof adj.)		0.00
Determinant resid covariance		0.00
Log likelihood		314.53
Akaike information criterion		-9.69
Schwarz criterion		-9.21

Sources: WTO (2015) and author’s calculations.

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