Trade and Growth in the Age of Global Value Chains

Carlo Altomonte* Laura Bonacorsi+ Italo Colantone*

*Bocconi University

+FEEM

This Version: August 2018

Introduction

- GVCs entail slicing production processes across countries.

Introduction

- GVCs entail slicing production processes across countries.
- 3 main implications on export data:

Introduction

- GVCs entail slicing production processes across countries.
- 3 main implications on export data:
  1. exports of any country embody an increasing share of foreign value added;

Introduction

- GVCs entail slicing production processes across countries.

- 3 main implications on export data:

  1. exports of any country embody an increasing share of foreign value added;
  2. intermediates cross borders multiple times before absorption, leading to double-counting;

Introduction

- GVCs entail slicing production processes across countries.

- 3 main implications on export data:

  1. exports of any country embody an increasing share of foreign value added;
  2. intermediates cross borders multiple times before absorption, leading to double-counting;
  3. for given exports, countries may differ in terms of *participation* and *positioning* in GVCs.

Introduction

- GVCs entail slicing production processes across countries.
- 3 main implications on export data:
  1. exports of any country embody an increasing share of foreign value added;
  2. intermediates cross borders multiple times before absorption, leading to double-counting;
  3. for given exports, countries may differ in terms of *participation* and *positioning* in GVCs.
- We shed the first light on the implications of these phenomena for the trade-growth nexus.

This paper

- We make 3 contributions:

This paper

- We make 3 contributions:

  1. New geography-based and time-varying instrument for trade over 1995-2007, exploiting a recent shock to transportation technology.

This paper

- We make 3 contributions:

1. New geography-based and time-varying instrument for trade over 1995-2007, exploiting a recent shock to transportation technology.

2. Assess impact of export on GDP per capita, showing evidence on channels (productivity growth and capital deepening).

This paper

- We make 3 contributions:

1. New geography-based and time-varying instrument for trade over 1995-2007, exploiting a recent shock to transportation technology.

2. Assess impact of export on GDP per capita, showing evidence on channels (productivity growth and capital deepening).

3. Study how GVCs affect the relation between export and income, through changes in the value added composition of exports, participation, and positioning.

Main findings

Using WIOD data for 40 countries, over 1995-2007, we find:

- Export has a positive effect on GDP per capita, both in levels (elasticity of about 0.35) and in growth terms.

Main findings

Using WIOD data for 40 countries, over 1995-2007, we find:

- Export has a positive effect on GDP per capita, both in levels (elasticity of about 0.35) and in growth terms.
- The effect works through both productivity improvements and capital deepening.

Main findings

Using WIOD data for 40 countries, over 1995-2007, we find:

- Export has a positive effect on GDP per capita, both in levels (elasticity of about 0.35) and in growth terms.
- The effect works through both productivity improvements and capital deepening.
- The effect is significantly moderated by countries' involvement in GVCs:

Main findings

Using WIOD data for 40 countries, over 1995-2007, we find:

- Export has a positive effect on GDP per capita, both in levels (elasticity of about 0.35) and in growth terms.
- The effect works through both productivity improvements and capital deepening.
- The effect is significantly moderated by countries' involvement in GVCs:
  - Lower trade elasticity when more foreign value is embodied in exports,

Main findings

Using WIOD data for 40 countries, over 1995-2007, we find:

- Export has a positive effect on GDP per capita, both in levels (elasticity of about 0.35) and in growth terms.
- The effect works through both productivity improvements and capital deepening.
- The effect is significantly moderated by countries' involvement in GVCs:
  - Lower trade elasticity when more foreign value is embodied in exports,
  - but not for countries that increase their participation or upgrade their positioning more than the median over time.

Main findings

Using WIOD data for 40 countries, over 1995-2007, we find:

- Export has a positive effect on GDP per capita, both in levels (elasticity of about 0.35) and in growth terms.
- The effect works through both productivity improvements and capital deepening.
- The effect is significantly moderated by countries' involvement in GVCs:
  - Lower trade elasticity when more foreign value is embodied in exports,
  - but not for countries that increase their participation or upgrade their positioning more than the median over time.
- Focus on WIOD countries due to need for value added decomposition of gross exports.

Main findings

Using WIOD data for 40 countries, over 1995-2007, we find:

- Export has a positive effect on GDP per capita, both in levels (elasticity of about 0.35) and in growth terms.
- The effect works through both productivity improvements and capital deepening.
- The effect is significantly moderated by countries' involvement in GVCs:
  - Lower trade elasticity when more foreign value is embodied in exports,
  - but not for countries that increase their participation or upgrade their positioning more than the median over time.
- Focus on WIOD countries due to need for value added decomposition of gross exports.
- The main results on the effect of gross exports on GDP per capita are confirmed on a broader set of 188 countries, based on BACI data.

Related literature

- Studies on trade and growth.

  [Frankel and Romer, 1999; Rodriguez and Rodrik, 2001; Feyrer, 2009ab; Felbermayr and Groschl, 2013; Pascali, 2017]

  None of the available studies considers GVCs.

Related literature

- Studies on trade and growth.

  [Frankel and Romer, 1999; Rodriguez and Rodrik, 2001; Feyrer, 2009ab; Felbermayr and Groschl, 2013; Pascali, 2017]

  None of the available studies considers GVCs.

- Growing literature on GVCs.

Related literature

- Studies on trade and growth.

  [Frankel and Romer, 1999; Rodriguez and Rodrik, 2001; Feyrer, 2009ab; Felbermayr and Groschl, 2013; Pascali, 2017]

  None of the available studies considers GVCs.

- Growing literature on GVCs.

  Export decomposition: [Johnson and Noguera 2012; Wang et al., 2013; Johnson 2014; Koopman et al., 2014; Borin and Mancini, 2015; de Gortari, 2017]

Related literature

- Studies on trade and growth.

  [Frankel and Romer, 1999; Rodriguez and Rodrik, 2001; Feyrer, 2009ab; Felbermayr and Groschl, 2013; Pascali, 2017]

  None of the available studies considers GVCs.

- Growing literature on GVCs.

  Export decomposition: [Johnson and Noguera 2012; Wang et al., 2013; Johnson 2014; Koopman et al., 2014; Borin and Mancini, 2015; de Gortari, 2017]

  GVCs indicators: [Antràs et al., 2012; Fally, 2012; Antràs and Chor, 2013; Antràs and de Gortari, 2017; Del Prete and Rungi, 2017; Antràs and Chor, 2018; Alfaro et al. 2018; Del Prete and Rungi, 2018]

Related literature

- Studies on trade and growth.

  [Frankel and Romer, 1999; Rodriguez and Rodrik, 2001; Feyrer, 2009ab; Felbermayr and Groschl, 2013; Pascali, 2017]

  None of the available studies considers GVCs.

- Growing literature on GVCs.

  Export decomposition: [Johnson and Noguera 2012; Wang et al., 2013; Johnson 2014; Koopman et al., 2014; Borin and Mancini, 2015; de Gortari, 2017]

  GVCs indicators: [Antràs et al., 2012; Fally, 2012; Antràs and Chor, 2013; Antràs and de Gortari, 2017; Del Prete and Rungi, 2017; Antràs and Chor, 2018; Alfaro et al. 2018; Del Prete and Rungi, 2018]

  Applications: [Johnson, 2014; Nagengast and Stehrer, 2015; Johnson and Noguera, 2017; Wang et al., 2017]

  No studies on the growth implications through exports.

Identification

Identification

- Assessing the causal impact of trade on growth: not easy.

Identification

- Assessing the causal impact of trade on growth: not easy.
- Frankel and Romer (1999) seminal idea: use geographic variables as IVs in a gravity framework.

Identification

- Assessing the causal impact of trade on growth: not easy.
- Frankel and Romer (1999) seminal idea: use geographic variables as IVs in a gravity framework.
- Intuition: isolating variation in bilateral trade flows due to exogenous geographic characteristics.

Identification

- Assessing the causal impact of trade on growth: not easy.
- Frankel and Romer (1999) seminal idea: use geographic variables as IVs in a gravity framework.
- Intuition: isolating variation in bilateral trade flows due to exogenous geographic characteristics.
- Issue: geography might affect income through channels other than trade (Rodriguez and Rodrik, 2001).

Identification

- Assessing the causal impact of trade on growth: not easy.
- Frankel and Romer (1999) seminal idea: use geographic variables as IVs in a gravity framework.
- Intuition: isolating variation in bilateral trade flows due to exogenous geographic characteristics.
- Issue: geography might affect income through channels other than trade (Rodriguez and Rodrik, 2001).
- Solution: exploit geography to construct time-varying instruments, controlling for time-invariant determinants of income through fixed effects.

Identification

- How?

Identification

- How?

- We exploit an exogenous shock to transportation technology...
- ... which has an asymmetric impact on different trade flows, due to geographic characteristics.

Identification

- How?

- We exploit an exogenous shock to transportation technology...
- ... which has an asymmetric impact on different trade flows, due to geographic characteristics.

- Intuition: geography is not a static concept. The interaction between physical geography and transportation technology determines effective distance.

Identification

- How?

- We exploit an exogenous shock to transportation technology...
- ... which has an asymmetric impact on different trade flows, due to geographic characteristics.

- Intuition: geography is not a static concept. The interaction between physical geography and transportation technology determines effective distance.

- Pascali (2017): between the 1860s and 1870s, steam ships reduce transport costs relatively more for routes not favored by wind patterns.

Identification

- How?

- We exploit an exogenous shock to transportation technology...
- ... which has an asymmetric impact on different trade flows, due to geographic characteristics.

- Intuition: geography is not a static concept. The interaction between physical geography and transportation technology determines effective distance.

- Pascali (2017): between the 1860s and 1870s, steam ships reduce transport costs relatively more for routes not favored by wind patterns.

- Feyrer (2009): between 1960 and 1995, reduction in air transport cost has stronger impact on country pairs where air distance is much shorter than sea distance.

The instrument

- The adoption of containers has been a game changer for the shipping industry, and an important driver of globalization.

- Bernhofen et al. (2016) show strong short-run positive effects of container adoption on trade between 1962 and 1990.

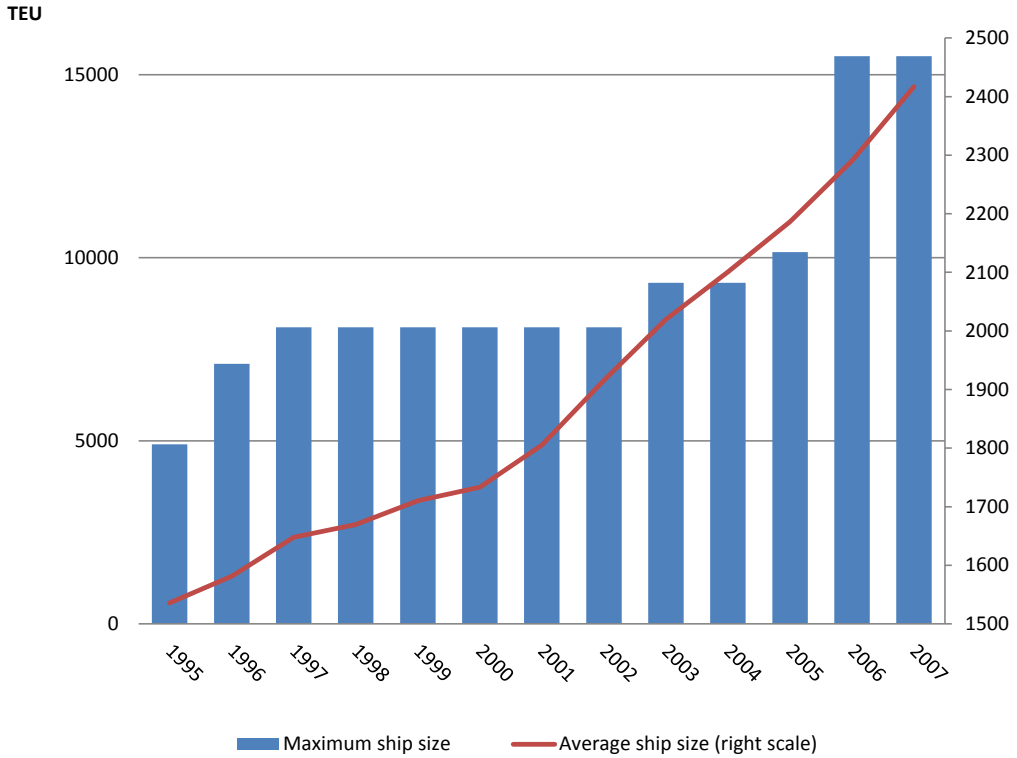
The instrument

- The adoption of containers has been a game changer for the shipping industry, and an important driver of globalization.
- Bernhofen et al. (2016) show strong short-run positive effects of container adoption on trade between 1962 and 1990.
- We consider a second shock to transportation technology, taking place from the mid-90s:
- The sharp increase in the size of container ships.

The instrument

- Maximum capacity more than triples.
- Average capacity of world fleet increases by around 60%.

Figure: Evolution of container ships (TEU), 1995-2007



Source: Authors' elaboration from UNCTAD, Review of Maritime Transport, various years

The instrument

- As capacity grows, so does the maximum draft: from 12 to 15.5 meters (39.4 to 50.9 ft).

Table: Evolution of Container Ships

Ship	**Built** (Year)	**Capacity** (TEU)	**Length** (m)	**Breath** (m)	**Max Draft** (m)
Panamax Class	pre-1994	4,500	294	32	12
NYK Altair	1994	4,900	300	37	13
Regina Maersk (Maersk Kure)	1996	7,100	318.2	42.8	14.6
Sovereign Maersk	1997	8,100	347	42.8	14
Axel Maersk	2003	9,310	352.6	42.8	15
Gudrun Maersk	2005	10,150	367.3	42.8	15
Emma Maersk	2006	15,500	397.7	56.4	15.5

Source: Authors' elaboration from www.containership-info.com, Alphaliner and Maersk.

The instrument

- As capacity grows, so does the maximum draft: from 12 to 15.5 meters (39.4 to 50.9 ft).
- That is the distance between the waterline and the lowest point of the keel.

Table: Evolution of Container Ships

Ship	**Built** (Year)	**Capacity** (TEU)	**Length** (m)	**Breath** (m)	**Max Draft** (m)
Panamax Class	pre-1994	4,500	294	32	12
NYK Altair	1994	4,900	300	37	13
Regina Maersk (Maersk Kure)	1996	7,100	318.2	42.8	14.6
Sovereign Maersk	1997	8,100	347	42.8	14
Axel Maersk	2003	9,310	352.6	42.8	15
Gudrun Maersk	2005	10,150	367.3	42.8	15
Emma Maersk	2006	15,500	397.7	56.4	15.5

Source: Authors' elaboration from www.containership-info.com, Alphaliner and Maersk.

The instrument

- The increase in the maximum draft generates an asymmetry in the impact of the transportation shock across different trade flows.

The instrument

- The increase in the maximum draft generates an asymmetry in the impact of the transportation shock across different trade flows.

- Intuition: in order to accommodate a container ship, a port needs to have water depth at least equal to the max draft, plus half meter buffer.

The instrument

- The increase in the maximum draft generates an asymmetry in the impact of the transportation shock across different trade flows.
- Intuition: in order to accommodate a container ship, a port needs to have water depth at least equal to the max draft, plus half meter buffer.
- Until 1994, the largest container ships had a max draft of 12 m., so all ports with water depth $>=$ 12.5 m. could accommodate all of them.

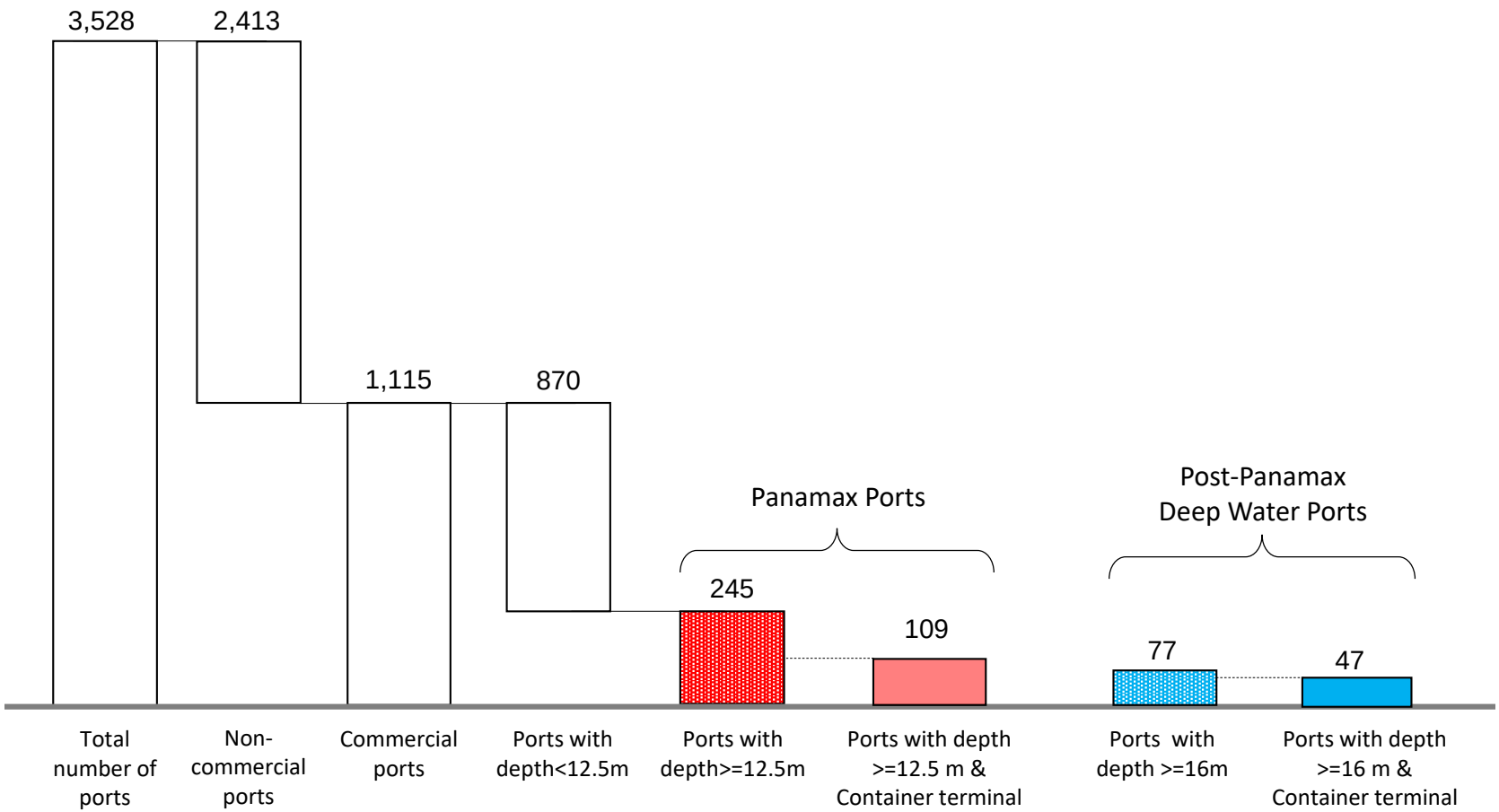
The instrument

- The increase in the maximum draft generates an asymmetry in the impact of the transportation shock across different trade flows.
- Intuition: in order to accommodate a container ship, a port needs to have water depth at least equal to the max draft, plus half meter buffer.
- Until 1994, the largest container ships had a max draft of 12 m., so all ports with water depth $>=$ 12.5 m. could accommodate all of them.
- As bigger ships are introduced and adopted, a large number of ports are cut out from the main routes operated by larger container ships (Sys et al., 2008).

The instrument

We have constructed a new original database on all ports in the world, based on detailed text analysis of worldportsource.com and a number of secondary sources. Here we report info on the 40 WIOD countries:

Figure: Summary of ports in WIOD countries



Source: authors' elaboration on data from worldportsource.com and secondary sources.

The instrument

- From the mid-90s, a restricted number of 47 Deep-Water Ports (DWPs) becomes increasingly central for global trade.
- Out of 40 WIOD countries: 19 countries have at least one DWP; 16 countries have sea access but no DWPs; 5 countries are landlocked.
- DWPs number does not change over the sample, akin to a time-invariant geographic characteristic. Systematic dredging starts only more recently.
- The uneven presence of DWPs across countries –interacted with the transport shock– generates the exogenous variation in trade flows that we exploit for identification.
- Relevance: volume of containerized seaborne trade has grown by almost four times over the sample, twice as much as compared to the rest of seaborne trade (UNCTAD, 2014).

The instrument

- We construct the IV through gravity estimations.

The instrument

- We construct the IV through gravity estimations.

- We augment the standard gravity with this interaction:

  [max size of container ships operating in a year] * [number of DWPs in the partner country, normalized by coast length]

The instrument

- We construct the IV through gravity estimations.
- We augment the standard gravity with this interaction:

  [max size of container ships operating in a year] * [number of DWPs in the partner country, normalized by coast length]
- This term is further interacted with the dyadic terms, e.g., distance. This captures potential heterogeneous impact of the shock as driven, e.g., by higher cost-effectiveness of containerized trade for long-distance shipping (Coşar and Demir, 2017).

The instrument

- We construct the IV through gravity estimations.
- We augment the standard gravity with this interaction:

  [max size of container ships operating in a year] * [number of DWPs in the partner country, normalized by coast length]
- This term is further interacted with the dyadic terms, e.g., distance. This captures potential heterogeneous impact of the shock as driven, e.g., by higher cost-effectiveness of containerized trade for long-distance shipping (Coşar and Demir, 2017).
- Moreover, all gravity estimations are industry-specific, capturing potential heterogeneity related to differences in containers relevance across industries (Bernhofen et al., 2016).

The instrument

- In order to ensure the validity of the exclusion restriction, we employ the presence of DWPs only in partner countries.

The instrument

- In order to ensure the validity of the exclusion restriction, we employ the presence of DWPs only in partner countries.

- Identifying assumption: conditional on controls, the presence of DWPs in partner countries –combined with the increase in ship size– affects domestic GDP in the exporting country only through the trade channel.

The instrument

- In order to ensure the validity of the exclusion restriction, we employ the presence of DWPs only in partner countries.

- Identifying assumption: conditional on controls, the presence of DWPs in partner countries –combined with the increase in ship size– affects domestic GDP in the exporting country only through the trade channel.

- Had we used domestic DWPs, one could wonder that they might affect GDP through other channels (Brooks, Gendron-Carrier, Rua, 2018).

The instrument

- In order to ensure the validity of the exclusion restriction, we employ the presence of DWPs only in partner countries.
- Identifying assumption: conditional on controls, the presence of DWPs in partner countries –combined with the increase in ship size– affects domestic GDP in the exporting country only through the trade channel.
- Had we used domestic DWPs, one could wonder that they might affect GDP through other channels (Brooks, Gendron-Carrier, Rua, 2018).
- Yet, one might have additional concerns with the exclusion restriction...

The instrument

- What determines the presence of DWPs in partner countries?

The instrument

- What determines the presence of DWPs in partner countries?

- Geographic characteristics like location and coastal conformation.

The instrument

- What determines the presence of DWPs in partner countries?
- Geographic characteristics like location and coastal conformation.
- No significant correlation with GDP per capita in 1995.

The instrument

- What determines the presence of DWPs in partner countries?
- Geographic characteristics like location and coastal conformation.
- No significant correlation with GDP per capita in 1995.
- Yet, partner countries might invest in creating new DWPs by dredging in the expectation of higher growth in exporting country, leading to endogeneity.

The instrument

- What determines the presence of DWPs in partner countries?
- Geographic characteristics like location and coastal conformation.
- No significant correlation with GDP per capita in 1995.
- Yet, partner countries might invest in creating new DWPs by dredging in the expectation of higher growth in exporting country, leading to endogeneity.
- This does not happen in our sample, where number of DWPs is fixed. Systematic dredging happens only after 2007 (e.g. New York, Baltimore and Miami).

The instrument

- What determines the presence of DWPs in partner countries?
- Geographic characteristics like location and coastal conformation.
- No significant correlation with GDP per capita in 1995.
- Yet, partner countries might invest in creating new DWPs by dredging in the expectation of higher growth in exporting country, leading to endogeneity.
- This does not happen in our sample, where number of DWPs is fixed. Systematic dredging happens only after 2007 (e.g. New York, Baltimore and Miami).
- Moreover, there is no higher pre-sample growth for countries that in 1995 export relatively more towards partners with more DWPs.

The instrument

- What determines the increase in container ship size?

The instrument

- What determines the increase in container ship size?

- Supply side: technological improvements, e.g., efficient 2-Stroke Low-Speed Engines.

The instrument

- What determines the increase in container ship size?
- Supply side: technological improvements, e.g., efficient 2-Stroke Low-Speed Engines.
- Demand side: positive expectations on future utilization of ship capacity (Sys et al., 2008).

The instrument

- What determines the increase in container ship size?
- Supply side: technological improvements, e.g., efficient 2-Stroke Low-Speed Engines.
- Demand side: positive expectations on future utilization of ship capacity (Sys et al., 2008).
- Economies of scale are the key advantage of bigger container ships.

The instrument

- What determines the increase in container ship size?
- Supply side: technological improvements, e.g., efficient 2-Stroke Low-Speed Engines.
- Demand side: positive expectations on future utilization of ship capacity (Sys et al., 2008).
- Economies of scale are the key advantage of bigger container ships.
- An increase in capacity from 5,000 to 15,000 TEU reduces annual operation costs per TEU by almost 43%, from around 700$ to 400$ (OECD, 2015).

The instrument

- Endogeneity concern: positive expectations on capacity utilization are related to encouraging forecasts on trade growth, and relatedly GDP growth...

The instrument

- Endogeneity concern: positive expectations on capacity utilization are related to encouraging forecasts on trade growth, and relatedly GDP growth...

- ... Hence, the increase in ship size might be endogenous to income.

The instrument

- Endogeneity concern: positive expectations on capacity utilization are related to encouraging forecasts on trade growth, and relatedly GDP growth...
- ... Hence, the increase in ship size might be endogenous to income.
- To tackle this issue:

The instrument

- Endogeneity concern: positive expectations on capacity utilization are related to encouraging forecasts on trade growth, and relatedly GDP growth...
- ... Hence, the increase in ship size might be endogenous to income.
- To tackle this issue:
  - In the gravity approach, we only exploit variation in bilateral trade flows within each year, as induced by uneven presence of DWPs and other bilateral features.

The instrument

- Endogeneity concern: positive expectations on capacity utilization are related to encouraging forecasts on trade growth, and relatedly GDP growth...
- ... Hence, the increase in ship size might be endogenous to income.
- To tackle this issue:
  - In the gravity approach, we only exploit variation in bilateral trade flows within each year, as induced by uneven presence of DWPs and other bilateral features.
  - Several robustness checks controlling for underlying trends and contemporaneous shocks, and excluding countries for which the endogeneity concern might be more relevant, e.g., China, Denmark and South Korea.

Gravity

Gravity specification - without MRTs (à la Frankel and Romer, 1999)

Based on WIOD data for 40 countries ▸ Details and 35 industries ▸ Details separately for each industry z, we estimate:

$$\ln Export_{ijz,t} = \beta_{z0} + \beta_{z1} \ln Distance_{ij} + \beta_{z2} Contiguity_{ij} + \beta_{z3} Landlocked_{ij}$$

$$+ \beta_{z4} \ln Pop_{i,t} + \beta_{z5} \ln Pop_{j,t} + \beta_{z6} DWP_j * \ln MaxSize_t$$

$$+ Z_{ij,t}\delta'_z + \alpha_{zi} + \alpha_{zj} + \alpha_{zt} + \epsilon_{ijz,t}$$

Gravity specification - without MRTs (à la Frankel and Romer, 1999)

Based on WIOD data for 40 countries ▸ Details and 35 industries ▸ Details separately for each industry z, we estimate:

$$\ln Export_{ijz,t} = \beta_{z0} + \beta_{z1} \ln Distance_{ij} + \beta_{z2} Contiguity_{ij} + \beta_{z3} Landlocked_{ij}$$
$$+ \beta_{z4} \ln Pop_{i,t} + \beta_{z5} \ln Pop_{j,t} + \beta_{z6} DWP_j * \ln MaxSize_t$$
$$+ Z_{ij,t}\delta'_z + \alpha_{zi} + \alpha_{zj} + \alpha_{zt} + \epsilon_{ijz,t}$$

- $Export_{ijz,t}$: export from country i to country j, in industry z and year t.

Gravity specification - without MRTs (à la Frankel and Romer, 1999)

Based on WIOD data for 40 countries ▸ Details and 35 industries ▸ Details separately for each industry z, we estimate:

$$\ln Export_{ijz,t} = \beta_{z0} + \beta_{z1} \ln Distance_{ij} + \beta_{z2} Contiguity_{ij} + \beta_{z3} Landlocked_{ij}$$
$$+ \beta_{z4} \ln Pop_{i,t} + \beta_{z5} \ln Pop_{j,t} + \beta_{z6} DWP_j * \ln MaxSize_t$$
$$+ Z_{ij,t}\delta'_z + \alpha_{zi} + \alpha_{zj} + \alpha_{zt} + \epsilon_{ijz,t}$$

- $Export_{ijz,t}$: export from country i to country j, in industry z and year t.
- $Z_{ij,t}$: vector of interactions between $DWP_j * \ln MaxSize_t$ and the other controls.

Gravity specification - without MRTs (à la Frankel and Romer, 1999)

Based on WIOD data for 40 countries ▸ Details and 35 industries ▸ Details separately for each industry z, we estimate:

$$\ln Export_{ijz,t} = \beta_{z0} + \beta_{z1} \ln Distance_{ij} + \beta_{z2} Contiguity_{ij} + \beta_{z3} Landlocked_{ij}$$
$$+ \beta_{z4} \ln Pop_{i,t} + \beta_{z5} \ln Pop_{j,t} + \beta_{z6} DWP_j * \ln MaxSize_t$$
$$+ Z_{ij,t}\delta'_z + \alpha_{zi} + \alpha_{zj} + \alpha_{zt} + \epsilon_{ijz,t}$$

- $Export_{ijz,t}$: export from country i to country j, in industry z and year t.
- $Z_{ij,t}$: vector of interactions between $DWP_j * \ln MaxSize_t$ and the other controls.
- Main analysis on 14 manufacturing industries. Services used for robustness.

Gravity specification - with MRTs

Separately for each industry z, we estimate:

$$\ln Export_{ijz,t} = \beta_{z0} + \beta_{z1} \ln Distance_{ij} + \beta_{z2} Contiguity_{ij} + \beta_{z3} Landlocked_{ij}$$

$$+ W_{ij,t}\delta'_z + \alpha_{zi,t} + \alpha_{zj,t} + \epsilon_{ijz,t}$$

Gravity specification - with MRTs

Separately for each industry z, we estimate:

$$\ln Export_{ijz,t} = \beta_{z0} + \beta_{z1} \ln Distance_{ij} + \beta_{z2} Contiguity_{ij} + \beta_{z3} Landlocked_{ij}$$
$$+ W_{ij,t}\delta'_z + \alpha_{zi,t} + \alpha_{zj,t} + \epsilon_{ijz,t}$$

- $\alpha_{zi,t}$ and $\alpha_{zj,t}$: exporter-year and partner-year effects, i.e., Multilateral Resistance Terms (MRTs - Anderson and van Wincoop, 2003).

Gravity specification - with MRTs

Separately for each industry z, we estimate:

$$\ln Export_{ijz,t} = \beta_{z0} + \beta_{z1} \ln Distance_{ij} + \beta_{z2} Contiguity_{ij} + \beta_{z3} Landlocked_{ij}$$
$$+ W_{ij,t}\delta'_z + \alpha_{zi,t} + \alpha_{zj,t} + \epsilon_{ijz,t}$$

- $\alpha_{zi,t}$ and $\alpha_{zj,t}$: exporter-year and partner-year effects, i.e., Multilateral Resistance Terms (MRTs - Anderson and van Wincoop, 2003).
- $W_{ij,t}$: vector of interactions between $DWP_j * \ln MaxSize_t$ and the dyadic variables.

Gravity specification - with MRTs

Separately for each industry z, we estimate:

$$\ln Export_{ijz,t} = \beta_{z0} + \beta_{z1} \ln Distance_{ij} + \beta_{z2} Contiguity_{ij} + \beta_{z3} Landlocked_{ij}$$
$$+ W_{ij,t}\delta'_z + \alpha_{zi,t} + \alpha_{zj,t} + \epsilon_{ijz,t}$$

- $\alpha_{zi,t}$ and $\alpha_{zj,t}$: exporter-year and partner-year effects, i.e., Multilateral Resistance Terms (MRTs - Anderson and van Wincoop, 2003).
- $W_{ij,t}$: vector of interactions between $DWP_j * \ln MaxSize_t$ and the dyadic variables.
- Notice: $DWP_j * \ln MaxSize_t$ is absorbed by $\alpha_{zj,t}$. We identify on the remaining variation.

Computation of the instrument

- Country-level instrument:

$$Instrument_{i,t} = \sum_{j} \sum_{z} (\widehat{Export}_{ijz,t})$$

Computation of the instrument

- Country-level instrument:

$$Instrument_{i,t} = \sum_{j} \sum_{z} (\widehat{Export}_{ijz,t})$$

- Country-industry level instrument:

$$Instrument_{iz,t} = \sum_{j} (\widehat{Export}_{ijz,t})$$

Gravity results

Table: Gravity estimations: summary statistics

Dependent Variable: ln(Export)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Depth:	Ports >=16 m.		Ports >=16 m.		Ports >=12.5 m.		Ports >=16 m.	
Only with container terminal:	Yes		No		Yes		Yes	
Sectors:	Manufacturing		Manufacturing		Manufacturing		All Sectors	
Summary statistic:	Avg.	Med.	Avg.	Med.	Avg.	Med.	Avg.	Med.
Partner DWPs * ln(MaxSize)	1.860	1.550	0.224	0.190	0.391	0.263	0.564	0.842
Distance	-1.668	-1.648	-1.647	-1.629	-1.665	-1.644	-1.363	-1.303
Dist. * Part. DWPs * ln(MaxSize)	0.005	0.005	0.001	0.001	0.002	0.002	0.005	0.005
Contiguity	0.543	0.578	0.556	0.598	0.541	0.577	0.606	0.572
Cont. * Part. DWPs * ln(MaxSize)	-0.003	-0.004	-0.004	-0.005	-0.001	-0.001	-0.002	-0.003
Landlocked	-0.317	-0.156	-0.360	-0.185	-0.317	-0.158	-0.212	-0.141
Land. * Part. DWPs * ln(MaxSize)	0.003	0.002	0.004	0.004	0.001	0.000	0.003	0.003

Magnitude

- What is the substantive magnitude of $DWP_j * \ln MaxSize_t$?

Magnitude

- What is the substantive magnitude of $DWP_j * \ln MaxSize_t$?

- DWP_j is the number of DWPs divided by the number of kilometers of coast in country j, in thousands.

Magnitude

- What is the substantive magnitude of $DWP_j * \ln MaxSize_t$?
- DWP_j is the number of DWPs divided by the number of kilometers of coast in country j, in thousands.
- The average baseline coefficient in the first column (1.86) implies that one extra port per th. km. leads to higher exports to country j by 1.86*ln $MaxSize_t$ percentage points.

Magnitude

- What is the substantive magnitude of $DWP_j * \ln MaxSize_t$?
- DWP_j is the number of DWPs divided by the number of kilometers of coast in country j, in thousands.
- The average baseline coefficient in the first column (1.86) implies that one extra port per th. km. leads to higher exports to country j by 1.86*ln $MaxSize_t$ percentage points.
- If we take the average of ln $MaxSize_t$ (9.09), this brings an increase by 16.9% in a year, all else equal.

Magnitude

- What is the substantive magnitude of $DWP_j * \ln MaxSize_t$?
- DWP_j is the number of DWPs divided by the number of kilometers of coast in country j, in thousands.
- The average baseline coefficient in the first column (1.86) implies that one extra port per th. km. leads to higher exports to country j by 1.86*ln $MaxSize_t$ percentage points.
- If we take the average of ln $MaxSize_t$ (9.09), this brings an increase by 16.9% in a year, all else equal.
- To give an idea: Germany has 3,624 km. of coast. One additional DWP would be associated, on average, to an increase in yearly exports directed to Germany by 4.7%.

Trade and income

Income regressions

- Baseline specification as in Pascali (2017) and Feyrer (2009):

$$\ln GDPpc_{i,t} = \beta_0 + \beta_1 \ln Export_{i,t} + \alpha_i + \alpha_t + \epsilon_{i,t}$$

Income regressions

- Baseline specification as in Pascali (2017) and Feyrer (2009):

$$\ln GDPpc_{i,t} = \beta_0 + \beta_1 \ln Export_{i,t} + \alpha_i + \alpha_t + \epsilon_{i,t}$$

- $GDPpc_{i,t}$: GDP per capita of country i in year t, sourced from World Development Indicators.

Income regressions

- Baseline specification as in Pascali (2017) and Feyrer (2009):

$$\ln GDPpc_{i,t} = \beta_0 + \beta_1 \ln Export_{i,t} + \alpha_i + \alpha_t + \epsilon_{i,t}$$

- $GDPpc_{i,t}$: GDP per capita of country i in year t, sourced from World Development Indicators.

- $Export_{i,t}$: aggregate manufacturing exports of country i in year t towards all partner countries.

Income regressions

- Baseline specification as in Pascali (2017) and Feyrer (2009):

$$\ln GDPpc_{i,t} = \beta_0 + \beta_1 \ln Export_{i,t} + \alpha_i + \alpha_t + \epsilon_{i,t}$$

- $GDPpc_{i,t}$: GDP per capita of country i in year t, sourced from World Development Indicators.
- $Export_{i,t}$: aggregate manufacturing exports of country i in year t towards all partner countries.
- α_i and α_t: country and year fixed effects.

Income regressions

Table: Income regressions: 188 countries

Dependent Variable: ln(GDP p.c.)	(1)	(2)	(3)
IV based on gravity:		Without MRTs	With MRTs
ln(Export)	0.165***	0.378***	0.277***
	[0.041]	[0.072]	[0.034]
Estimator	OLS	2SLS	2SLS
Country effects	yes	yes	yes
Year effects	yes	yes	yes
Obs.	2,363	2,363	2,363
R2	0.72	-	-
First-stage results			
Predicted trade flows from gravity	-	0.895***	0.716***
	-	[0.088]	[0.030]
Kleibergen-Paap F-Statistic	-	103.9	571.9

Income regressions

From now on we focus on WIOD countries, for which we can decompose gross exports.

Table: Income regressions: 40 WIOD countries

Dependent Variable: ln(GDP p.c.)	(1)	(2)	(3)
IV based on gravity:		Without MRTs	With MRTs
ln(Export)	0.270***	0.347***	0.321***
	[0.051]	[0.061]	[0.029]
Estimator	OLS	2SLS	2SLS
Country effects	yes	yes	yes
Year effects	yes	yes	yes
Obs.	507	507	507
R2	0.82	-	-
First-stage results			
Predicted trade flows from gravity	-	0.631***	0.592***
	-	[0.091]	[0.025]
Kleibergen-Paap F-Statistic	-	48.34	569.5

Growth

Table: Growth regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Δ ln(GDP p.c.) 1 year		Δ ln(GDP p.c.) 2 years		Δ ln(GDP p.c.) 3 years	
Δ ln(Export) 1 year (lag)	0.069***	0.088***				
	[0.013]	[0.019]				
Δ ln(Export) 2 years (lag)			0.103***	0.129***		
			[0.017]	[0.022]		
Δ ln(Export) 3 years (lag)					0.142***	0.173***
					[0.024]	[0.032]
Δ ln(Export) 4 years (lag)						
Δ ln(Export) 5 years (lag)						
Δ ln(Export) 12 years						
Estimator	OLS	2SLS	OLS	2SLS	OLS	2SLS
Obs.	429	429	351	351	273	273
R2	0.06	-	0.12	-	0.15	-
KP F-Stat.		298.1		484.6		355.3

Growth

Table: Growth regressions

	(7)	(8)	(9)	(10)	(11)	(12)
Dependent Variable:	Δ ln(GDP p.c.) 4 year		Δ ln(GDP p.c.) 5 years		Δ ln(GDP p.c.) 12 years	
Δ ln(Export) 1 year (lag)						
Δ ln(Export) 2 years (lag)						
Δ ln(Export) 3 years (lag)						
Δ ln(Export) 4 years (lag)	0.174***	0.213***				
	[0.039]	[0.053]				
Δ ln(Export) 5 years (lag)			0.175***	0.200**		
			[0.055]	[0.079]		
Δ ln(Export) 12 years					0.331***	0.379***
					[0.075]	[0.082]
Estimator	OLS	2SLS	OLS	2SLS	OLS	2SLS
Obs.	195	195	117	117	39	39
R2	0.14	-	0.11	-	0.47	-
KP F-Stat.		210.2		108.3		115.8

The IV coefficient on the sample of 188 countries is 0.685** (std. error 0.273).

Channels

Table: Productivity

Dep. Variable: ln(VA per worker)	(1)	(2)	(3)	(4)
Level of analysis:	Country-level		Industry-level	
Export	0.559***	0.567***	0.258***	0.314***
	[0.194]	[0.116]	[0.044]	[0.027]
Estimator	OLS	2SLS	OLS	2SLS
Country effects	yes	yes	no	no
Country-Industry effects	no	no	yes	yes
Year effects	yes	yes	yes	yes
Obs.	507	507	7,032	7,032
R2	0.52	-	0.45	-
Kleibergen-Paap F-Statistic		565.2		1,536

Channels

Table: Productivity

Dep. Var.: Δ ln(VA per worker) 12 years	(1)	(2)	(3)	(4)
Level of analysis:	Country-level		Industry-level	
Δ ln(Export) 12 years	1.089***	1.037***	0.458***	0.436***
	[0.330]	[0.353]	[0.067]	[0.077]
Estimator	OLS	2SLS	OLS	2SLS
Obs.	39	39	534	534
R2	0.24	-	0.12	-
Kleibergen-Paap F-Statistic		116.4		741.5

Channels

Table: Capital deepening

Dep. Variable: ln(Capital per worker)	(1)	(2)	(3)	(4)
Level of analysis:	Country-level		Industry-level	
Gross exports	0.108*	0.129***	0.032	0.102***
	[0.062]	[0.037]	[0.035]	[0.023]
Estimator	OLS	2SLS	OLS	2SLS
Country effects	yes	yes	no	no
Country-Industry effects	no	no	yes	yes
Year effects	yes	yes	yes	yes
Obs.	507	507	7,032	7,032
R2	0.48	-	0.37	-
Kleibergen-Paap F-Statistic		565.2		1,536

Channels

Table: Capital deepening

Dep. Var.: Δ ln(Capital per worker) 12 years	(1)	(2)	(3)	(4)
Level of analysis:	Country-level		Industry-level	
Δ ln(Export) 12 years	0.185**	0.204**	0.114**	0.177***
	[0.086]	[0.097]	[0.048]	[0.050]
Estimator	OLS	2SLS	OLS	2SLS
Obs.	39	39	534	534
R2	0.11	-	0.03	-
Kleibergen-Paap F-Statistic		116.4		741.5

Income regressions

Table: Robustness

Dependent Variable: ln(GDP p.c.)	Coeff.	Std. Err.	Obs.	KP F-Stat.
1) Baseline	0.321***	[0.029]	507	569.5
2) Controlling for country-pair dummies	0.316***	[0.029]	507	639.2
3) Including exporter DWPs	0.321***	[0.029]	507	570.7
4) Sum of importer and exporter DWPs	0.322***	[0.029]	507	568.8
5) Dummy for country pairs with at least 1 DWP in both	0.324***	[0.029]	507	569.4
6) Only countries with no domestic DWPs	0.353***	[0.018]	273	1227
7) Plain number of DWPs	0.316***	[0.029]	507	571.5
8) Including 4 additional DWPs	0.321***	[0.029]	507	568.5
9) Interactions based on Max Draft	0.321***	[0.029]	507	569.5
10) Excluding China	0.283***	[0.029]	494	580.5
11) Excluding Denmark and South Korea	0.317***	[0.030]	481	536.1
12) Considering total exports (manufacturing + services)	0.361***	[0.031]	507	862.3
13) Considering total trade (exports + imports)	0.341***	[0.026]	507	283.5
14) Helpman, Melitz, Rubinstein (2008)	0.196***	[0.026]	507	726.8
15) Gravity based on aggregate data	0.298***	[0.027]	507	781.2
16) Excluding fixed effects from IV computation	0.345***	[0.073]	507	16.4
17) Using a time trend instead of Max Size: much weaker!	0.168*	[0.089]	507	5.4
18) PPML estimator	0.388***	[0.071]	507	31.2

Income regressions

Table: Underlying trends and contemporaneous shocks

Dependent Variable: ln(GDP p.c.)	Coeff.	Std. Err.	Obs.	KP F-Stat.
a) Underlying trends based on pre-sample country characteristics				
1) Year dummies * initial GDP per capita (1995)	0.260***	[0.033]	507	280.1
2) Year dummies * pre-sample growth of GDP per capita (1990-1995)	0.262***	[0.026]	507	466.0
3) Year dummies * initial capital intensity (1995)	0.295***	[0.032]	507	344.9
4) Year dummies * pre-sample growth of capital intensity (1990-1995)	0.313***	[0.029]	507	559.6
5) Year dummies * initial TFP (1995)	0.251***	[0.033]	507	328.3
6) Year dummies * pre-sample growth of TFP (1990-1995)	0.267***	[0.024]	507	483.4
7) Year dummies * initial import/GDP (1995)	0.327***	[0.030]	507	540.3
8) Year dummies * pre-sample growth of import/GDP (1990-1995)	0.350***	[0.029]	507	588.9
9) Year dummies * initial export/GDP (1995)	0.328***	[0.030]	507	464.9
10) Year dummies * pre-sample growth of export/GDP (1990-1995)	0.319***	[0.028]	507	648.8
b) Contemporaneous shocks based on country performance in sample				
11) Year dummies * country group - GDP per capita growth (1995-2007)	0.094***	[0.028]	507	216.5
12) Year dummies * country group - capital intensity growth (1995-2007)	0.270***	[0.026]	507	470.4
13) Year dummies * country group - TFP growth (1995-2007)	0.282***	[0.027]	507	439.4
14) Year dummies * country group - import/GDP growth (1995-2007)	0.259***	[0.026]	507	441.7
15) Year dummies * country group - export/GDP growth (1995-2007)	0.379***	[0.032]	507	434.1

Global Value Chains

The role of GVCs

- GVCs entail slicing production processes across countries.

The role of GVCs

- GVCs entail slicing production processes across countries.
- 3 main implications on export data:

The role of GVCs

- GVCs entail slicing production processes across countries.
- 3 main implications on export data:
  1. exports of any country embody an increasing share of foreign value added;

The role of GVCs

- GVCs entail slicing production processes across countries.
- 3 main implications on export data:
  1. exports of any country embody an increasing share of foreign value added;
  2. intermediates cross borders multiple times before absorption, leading to double-counting;

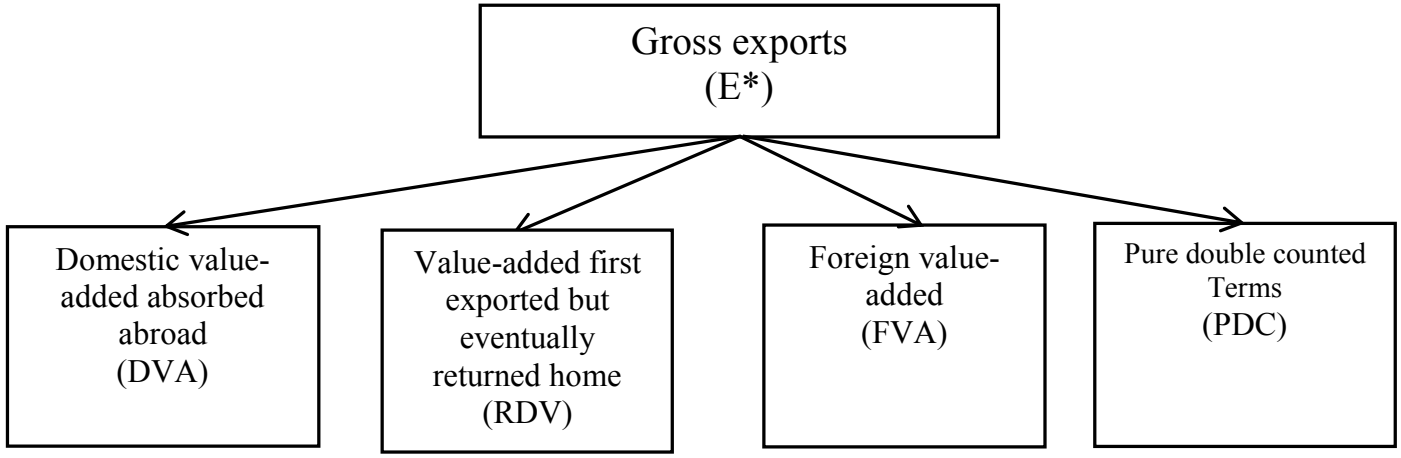
The role of GVCs

- GVCs entail slicing production processes across countries.
- 3 main implications on export data:
  1. exports of any country embody an increasing share of foreign value added;
  2. intermediates cross borders multiple times before absorption, leading to double-counting;
  3. for given exports, countries may differ in terms of *participation* and *positioning* in GVCs.

Export decomposition

- Methodology by Wang, Wei and Zhu (2013).
- Exact partition of bilateral trade flows by industry ("backward linkage" approach).

Figure: Main value added components of exports



Source: Wang et al. (2013)

Export decomposition

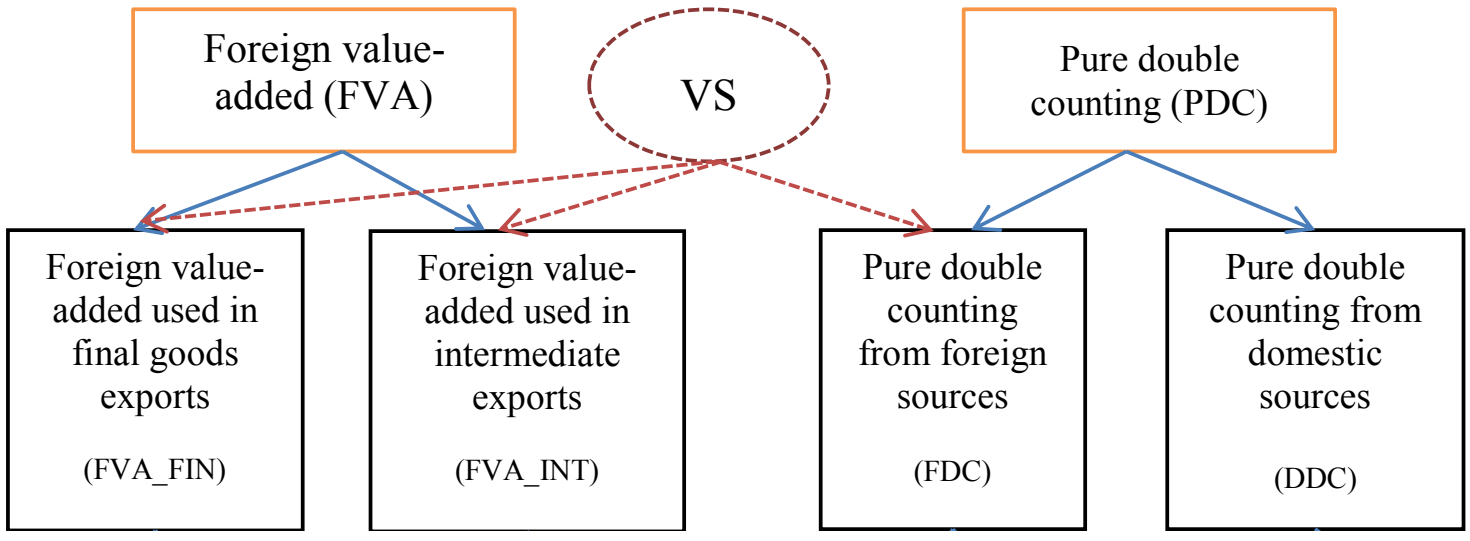
- DVA share decreases from 73 to 67% over the sample.
- FVA and PDC both grow by around 3 p.p.

Table: Value added shares

Variable	Obs.	Mean	Std. Dev.	Min	Max
Share DVA	278,700	0.698	0.136	0.070	1
Share RDV	278,700	0.004	0.012	0	0.338
Share FVA	278,700	0.224	0.112	0	0.924
Share PDC	278,700	0.074	0.067	0	0.662

Export decomposition

Figure: FVA, PDC, and VS



Source: Wang et al. (2013)

GVC indicators

- Vertical Specialization: (FVA+FDC), i.e., the overall foreign value embodied in exports (Hummels et al., 2001).

GVC indicators

- Vertical Specialization: (FVA+FDC), i.e., the overall foreign value embodied in exports (Hummels et al., 2001).

- Domestic Value: (DVA+RDV+DDC), i.e., the overall domestic value embodied in exports.

GVC indicators

- Vertical Specialization: (FVA+FDC), i.e., the overall foreign value embodied in exports (Hummels et al., 2001).
- Domestic Value: (DVA+RDV+DDC), i.e., the overall domestic value embodied in exports.
- GVC Positioning: (FVA_INT/VS), rises as a country upgrades its industries from assembling to producing intermediates for other countries (Wang et al., 2013).

GVC indicators

- Vertical Specialization: (FVA+FDC), i.e., the overall foreign value embodied in exports (Hummels et al., 2001).
- Domestic Value: (DVA+RDV+DDC), i.e., the overall domestic value embodied in exports.
- GVC Positioning: (FVA_INT/VS), rises as a country upgrades its industries from assembling to producing intermediates for other countries (Wang et al., 2013).
- GVC Participation: (FDC/VS), rises as cross-country production sharing deepens, and the exporting country gets more embedded in GVCs (Wang et al., 2013).

Instruments

- We run separate gravity estimations for each component of trade: DVA; RDV; FVA_INT; FVA_FIN; DDC; FDC.

Instruments

- We run separate gravity estimations for each component of trade: DVA; RDV; FVA_INT; FVA_FIN; DDC; FDC.

- By industry, and including MRTs.

Instruments

- We run separate gravity estimations for each component of trade: DVA; RDV; FVA_INT; FVA_FIN; DDC; FDC.

- By industry, and including MRTs.

- We build an instrument for each component by aggregating predicted flows at the country level.

Instruments

- We run separate gravity estimations for each component of trade: DVA; RDV; FVA_INT; FVA_FIN; DDC; FDC.
- By industry, and including MRTs.
- We build an instrument for each component by aggregating predicted flows at the country level.
- We build an instrument for each GVC indicator by combining the instruments of the different components.

Instruments

- We run separate gravity estimations for each component of trade: DVA; RDV; FVA_INT; FVA_FIN; DDC; FDC.
- By industry, and including MRTs.
- We build an instrument for each component by aggregating predicted flows at the country level.
- We build an instrument for each GVC indicator by combining the instruments of the different components.
- For example:

$$Instrument\_Participation_{i,t} = \sum_{j} \sum_{z} \left(\frac{\widehat{FDC}_{ijz,t}}{\widehat{VS}_{ijz,t}} \right)$$

The role of GVCs

Table: The role of GVCs - levels

Dep. Var.: ln(GDP p.c.)	(1)	(2)	(3)	(4)	(5)	(6)
Gross exports	0.321***					
	[0.029]					
Domestic Value (DVA+RDV+DDC)		0.370***		0.489***	0.431***	0.487***
		[0.031]		[0.045]	[0.055]	[0.044]
Foreign Value (VS)			0.217***	-0.108***	-0.220***	-0.046
			[0.024]	[0.027]	[0.039]	[0.032]
VS * Δ Participation (FDC/VS)					1.898***	
					[0.397]	
VS * Δ Positioning (FVA_INT/VS)						0.794***
						[0.163]
Country and Year effects	yes	yes	yes	yes	yes	yes
Estimator	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Obs.	507	507	507	507	507	507
R2	0.82	0.83	0.77	0.83	0.82	0.83
Kleibergen-Paap F-Statistic	569.5	577	647.4	298.5	32.5	30.2

The role of GVCs

Table: The role of GVCs - long differences

Dep. Var.: Δ ln(GDP p.c.) 12 years	(1)	(2)	(3)	(4)	(5)	(6)
Gross exports	0.379***					
	[0.082]					
Domestic Value (DVA+RDV+DDC)		0.436***		0.642***	0.578***	0.590***
		[0.077]		[0.111]	[0.141]	[0.125]
Foreign Value (VS)			0.264***	-0.186**	-0.295***	-0.068
			[0.077]	[0.075]	[0.111]	[0.119]
VS * Δ Participation (FDC/VS)					1.957**	
					[0.876]	
VS * Δ Positioning (FVA_INT/VS)						0.865**
						[0.431]
Estimator	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Obs.	39	39	39	39	39	39
R2	0.46	0.52	0.28	0.56	0.47	0.56
Kleibergen-Paap F-Statistic	115.8	115.8	156.9	59.15	5.2	4.4

Conclusion

Conclusion

- New instrument for trade –and each value added component– encompassing the surge of GVCs.

Conclusion

- New instrument for trade –and each value added component– encompassing the surge of GVCs.

- Export has a positive effect on income, through productivity improvements and capital deepening.

Conclusion

- New instrument for trade –and each value added component– encompassing the surge of GVCs.
- Export has a positive effect on income, through productivity improvements and capital deepening.
- Effect significantly moderated by countries' involvement in GVCs.

Conclusion

- New instrument for trade –and each value added component– encompassing the surge of GVCs.
- Export has a positive effect on income, through productivity improvements and capital deepening.
- Effect significantly moderated by countries' involvement in GVCs.
- Lower trade elasticity when more foreign value is embodied in exports.

Conclusion

- New instrument for trade –and each value added component– encompassing the surge of GVCs.
- Export has a positive effect on income, through productivity improvements and capital deepening.
- Effect significantly moderated by countries' involvement in GVCs.
- Lower trade elasticity when more foreign value is embodied in exports.
- But not for countries that increase their participation or upgrade their positioning more than the median over time.

Conclusion

- New instrument for trade –and each value added component– encompassing the surge of GVCs.
- Export has a positive effect on income, through productivity improvements and capital deepening.
- Effect significantly moderated by countries' involvement in GVCs.
- Lower trade elasticity when more foreign value is embodied in exports.
- But not for countries that increase their participation or upgrade their positioning more than the median over time.
- These findings are key for trade policy.

Appendix

WIOD - Release 2013

Table: WIOD countries

Australia	Japan
Austria	Latvia
Belgium	Lithuania
Brazil	Luxembourg
Bulgaria	Malta
Canada	Mexico
China	Netherlands
Cyprus	Poland
Czech Republic	Portugal
Denmark	Romania
Estonia	Russia
Finland	Slovakia
France	Slovenia
Germany	South Korea
Greece	Spain
Hungary	Sweden
India	Taiwan
Indonesia	Turkey
Ireland	UK
Italy	USA

Back

WIOD - Release 2013

Table: WIOD industries

Code	Description	Code	Description
c01	Agriculture, Hunting, Forestry and Fishing	c19	Sale, Maint. and Repair of Motor V. Retail Sale of Fuel
c02	Mining and Quarrying	c20	Wholesale and Commission Trade, Exc. Motor V.
c03	Food, Beverages and Tobacco	c21	Retail Trade, Except Motor V. ; Repair of HH Goods
c04	Textiles and Textile Products	c22	Hotels and Restaurants
c05	Leather and Footwear	c23	Inland Transport
c06	Wood and Products of Wood and Cork	c24	Water Transport
c07	Pulp, Paper, Printing and Publishing	c25	Air Transport
c08	Coke, Refined Petroleum and Nuclear Fuel	c26	Other Supporting and Auxiliary Transport Activ.
c09	Chemicals and Chemical Products	c27	Post and Telecommunications
c10	Rubber and Plastics	c28	Financial Intermediation
c11	Other Non-Metallic Mineral	c29	Real Estate Activities
c12	Basic Metals and Fabricated Metal	c30	Renting of M&Eq and Other Business Activities
c13	Machinery, Nec	c31	Public Admin and Defence; Compulsory Social Sec.
c14	Electrical and Optical Equipment	c32	Education
c15	Transport Equipment	c33	Health and Social Work
c16	Manufacturing, Nec; Recycling	c34	Other Community, Social and Personal Services
c17	Electricity, Gas and Water Supply	c45	Private Households With Employed Persons
c18	Construction		

Back