Does (Value Added) Trade Cause Growth?

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PRELIMINARY AND INCOMPLETE

Abstract

In this paper we revisit the relationship between trade and growth, taking into account the recent surge of Global Value Chains. We make two novel contributions. First, we study whether different components of exports, e.g. domestic vs. foreign value-added shares, have different implications for growth. For doing so, we exploit the Wang et al. (2013) decomposition of gross exports in several value-added components, as applied to WIOD data for the time-span 1995-2011. Second, we develop a new geography-based, time-varying instrument for export and each of its components. This instrument is based on the interaction between an exogenous geographic characteristic, and a shock to transportation technology. The geographic characteristic is the presence of coastal features allowing for deep-water ports in partner countries. The transportation shock is the quadrupling of the maximum size of container ships between the mid-1990s and the mid-2000s. The rationale for interacting these two variables is that the new larger ships introduced after 1995 can only access deep-water ports. As in Frankel and Romer (1999), the instrumental variables are obtained in a gravity framework, separately for gross exports and the different value-added components. We find that trade has a positive effect on GDP growth, through all its components. In particular, the effect is driven by both domestic and foreign value-added shares of exports in roughly equal terms.

1 Introduction

The last two decades have been characterized by the surge of Global Value Chains (GVC-s), i.e. the break-up of production processes into ever-narrower discreet activities and tasks, which are dispersed across borders. In a world characterized by GVCs, gross exports from any home country to any partner country do not only include domestic value added generated in the home country, but also an increasing share of foreign value added generated abroad. Related to this, a large chunk of trade is nowadays accounted for by intermediates crossing borders multiple times before being embodied in final goods, thus generating a "double counting" distortion in gross export statistics (Koopman et al., 2014).[1] What are the implications of this broad phenomenon for the relationship between trade and growth? In this paper, we aim to provide an answer to this question, which, in causal terms, has not been addressed in the literature so far.

We make two novel contributions. First, we study how each component of gross exports, e.g. domestic vs. foreign value added, affects GDP growth. For doing this, we exploit the Wang et al. (2013) decomposition of gross export flows in several value added components, covering forty countries over the period 1995-2011.[2] Second, we develop a new geography-based, time-varying instrument for trade and its value-added components. In line with recent contributions to the literature on trade and growth (Feyrer, 2009, and Pascali, 2014), our instrument is based on the interaction between an exogenous geographic characteristic, and a shock to transportation technology. The geographic characteristic is the presence of coastal features allowing for deep-water ports in partner countries. The transportation shock is the quadrupling of the maximum size of container ships between the mid-1990s and the mid-2000s. The rationale for interacting these two variables is that the new larger ships introduced after 1995 can only access deep-water ports. Relying on this IV strategy, we construct our instrumental variables in a gravity framework as in Frankel and Romer (1999), separately for gross exports and the four main value-added components. Thus, each component of exports has its own specific instrument. We find that trade has a positive effect on GDP growth. All the components of exports contribute to this effect, although with different magnitudes. Notably, domestic and foreign value added components of exports contribute to domestic GDP growth in roughly equal terms.

Our analysis relies on trade data from the World Input-Output Database (WIOD).

[1] Koopman et al. (2011) were among the first to identify the "double counting" factor in gross export statistics, estimating it to account for about 25% of gross global exports.

[2] We are very grateful to Zhi Wang, Shang-Jin Wei, and Kunfu Zhu for having shared their data on the exports' decomposition with us.

We have information on export flows and Input-Output matrices for 40 countries and 34 industries, including both manufacturing and services (see Appendix A for details). Using the methodology by Wang et al. (2013), which generalizes Koopman et al. (2014), we decompose each yearly gross export flow from each country -and each industry- to any partner country. In particular, we focus on four main value added components, which sum up precisely to each gross flow. The first component is Domestic Value Added (DVA), i.e. value added generated in the exporting country and absorbed abroad. The second component is Returned Domestic Value Added (RDV), i.e. value added generated in the exporting country which is first embodied in exports of intermediates, but then returns home for final consumption. The third component is Foreign Value Added (FVA), i.e. the foreign value added embodied in domestic exports. The fourth component is Pure Double Counting (PDC), i.e. the portion of gross exports accounted for by intermediates crossing borders several times before being finally absorbed. According to our data, DVA accounts on average for 77% of gross exports, followed by FVA with around 17%, and PDC with slightly more than 6%. RDV is on average much less relevant, below 1%, but it can rise up to 30% for some export flows. Overall, the relative importance of the four components may change substantially across different export flows. For instance, foreign value added may account for up to 80% of gross exports in some cases. These changes reflect differences in the relevance and shape of GVCs across countries and industries. Such variability motivates our analysis, which investigates how each component of exports affects economic growth.

Any regression of GDP over trade, in search of growth effects, entails a well known endogeneity problem. For instance, countries whose income is higher for reasons that are not related to trade, may still engage in more trade. Finding a good instrument for trade is a challenging task. In a seminal paper, Frankel and Romer (1999) have focused on geographical characteristics such as bilateral distances between countries. These characteristics are indeed powerful determinants of trade flows. However, their use as instruments has been criticized since they might affect countries' growth through channels other than trade, thus violating the exclusion restriction. Evidence on this issue has been provided, for instance, with respect the role of distance from the equator (Rodriguez and Rodrik, 2001). More recent contributions have capitalized on the Frankel and Romer (1999) approach by interacting geographic characteristics with shocks to transportation technology, thus constructing time-varying instruments for trade (Feyrer, 2009, and Pascali, 2014). Working with panel data is crucial in this context. In fact, it allows to include country fixed effects, thus controlling for any constant determinants of income, such as geographical, historical, and institutional factors. The identification strategy then relies on the assumption that the same transportation shock has a differentiated impact on different countries, due to some exogenous geographic characteristics.

In this paper, we construct a new geography-based, time-varying instrument for trade following the same identification strategy. To this purpose, we exploit the technological shock in the size of container ships that has taken place around the turn of the century. In particular, between the mid 1990s and the mid 2000s, the maximum capacity of container ships has almost quadrupled (from around 4,500 TEU up to around 16,000 TEU by 2006), thanks to the introduction of the so-called Post-Panamax ships.[3] As a growing number of larger container ships was built over time, the average TEU capacity of the world cargo fleet has doubled, from 1,500 to 3,000 TEU between 2000 and 2010. To gauge the size of this shock, it is worth mentioning that, since the widespread adoption of containerized transport at the end of the 60s, the world fleet of container ships took 30 years to reach an average capacity of 1,500 TEU. As a result of the shock, containerized seaborne trade has been the fastest growing modality of trade since the mid-1990s. By 2010, seaborne trade accounted for 75% of global trade volume and 60% of trade value, of which more than 60% was containerized (UNCTAD, 2014, and WEO, 2012).[4]

Crucially for our identification strategy, the impact of the transportation shock is not homogeneous across export destinations. Indeed, it depends on the presence of deep-water ports (DWPs) in partner countries, which is in turn determined by an exogenous geographic characteristic, i.e. the presence of coastal features allowing for a water depth of at least 13 meters, which is the minimum required to accomodate the new larger ships. As a result, starting from the mid-90s, a restricted group of around 200 container ports -the deep water ones- has became increasingly relevant for global trade flows. In light of this, we construct our instrument for exports by interacting the maximum size of container ships available each year in the world market, with a variable capturing the presence of deep-water ports in partner countries.[5] In particular, we employ the number of DWPs in each partner country, normalized over the number of kilometers of coastal line. While

[3]A TEU stands for a Twenty-foot Equivalent Unit, a unit of cargo capacity generally used to describe the capacity of container ships and container terminals. It is based on the volume of an internationally standardized intermodal container, 20-feet-long (6.1 m) and 8-feet-wide (2.44 m). No precise standard exists on height, although in general the most common height is 8 feet 6 inches (2.59 m), to fit into railway tunnels. Data on the evolution of container ships are provided by the OECD / International Transport Forum project on the 'Impact of Mega-Ships' (OECD, 2015).

[4]Containerized trade was already instrumental to the first wave of globalization in the 80s, as shown by Bernhofen et al. (2013). However, its growth accelerated further in the 1990s and the 2000s, with growth rates exceeding 10 per cent per year in volumes.

[5]By focusing on the presence of DWPs in partner countries, we are following the same approach as Felbermayr and Gröschl (2013). In fact, in a similar setting, they employ as instruments the number of natural disasters in partner countries, to make sure that the exclusion restriction is satisfied.

the maximum size of container ships is time-varying, the presence of deep-water ports does not vary over the sample. Thus, it essentially reflects an exogenous geographic characteristic of each partner country.[6]

Summing up, to isolate the variation in export flows that is exogenous with respect to domestic GDP growth, we exploit the technological shock of the increase in the size of container ships over time. This shock affects exports towards different partner countries in a different way. In particular, it increases exports relatively more towards partner countries that are more endowed with deep-water ports, as these are the only ones which can accommodate the larger container ships introduced over time. To ensure the validity of the exclusion restriction, we employ the presence of deep-water ports *only* in foreign countries. The identifying assumption is that, conditional on controls, the presence of deep-water ports in foreign countries affects domestic GDP growth in the exporting country only through the trade channel.

To build our instrumental variables, we estimate modified gravity equations using bilateral export flows. In particular, following Frankel and Romer (1999) and several subsequent papers (e.g. Feyrer, 2009; Felbermayr and Gröschl, 2013), we include as regressors only population (for both the exporter and the importer) and the standard geographic variables (i.e. distance, dummy for contiguity of the trading partners, and dummy for whether one of the two is landlocked). We also include fixed effects for exporting country, importing country, and year. We then add our instrument: the interaction between the presence of deep-water ports in the partner country and the maximum size of container ships available in the world market in a given year. We estimate separate gravity equations for gross export flows and their four value added components (DVA, RDV, FVA, and PDC). Next, we aggregate the predicted bilateral flows at the (exporting) country level, and use them as instrumental variables in our regressions of growth over trade. We first regress GDP per capita growth over instrumented gross exports, and then, separately, over instrumented DVA, RDV, FVA and PDC. Each component of exports is instrumented by its predicted values from the relevant gravity estimation. We find evidence of a positive effect of exports on GDP. This effect is driven by all the value-added components, although with different magnitudes. Importantly, domestic and foreign value added contribute to GDP growth in roughly equal terms.

[6]It is only more recently that some large infrastructural investments have been undertaken for artificially turning standard ports into deep water ones, for instance in the US ports of Houston and Baltimore.

Our paper speaks to different strands of literature. In particular, it contributes to the literature on trade and growth, in which recent studies have started to build instruments by exploiting the interaction between geographic characteristics and shocks to transportation technology. Specifically, Feyrer (2009) exploits the reduction in air transportation costs between 1960 and 1995, which has had a larger positive effect on trade for country-pairs where air distance is much shorter than sea distance. Pascali (2014) instead exploits the introduction of the steam engine in the shipping industry, between the 1860s and the 1870s, which has reduced shipping costs relatively more for trade routes that were not favored by wind patterns. As already stressed, while relying on a similar identification strategy, our paper makes two novel contributions with respect to this literature, (1) by studying the growth effect of each value-added component of trade, and (2) by employing a novel instrument which exploits a more recent transportation shock that is relevant for global value chains. As a matter of fact, the development of GVCs has indeed been strongly intertwined with the progress in maritime containerized transport (Memedovic et al., 2008). For all these reasons, we believe that our contribution is key for assessing the trade-growth nexus in the world of global value chains.

Our work is also related to the growing literature on GVCs. From the methodological point of view, a number of contributions have provided the tools for decomposing gross export flows into their value added components (Johnson and Noguera, 2012; Koopman et al., 2014; Wang et al., 2013). We capitalize on these studies, especially Wang et al. (2013), by exploiting the trade decomposition for assessing how different components of exports affect growth. Other papers have exploited the decomposition by Koopman et al. (2014) for studying the evolution of value-added exports over the recent financial crisis (e.g. Nagengast and Stehrer, 2015). A recent study by Johnson (2014) focuses instead on the role of GVCs with respect to the synchronization of business cycles across countries. Our paper is different, as it studies the causal relation between exports and economic growth, taking into account the role of global value chains by considering the effect of each value-added component of exports.

The remaining of the paper is organized as follows. Section 2 presents our trade data and the decomposition of exports. Section 3 introduces our instrument. The main results are presented and discussed in Section 4, wile Section 5 presents a battery of robustness checks. Finally, Section 6 concludes.

2 TO BE ADDED

In this preliminary and incomplete version of the paper, we just show the table with our baseline results, both OLS and IV.

Table 1: Income Growth and Trade

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Estimation:	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Dependent Variable:	$\Delta GDP_{t,t-2}$	$\Delta GDP_{t,t-2}$	$\Delta GDP_{t,t-2}$	$\Delta GDP_{t,t-2}$	$\Delta GDP_{t,t-2}$	$\Delta GDP_{t,t-2}$	$\Delta GDP_{t,t-2}$	$\Delta GDP_{t,t-2}$	$\Delta GDP_{t,t-2}$	$\Delta GDP_{t,t-2}$
$Gross\_Exports_{t-3}$	0.0216	0.2754***								
	[0.029]	[0.090]								
DVA_{t-3}			0.0156	0.3757***						
			[0.034]	[0.137]						
FVA_{t-3}					0.0354**	0.2487***				
					[0.016]	[0.072]				
RDV_{t-3}							-0.0094	0.3088**		
							[0.016]	[0.136]		
PDC_{t-3}									0.0358***	0.2108***
									[0.013]	[0.059]
Observations	390	390	390	390	390	390	390	390	390	390
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
R-squared	0.121		0.118		0.142		0.119		0.146	
First-stage estimates and IV statistics										
Coeff. of the instrument		0.7581***		0.6214***		0.9315***		0.5137**		1.0452***
		[0.166]		[0.171]		[0.197]		[0.200]		[0.222]
F-statistic for weak identification		20.76		13.24		22.25		6.614		22.16

Appendix

Table A1: Countries in the WIOD sample

Australia	Japan
Austria	Latvia
Belgium	Lithuania
Brazil	Luxembourg
Bulgaria	Malta
Canada	Mexico
China	Netherlands
Cyprus	Poland
Czech Republic	Portugal
Denmark	Romania
Estonia	Russia
Finland	Slovak Republic
France	Slovenia
Germany	South Korea
Greece	Spain
Hungary	Sweden
India	Taiwan
Indonesia	Turkey
Ireland	U.S.A
Italy	United Kingdom

Table A2: Industries in the WIOD sample

Agriculture, Hunting, Forestry and Fishing	Construction
Mining and Quarrying	Sale, Maintenance and Repair of Motor Vehicles Retail Sale of Fuel
Food, Beverages and Tobacco	Wholesale Trade and Commission Trade, Except of Motor Vehicles
Textiles and Textile Products	Retail Trade, Except of Motor Vehicles ; Repair of Household Goods
Leather and Footwear	Hotels and Restaurants
Wood and Products of Wood and Cork	Inland Transport
Pulp, Paper, Paper, Printing and Publishing	Water Transport
Coke, Refined Petroleum and Nuclear Fuel	Air Transport
Chemicals and Chemical Products	Other Supporting and Auxiliary Transport Activities
Rubber and Plastics	Post and Telecommunications
Other Non-Metallic Mineral	Financial Intermediation
Basic Metals and Fabricated Metal	Real Estate Activities
Machinery, Nec	Renting of M&Eq and Other Business Activities
Electrical and Optical Equipment	Public Admin and Defence; Compulsory Social Security
Transport Equipment	Education
Manufacturing, Nec; Recycling	Health and Social Work
Electricity, Gas and Water Supply	Other Community, Social and Personal Services

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