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## ► To cite this version:

Mariana Vijil, Laurent Wagner. Does Aid for Trade Enhance Export Performance? Investigating the Infrastructure Channel. *The World Economy*, 2012, 35 (7), pp.838-868. 10.1111/j.1467-9701.2012.01437.x . hal-01208811

**HAL Id: hal-01208811**

**<https://hal.science/hal-01208811>**

Submitted on 29 May 2020

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## Does Aid for Trade Enhance Export Performance? Investigating the Infrastructure Channel

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### 1. INTRODUCTION

EXISTING empirical literature has demonstrated that trade can be a powerful engine for enhancing economic development and poverty reduction (Winters et al., 2004). Thus, outward-oriented growth has been a popular development strategy in low-income countries since the introduction of structural adjustments plans. However, there are only a few cases where these policies have effectively succeeded in reducing poverty. Furthermore, as Brun et al. (2005) note, the evidence is consistent with the claim that poor countries have been marginalised by the recent wave of globalisation. Also, the share of the poorest developing countries in global trade has not increased despite the preferential trade schemes offered by their industrialised partners (Huchet-Bourdon et al., 2009).

Indeed, market access seems not enough for some countries facing internal obstacles to trade, such as a lack of knowledge, excessive red tape, insufficient financing and poor infrastructure. Therefore, the international community is placing an increasing emphasis on the aid for trade (AfT) initiative to assist developing countries in their attempt to enhance export performance and integration into the global economy, by targeting their own domestic constraints.

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The findings, interpretations and conclusions expressed in this paper are entirely those of the authors. Mariana Vijil acknowledges funding from the French Development Agency (AFD). Without implicating them, the authors thank Chantal Le Mouél, Marilyne Huchet-Bourdon, Patrick Guillaumont, Céline Carrère, Marcelo Olarreaga, Angela Chepte, Marie-Cécile Thirion, participants in the PhD seminar held at the UMR SMART in Rennes and into the 'Agence Nationale de la Recherche' aid seminar held at the CERDI in Clermont-Ferrand as well as an anonymous referee for helpful comments and valuable discussions.

The AFT Task Force defines this initiative as assistance to developing countries to increase exports of goods and services, to integrate the multilateral trading system and to benefit from liberalised trade and increased market access. Furthermore, AfT should increase economic growth and reduce poverty while complementing multilateral trade negotiations. Despite the ongoing debate on aid effectiveness following the 'Paris Declaration' and the Doha Agenda, there is little evidence about the success or otherwise of previous attempts to support export development. With this in mind, it seems relevant to assess the impact of assistance to trade on trade performance.

Starting from a macroeconomic perspective, the literature on the impact of aid on growth has so far failed to provide strong and convincing results (Roodman, 2007; Rajan and Subramanian, 2008), partly because of its effects on trade via the 'Dutch disease' phenomenon related to real exchange rates appreciation. Nevertheless, Adam and Bevan (2006) find that this short-run negative impact can be offset in the medium term by potential productivity spillovers created by aid-financed public expenditures. Furthermore, following the work of Clemens et al. (2004), researchers, in order to avoid the caveats of the aid-growth nexus, have focused on the impact of sectoral aid on narrower targets (e.g. school enrolment, infant mortality). As the effect of aid on growth is difficult, if not impossible, to capture, focusing on more specific outcome variables appears to be a promising new way of addressing the aid effectiveness issue.

In fact, there are few empirical studies that assess the effectiveness of aid for trade on trade performance, mainly because of the lack of sectoral data of sufficient quality and time span. Nevertheless, this kind of approach seems relevant to understanding the various channels through which the various types of aid operate (Mavrotas and Nunnenkamp, 2007). Among the papers seeking to quantify empirically the impact of aid for trade on trade flows, Helble et al. (2009) find that assistance directed towards trade enhances the trade performance of recipient countries. They estimate, using a gravity model, that a 1 per cent increase in assistance to trade facilitation could generate an increase in global trade of about US\$415 million. Furthermore, the effect of aid directed to the 'Trade Policy and Regulation' category seems stronger both in significance and in magnitude, with a particularly high impact on aid recipient's exports. Also, this aid category exhibits the highest rate of return with US\$697 in additional trade for every dollar invested. Nevertheless, the gravity model may not be suitable for testing the effectiveness of aid for trade; there is no reason to think that a project or programme financed by this assistance (e.g. for roads, telecommunications) will benefit one direction of trade more than another. Thus, an estimation using aggregate export flows across partners may be more accurate.

Cali and te Velde (2011) assess the impact of different types of aid for trade flows on the economic environment of recipient countries. Using panel data for

130 developing countries, they find that aid for ‘trade facilitation’ reduces the time and the cost to import. In addition, they test whether aid related to infrastructure and capacity building has an impact on both sectoral and total exports. They find that aid for infrastructure has a significant impact on total exports, while aid for capacity building never turns out to be significant. Nevertheless, considering the short time span of aid for trade data and the persistence of aid, dynamic panel generalised method of moments (GMM) techniques may not be recommended for studies on aid effectiveness. Thus, for instance, cross-section estimations could be a better choice.

Furthermore, existing work does not explicitly test the channels of transmission of aid for trade. We might surmise that some are related to internal costs to trade. Considering that the literature on trade costs and trade exhibits strong results, it seems relevant to focus on the effectiveness of aid flows on these internal constraints.

After reviewing the literature on trade cost in the next section, we present the available data on aid for trade in Section 3. The remainder of the paper addresses the question of the effectiveness of aid for trade using a two-step empirical analysis. Our empirical specification derives from the theoretical model of export performance of Redding and Venables (2003, 2004). Using an aggregation of gravity equations for each exporter, export supply for a country  $i$  depends on its size, internal costs and international market access. With that in mind, in the fourth section, as the first empirical step, we test whether institutions and infrastructure, our two potential aid transmission channels, are significant determinants of export performance. In Section 5, as the second empirical step, we test the impact of aid for trade sectoral flows on the previously highlighted determinants of export performance.

Our first-step empirical results suggest that infrastructure has a highly significant positive impact on developing countries’ export performance, whereas the institutions turn out to have limited impact. Furthermore, in the second step, we show that aid for infrastructure has a strong and positive impact on the infrastructure level. Moreover, we propose a new instrument to address the endogeneity issue related to the aid for infrastructure variable.

## 2. EMPIRICAL LITERATURE ON TRADE COSTS

As Abe and Wilson (2009) note, trade costs can be widely defined as any costs that increase the price of traded goods during the delivery process from the exporters (or producers) in exporting countries to the final consumers. There is an extensive literature on internal trade barriers that demonstrates the opportunities for a well-designed aid for trade facilitation targeted at domestic constraints (Portugal-Perez and Wilson, 2008). The concept of trade facilitation

used in this study includes all customs, transit and multimodal trade procedures, including transport and infrastructure issues (UNCTAD, 2006). Within this context, three approaches have been used to quantify the economic impact of trade facilitation measures: computable general equilibrium (CGE) models that quantify effects on income and welfare; gravity models that focus on bilateral trade effects; and country-case studies.

The CGE approach usually mimics the effects of trade facilitation measures as an improvement in the productivity of the transport sector or as a reduction in trade costs. Within this framework, the OECD (2003) finds that developing countries will benefit more than the rest of the world from these measures because of their less efficient border procedures, the relative importance of their trade flows in agri-food products and their higher share of small- and medium-size exporting business. Nevertheless, as Helble et al. (2009) point out, there are little data on the generalised parameters used to simulate trade facilitation incidence. Furthermore, even if these studies conclude that potential gains arise from trade facilitation measures, they do not identify the channels through which these measures effectively affect transport productivity or trade costs.

The gravity model allows the impact of different trade facilitation reforms on bilateral trade flows to be estimated. Perhaps the major examples are Wilson et al. (2003, 2005) who analyse the effect of an improvement in port efficiency, customs environment, regulatory environment and electronic business-usage on Asian Pacific Economic Cooperation members' trade and for a broad sample of 75 countries. They find that improvements in these fields, even from unilateral efforts, significantly increase both imports and exports. Likewise, Hoekman and Nicita (2011) estimate over a sample of 105 countries that a 10 per cent fall in the domestic cost of exporting would increase exports by about 4.8 per cent.

Finally, country-case studies allow a broader analysis of trade facilitation programmes. In terms of costs of implementation, Duval (2006) presents the results of an expert survey on 12 trade facilitation measures. This study highlights experts' opinion that long-term benefits largely exceed the perceived costs of implementation.

In addition, a growing body of the empirical literature considers that costs induced by internal capacity constraints are comparable to, or even higher than, applied tariffs. Using a gravity model, Anderson and van Wincoop (2004) find that transportation, information and security costs for industrialised countries are equivalent to a 30 per cent tariff applied on trade flows, with an even higher magnitude for developing countries. Taking into account the relative preference margins of developing countries, Hoekman and Nicita (2010, 2011) suggest that an improvement in trade facilitation is likely to have a better pay-off for developing countries than further opening of the market. Portugal-Perez and Wilson (2008) report the same results for African exporters. Considering

that negotiations on tariff reduction in Doha are lingering, these conclusions support the focus on internal trade costs reduction as an alternative development policy to World Trade Organization (WTO) market opening for developing countries (Ikenson, 2008; Hoekman and Nicita, 2010).

Internal trade costs can be classified into two main categories: 'natural' barriers such as institutions, infrastructure and production costs; and trade policy barriers (de Melo and Grether, 2000; Anderson and van Wincoop, 2004; Gamberoni and Newfarmer, 2009). Using a gravity model, Gamberoni and Newfarmer (2009) find that all the types of internal trade costs matter in the explanation of both export volumes and the probability of exporting for developing countries. Using the same methodology, Francois and Manchin (2007) find the same results and note that North–South trade is more affected by infrastructure and institutions than by tariff barriers. Furthermore, Djankov et al. (2006) conclude that time delays are even more of an issue for developing countries' exports of perishable agricultural products. Also, this study highlights that 75 per cent of the time burdens are explained by weak institutional features and 25 per cent by poor physical infrastructure.

#### *a. Trade Costs Related to a Lack of Infrastructure*

The theoretical and empirical evidence suggests that investment in infrastructure quantity and quality effectively affects exports (Bougheas et al., 1999; Limao and Venables, 2001; Brun et al., 2005; Adam and Bevan, 2006). Introducing an index of the density of the road network, the paved road network, the rail network and the number of phone lines per person in a gravity model, Limao and Venables (2001) find that the level of infrastructure is one of the main determinants of transport costs and explains approximately half of the low export values of sub-Saharan countries. Brun et al. (2005) conclude that a lack of infrastructure hits bilateral trade between low-income countries and their exports to the North harder.<sup>1</sup>

Furthermore, soft infrastructure, in the sense of infrastructure services and related regulation, is also essential because of the high rents that prevail in every step of an often noncompetitive trade logistic chain. Indeed, a growing body of the literature suggests that transport costs are endogenous to the characteristics of the goods being traded and to the market or organisational structure of the industry providing the service (Hummels et al., 2009; Sequeira and Djankov, 2009, unpublished manuscript). These findings suggest that barriers to

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<sup>1</sup> There is also empirical evidence of the impact of a specific kind of infrastructure on exports. Freund and Weinhold (2004) find that a 10 per cent increase in the number of a country's web hosts is related to an export gain of around 0.2 per cent. Francois and Manchin (2007) find that transport infrastructure is more relevant for low-income countries, but that as income *per capita* rises telecommunications become more important.

trade need to be addressed by a concerted policy action and that technical assistance to upgrade logistics and decrease corruption can play a substantial role in this (Anderson and Marcouiller, 2002; Portugal-Perez and Wilson, 2008; Hoekman and Nicita, 2011).

#### *b. Trade Costs Related to Weak Institutions*

Findings on the effect of trade barriers owing to institutional weakness on exports are less clear than for infrastructure. As an example, using indices of the institutional quality in a gravity model, Francois and Manchin (2007) find some ambiguous impacts on exports. Also, controlling for foreign market access and geography, Redding and Venables's (2003) index of protection of property rights and risk of expropriation does not appear to be a robust determinant of export performance.

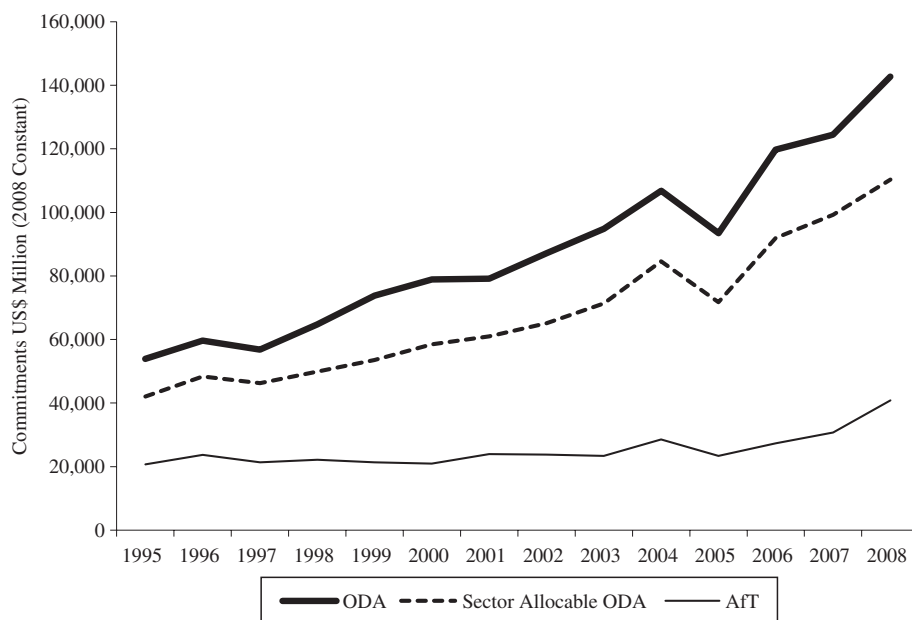
This ambiguity may be explained by the difficulty in measuring institutional costs exclusively related to trade activities. Consequently, a few papers have tried to focus on more specific data. For example, Sequeira and Djankov (2009, unpublished manuscript) estimate that corruption in Southern Africa's port institutions increases total shipping costs for a standard 20 foot container by 14 per cent. Anderson and Marcouiller (2002) also show that insecurity associated both with contractual enforcement problems and with transparency lowers international trade volumes significantly.

Finally, negotiations on multilateral and bilateral agreements by developing countries could also be considered to be a trade cost influenced by their institutional capacity. Talks on rules of origins, for example, are very complex and with substantial consequences on export performance (Carrère and de Melo, 2006; Cadot et al., 2008). Likewise, increasing the participation of developing countries in international standards organisations seems relevant to improving their institutional capacity on these nontariff barriers (Disdier et al., 2008).

### 3. AID FOR TRADE DATA AND DESCRIPTIVE STATISTICS

The previously mentioned supply-side constraints could be addressed through aid for trade, as part of the overall Official Development Assistance (ODA). The Development Assistance Committee (DAC) of the OECD is the main organ by which donors seek to coordinate their bilateral cooperation activities for development. Since its creation in 1961, the DAC has also been responsible for collecting statistics on the global effort of cooperation that relies primarily on declarations by DAC members and the multilateral organisations. Data are collected through two reporting systems: the aggregated DAC that includes a breakdown by type of aid, donor countries and sectors

FIGURE 1  
Medium-term Trends in ODA and AfT



Source: Authors' calculations.

and data from the Creditor Reporting System (CRS) that contain detailed information on individual projects and aid programmes. The CRS data thus allow the distribution of aid by sector, donor and recipient countries to be analysed. However, it should be noted that disbursements are only reported routinely by DAC members and the European Commission and not by multi-lateral donors such as The World Bank and the United Nations. Also, the aid data before 2003 suffer from a lack of quality. Thus, to reduce measurement errors in our empirical estimation, we only consider aid commitments between 2002 and 2008.

We can see in Figure 1 that commitments of total ODA and sector allocable ODA have more than doubled in volume over the period 1995–2008, with particularly strong growth since 2000 and the Paris Declaration on Aid Effectiveness.<sup>2</sup> Aid for trade volume has also doubled since then, while its share in total sector allocable ODA has declined from 49 per cent in 1995 to 37 per cent in 2008. Thus, the increase in volume is additional and not at the expense of a diversion of resources from other social or economic sectors.

<sup>2</sup> The Paris Declaration endorsed in 2005 is an international agreement to which over one hundred ministers, heads of agencies and other senior officials adhered and committed their countries and organisations to continue to increase efforts in harmonisation, alignment and managing aid for results with a set of monitorable actions and indicators.



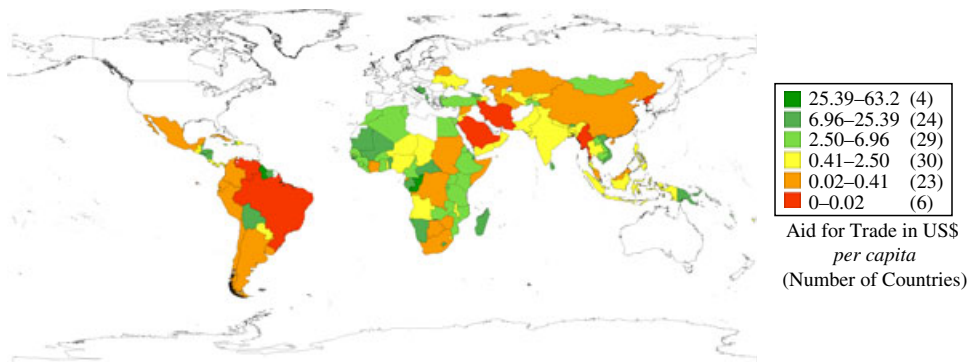
Following the task force on aid for trade definition, aid for trade can be divided into five categories: (i) technical assistance for trade policy and regulations; (ii) trade-related infrastructure; (iii) productive capacity building; (iv) trade-related adjustment; and (v) other trade-related needs. Nevertheless, there is no consensus on whether the productive capacity building category needs to be included on the agenda, that is, whether aid for trade should be confined to reducing trade costs or should also include support to increase the productive and competitive capacity of the private sector. There is even less agreement on the need to include trade-related adjustment costs and other trade-related needs (OECD, 2006). Considering that the aim of this paper is to test the channels by which aid for trade can affect trade performance, we only focus on aid for trade policy and regulations and aid for trade-related infrastructure, as other channels may be more difficult to comprehend.

Thus, the two categories covered in our study are as follows:

1. *Trade policy and regulations* is almost exclusively delivered by technical assistance and can be considered to be aid for *trade-related institutions*. On average between 2006 and 2008, this category accounts for US\$1,155 million (commitments, constant 2008). It includes five subcategories: projects and programmes oriented towards trade policy and administrative management; trade facilitation; regional trade agreements; multilateral trade negotiations; and trade education/training. As an example, flows from this category aim at helping countries to develop trade strategies, negotiate trade agreements and implement their outcomes.
2. *Economic infrastructure*, a proxy for *trade-related infrastructure*, has the main objective of connecting local markets to the global economy. On average between 2006 and 2008, this category received US\$17,758 million (commitments, constant 2008). This category includes three subcategories: aid for communications; energy; and transport and storage. Projects or programmes range from technical cooperation for policy planning for ministries to heavy constructions of roads, power plants and airports.

We observe from Figure 2 (and from Figures A1 and A2) that aid for trade is not always allocated to countries that need it the most. Indeed, some countries that are bad performers in terms of time delays to export and infrastructure quantity and quality still receive relatively less aid for trade *per capita* (Figures A3 and A4). Nevertheless, before advocating an increase in aid for trade flows, its effectiveness and channels of transmission on trade outcomes need to be investigated first. For this, we use a two-step empirical analysis. First, we test whether institutions and infrastructure, our two potential aid transmission channels, are significant determinants of developing countries' export performance. Second, we test and measure the impact of aid for trade sectoral flows on the determinants previously detected for developing countries.

FIGURE 2  
Aid for Trade in US\$ per Capita (2002–07, Trade Policy and Regulations and Economic Infrastructure)



Source: Authors' calculations.

#### 4. ON THE SEARCH FOR AID FOR TRADE EFFECTIVENESS CHANNELS

In order to reveal internal determinants of export performance that can be influenced by aid for trade, we use a theoretical model developed by Redding and Venables (2003, 2004). This framework relies on an aggregation of gravity equations of trade flows and allows us to explain the total volume of exports for a country by demand conditions and internal supply-side characteristics (see Redding and Venables, 2003, 2004 for more details).

##### *a. Theoretical Background*

Let us assume that the world is composed of  $i = 1, \dots, R$  countries whose tradable good sectors produce a range of symmetric differentiated products. Based on a symmetric constant elasticity of substitution (CES) demand function, the value of exports from  $i$  to  $j$  follows the traditional gravity trade model:

$$n_i p_i x_{ij} = n_i p_i^{1-\sigma} (t_i T_{ij} t_j)^{1-\sigma} E_j G_j^{\sigma-1}, \quad (1)$$

with;  $\sigma$ , elasticity of substitution between any pair of products;  $n_i$ , the set of varieties produced in country  $i$ ;  $x_{ij}$ , country  $j$ 's consumption of a variety from  $n_i$ ;  $E_j$ , total expenditure of country  $j$ ;  $G_j$ , the price index in country  $j$ ; and  $p_{ij} = p_i t_i T_{ij} t_j$  is the price of the variety exported by  $i$  to  $j$ , which includes a producer price  $p_i$  for varieties coming from  $i$ , an international transport cost between countries  $T_{ij}$  and two internal costs related to the delivery of the product from the factory gate to the exporter customs  $t_i$ , and from the partner customs to the consumer,  $t_j$ .

It should be noted that  $t_i$  and  $t_j$  can depend on trade-related infrastructure, such as the road or rail network, and on internal geography. Thus, unlike Redding and Venables (2003, 2004) for whom these variables capture the internal geography, we will use them as a measure of infrastructure. Indeed, as we saw earlier in the literature review, many studies underline the impact of transport costs related to infrastructure on developing countries' trade (Limao and Venables, 2001; Brun et al., 2005). Moreover, the internal geography is exogenous and cannot be influenced by aid for trade.

As in Redding and Venables (2003, 2004), in the rest of the model, we define the market capacity as  $m_i \equiv E_i(G_i/t_i)^{\sigma-1}$  and the supply capacity as

$$s_i \equiv n_i(p_i t_i)^{1-\sigma}. \quad (2)$$

Thus, aggregating the gravity equation over all importers for each  $i$  allows us to obtain each country's overall export value,  $V_i$ , which depends on supply capacity  $s_i$  and foreign market access  $M_i$ :

$$V_i = n_i p_i \sum_{j \neq i} x_{ij} = s_i \sum_{j \neq i} (T_{ij})^{1-\sigma} m_j = s_i M_i, \quad (3)$$

where  $M_i$  is the access to external markets for each exporter, and corresponds to the sum of market capacities of all partners, weighted by bilateral trade costs related to external geography:

$$M_i \equiv \sum_{j \neq i} (T_{ij})^{1-\sigma} m_j. \quad (4)$$

In order to endogenise supply capacity, Redding and Venables (2003, 2004) specify a supply function for exports  $\Omega$ :

$$n_i x_i = a_i \Omega \left( \frac{p_i}{c_i} \right), \text{ with } \Omega' > 0, \quad (5)$$

where  $\Omega$  is the same for all countries, but parameters  $c_i$  and  $a_i$  are country specific;  $c_i$  measures the relative costs of producing in the export sector of country  $i$ , and  $a_i$  measures the size of  $i$ 's economy. It is important to notice that we follow Redding and Venables (2003, 2004) and consider, in the remainder of this study,  $c_i$  to be an indicator of institutional quality.

Finally, confronting the gravity model with the supply function, performing a log-linearisation (variables denoted by  $\hat{\cdot}$ ) and eliminating the price term allow us to describe how the total value of exports  $V_i = n_i p_i x_i = s_i M_i$  varies according to

$$\hat{V} = \hat{n} + \hat{p} + \hat{x} = \hat{a} - \omega \hat{c} + [\hat{M} + (1 - \sigma)\hat{t} - \hat{x}] \frac{(1 + \omega)}{\sigma}, \quad (6)$$

where  $\omega$  is the price elasticity of export supply.

A final step allows us to derive the specification to be estimated empirically from equation (6); export volumes can vary between the number of varieties,  $n$ , and the output per variety,  $x$ .

Indeed, in a standard monopolistic competition model, the output per commodity is a constant, implying that export volumes become

$$\hat{V} = \hat{a} - \hat{c}\omega + [\hat{M} + (1 - \sigma)\hat{t}] \frac{(1 + \omega)}{\sigma}. \quad (7)$$

And if the number of varieties that can be produced by a country is fixed, export volumes are

$$\hat{V} = \left\{ \frac{(\sigma - 1)(\hat{a} - \hat{c}\omega) + [\hat{M} + (1 - \sigma)\hat{t}](1 + \omega)}{(\sigma + \omega)} \right\}. \quad (8)$$

Thus, for each country  $i$ , exports depend on the institutional environment  $c_i$ , the infrastructure  $t_i$ , the size of the economy  $a_i$ , and the foreign market access  $M_i$ .

#### *b. Empirical Analysis*

The empirical estimation that follows is derived from equations (7) and (8). The model can be translated into the following log-linear specification:

$$\ln(V_i) = \beta_0 + \beta_1 \ln(GDP_i) + \beta_2 \ln(Pop_i) + \beta_3 \ln(M_i) + \beta_4 \ln(t_i) + \beta_5 \ln(c_i) + \varepsilon_i, \quad (9)$$

where  $\beta$  are the parameters to be estimated.

All variables are in logarithmic form in order to interpret the coefficients as elasticities. For the estimation, we focus on developing countries and use average values for the period 2002–08. We deliberately choose to discard panel estimation techniques as we believe they would prevent us from using variables of higher quality and precision. Indeed, the most interesting and precise data for some variables (e.g. trade-related institutions, trade restrictiveness index) are only available for, at best, the most recent years (2005–08) and sometimes only for one year. Considering the trade-off between data quantity and quality, we believe that, in our case, simpler cross-section estimations might be more insightful. Furthermore, talks on trade oriented towards developing countries' concerns started with the Doha Round in 2001. Thus, we can expect a change in the behaviour of the donors and the developing countries' governments starting from this date.

The dependent variable implied by the theoretical model is total exports by country in constant US\$,  $V_i$ . Nevertheless, since we focus on a set of highly heterogeneous developing countries, we choose to normalise the export volumes by considering alternatively exports over GDP,  $(Exports_i)/GDP_i$ , following Guillaumont and Guillaumont Jeanneney (1988) and de Melo and Grether (2000).<sup>3</sup> Furthermore, from those two variables, we subtracted exports of oil and mineral resources. We believe that these two extractive sectors follow different economic mechanisms from those we are interested in. Data were obtained from the World Trade Indicators (WTI) database developed by The World Bank.

From the theoretical model, two variables can be considered as potential channels of transmission for the impact of aid for trade:  $t_i$  and  $c_i$ , which capture the comparative costs of exporting because of internal constraints.

The first variable,  $t_i$ , is related to the infrastructure quantity. More than the geographical characteristics of Redding and Venables (2003, 2004), we think it is the supply of infrastructure that undermines the export performance of a country. Following Limao and Venables (2001), Brun et al. (2005) and Francois and Manchin (2007), we construct an index of infrastructure that includes kilometres (km) of road and paved road (in total area, in km<sup>2</sup>) and the number of subscribers to mobile and telephone fixed lines (per 100 people) from the World Development Indicators (WDI) database. As in the study by Brun et al. (2005), the first two variables are normalised by the countries' surface. The infrastructure index used in the rest of the paper *Infrastructure<sub>i</sub>* is the first principal component obtained from our infrastructure variables by principal component analysis (PCA) (Calderon and Servén, 2004; Francois and Manchin, 2007).<sup>4</sup> This first component, associated with an eigenvalue of 2.33, accounts for 77 per cent of the variability of our sample and applies the following weights to our three variables, respectively: 0.62, 0.62 and 0.45. We expect this variable to have a positive effect on exports.

Another comparative cost of exporting because of internal constraints is the quality of institutions, in particular for developing countries (Redding and Venables, 2003, 2004; Djankov et al., 2006; Francois and Manchin, 2007). This is represented in the theoretical model by  $c_i$ , the relative cost of producing in the export sector. We follow Djankov et al. (2006) and Gamberoni and Newfarmer (2009) and use the number of days needed to export *Time<sub>i</sub>* from the Doing Business database. This variable measures the time required to move a standard cargo from the gate factory in the economic capital to the ship in the

<sup>3</sup> Indeed, Guillaumont and Guillaumont Jeanneney (1988) explain that an export over GDP measure is better than exports *per capita*, because the former increases mechanically with the revenue *per capita* for a specific export rate.

<sup>4</sup> PCA allows us to identify clusters of points in the data and to identify any linear combinations of variables that reduce the dimension of the index without losing much information.

most easily accessible port. Indeed, three-quarters of the delays seem to be because of administrative constraints, such as multiple procedures, taxes, licensing and inspection of containers (Djankov et al., 2006). Thus, an increase in days indicates a deterioration in the quality of the institutions related to trade. Therefore, we expect this variable to have a negative impact on exports.

Another variable derived from the theoretical model is country's size. At first, we capture this by population,  $Pop_i$ , and GDP in 2000 constant US\$,  $GDP_i$ , from the WDI database. When moving to  $(Exports_i)/GDP_i$  as the dependent variable, we then consider GDP *per capita* in 2000 constant US\$  $(GDP_i)/Pop_i$ . These two variables are measures of economic size, and their relationship with exports is ambiguous. On the one hand, we expect richer countries to have more capacity to export. On the other hand, an increase in income indicates that local production can serve a larger domestic market. We also expect population to be negatively related to the dependent variable, since populous countries face relatively lower costs to trade domestically and benefit from increasing returns. This variable can also be a proxy for relative factor endowments (Brun et al., 2005).

International market access for exports from  $i$ ,  $M_i$ , is captured by the market access owing to tariff and nontariff barriers  $MA-OTRI_i$  following Kee et al. (2009). This variable captures the distortions that the rest of the world's tariffs and non-tariffs barriers have on exports from country  $i$ .<sup>5</sup> We expect it to be negatively related to the dependent variable.

In order to address endogeneity problems because of reverse causality or any remaining unobserved heterogeneity that may lead to omitted-variable bias, we instrument infrastructure and institutions variables. Indeed, there is a potential reverse causality between the exports over GDP ratio and our two variables of interest, because countries with better export performance can be more interested in reducing internal trade costs and thus may invest more in infrastructure and institutions.

To control for this potential problem, infrastructure is instrumented by a variable reflecting internal geography taken from Gallup et al. (1999): the proportion of land area within 100 km of the coast or a navigable river in 1995. We expect that countries with better geographical conditions will tend to supply more infrastructure related to trade. Indeed, Canning (1998) explains that infrastructure has network effects, and the internal geography, such as the location of rivers and mountains, determines their supply. Also, these variables can be considered as exogenous to the error term.<sup>6</sup> Concerning institutions, we

<sup>5</sup> The non-tariff barriers included in this measure are: price control measures; quantity restrictions; monopolistic measures; technical regulations; and agricultural domestic support (Kee et al., 2009).

<sup>6</sup> The correlation between exports over GDP ratio and the infrastructure instrument is very low (18 per cent) and not significant.

decided to follow Djankov et al. (2006) and use the number of documents needed to export from the Doing Business database as an instrument for the time measure. The idea here is that the extra paperwork because of more documents extends the number of days for exports to be processed, but is unlikely to be affected by export volumes. Indeed, more trade may extend the waiting time for a document, but certainly not the number of documents needed.

Thus, the export equations to be estimated through the two-stage least squares (2SLS) method are the following:

$$\ln(V_i) = \beta_0 + \beta_1 \ln(\text{Infrastructure}_i) + \beta_2 \ln(\text{Time}_i) + \beta_3 \ln(\text{GDP}_i) + \beta_4 \ln(\text{Pop}_i) + \beta_5 \ln(\text{MA-OTRI}_i) + \varepsilon_i. \quad (10a)$$

$$\ln\left(\frac{\text{Exports}_i}{\text{GDP}_i}\right) = \beta_0 + \beta_1 \ln(\text{Infrastructure}_i) + \beta_2 \ln(\text{Time}_i) + \beta_3 \ln\left(\frac{\text{GDP}_i}{\text{Pop}_i}\right) + \beta_4 \ln(\text{Pop}_i) + \beta_5 \ln(\text{MA-OTRI}_i) + \varepsilon_i. \quad (10b)$$

As a robustness check, following Lederman et al. (2010), we choose to introduce sequentially two additional control variables outside of the model. First, we introduce the volatility of the exchange rate in country  $i$ ,  $\text{Volat}_i$ , as a proxy for business uncertainty (Lederman et al., 2010); this variable is measured by the coefficient of variation of the dollar to the local currency exchange rate and data come from the International Financial Statistics database of the International Monetary Fund (IMF). We expect this variable to be related negatively to export performance. Second, we control for the trade restrictiveness imposed by country  $i$  on its imports from the rest of the world  $\text{OTRI}_i$  from Kee et al. (2009).<sup>7</sup> As Brun et al. (2005) note, a tariff applied on imports can be equivalent to an export tax. Thus, we expect a negative relationship between this variable and exports over GDP.

### c. Results

The estimation results for equation (10a) using ordinary least squares (OLS) and 2SLS are reported in Table 1. In this table, we present the result of the equation reflecting directly the formulation of Redding and Venables (2003, 2004).

<sup>7</sup> This variable captures the relative price distortion created by the trade policy imposed by  $i$  on its own imports.

TABLE 1  
Trade Costs and Exports in Constant US\$

<i>Exports (Without Oil and Minerals)</i>	(1)	(2)	(3)
	<i>OLS</i>	<i>OLS</i>	<i>2SLS</i>
<i>Infrastructure</i>	1.211 (0.247)***	0.465 (0.204)**	2.390 (0.549)***
<i>Time</i>	-0.387 (0.133)***	-0.130 (0.171)	0.107 (0.462)
<i>GDP</i>	0.607 (0.078)***		0.421 (0.135)***
<i>Pop</i>	0.213 (0.077)***	-0.135 (0.042)***	0.419 (0.142)***
<i>MA-OTRI</i>	-0.698 (0.256)***	-0.164 (0.287)	-0.942 (0.346)***
Constant	3.532 (1.104)***	0.502 (1.099)	2.034 (2.299)
Observations	88	88	84
<i>R</i> -squared	0.93		0.92
First-stage <i>F</i> -stat for Infrastructure			51.38
First-stage <i>F</i> -stat for Time			10.04

Notes:

(i) Robust standard errors in parentheses. (ii) All variables are in logarithmic form.

(iii) OLS, ordinary least squares; 2SLS, two-stage least squares.

(iv) \*Significant at 10%; \*\*Significant at 5%; \*\*\*Significant at 1%.

In the first column, using the OLS estimator, all of our variables turn out to be significant with the expected sign (except for population that has a positive sign). Nevertheless, from the theoretical model, we have to check whether these results hold when imposing the constraint of a coefficient relative to GDP set to unity (when using the ratio of exports over GDP as the dependent variable).<sup>8</sup> As displayed in column (2), in this case, only *Infrastructure<sub>i</sub>* seems to have an impact on exports.

This is also the case in column (3) for 2SLS: once our infrastructure and institutions variables are instrumented, only the level of infrastructure seems to be correlated with exports. The coefficient is positive as expected. The geographical variable used to explain infrastructure has a fairly strong explaining power as the first-stage *F*-statistic is above the rule of thumb of ten, which is the standard threshold for weak instrumentation. The number of documents needed to export seems to be also a good instrument even if, in this case, the *F*-statistic is lower (see Table A1 for 2SLS first-stage results). It should be noted that results are robust to the use of the limited information maximum-likelihood estimator that helps to deal with the relative weakness of our

<sup>8</sup> For further details, see Redding and Venables (2003, 2004).



institutional instrument (results upon request). Moreover, considering that our model is not overidentified since there is only one instrument for each of our endogenous variables, we are naturally not able to provide the results of the Hansen  $J$ -test. Nevertheless, both theoretically and empirically, our instruments seem to be valid.

The results for equation (10b) using OLS and 2SLS are shown in Table 2.<sup>9</sup> As earlier, we can see in column (2) that once our infrastructure and institutions variables are instrumented, only the level of infrastructure seems to be correlated with the exports over GDP ratio.<sup>10</sup> As a robustness check, we then introduce sequentially additional control variables in columns (3) and (4). The results related to the infrastructure and institutions channels remain the same both in magnitude and in significance. As one can see in column (4), adding the Own Market Access variable,  $OTRI_i$ , reduces dramatically our sample without modifying our results.<sup>11</sup> Our preferred specification is that shown in column (5) where we dropped two outliers identified using the method of Hadi (1994).<sup>12</sup> These results indicate that infrastructure might be a potential channel of transmission by which aid for trade affects export performance. Indeed, an increase in 10 per cent of the quality and quantity of infrastructure leads to an average increase in exports over GDP of 20.6 per cent. This is a high economic effect that concurs with the extensive literature on infrastructure and trade (Lima and Venables, 2001; Brun et al., 2005; Francois and Manchin, 2007; Gamberoni and Newfarmer, 2009). However, institutions  $Time_i$  does not seem to be a determinant of export performance. The statistical significance of the time to export in the OLS estimation disappears once we control for endogeneity. This result is similar to the one by Lederman et al. (2010).

In the final column of Table 2, we report results once we dropped from the sample all the countries that are not receiving aid for trade. Clearly, one can argue that these countries are richer and that might influence our results and their interpretations. It is apparently not the case. Indeed, even with this reduced sample, the coefficient for infrastructure remains broadly the same, suggesting that the relationship we are investigating is robust and relatively stable among income groups. Likewise, the coefficient for our institutional variable remains insignificant.

<sup>9</sup> Alternatively using the limited information maximum-likelihood (LIML) estimator leads to the same results in term of significance levels.

<sup>10</sup> As a matter of fact, we try to disentangle our broad infrastructure effect by considering each of our three infrastructure variables (road, paved road and phone subscribers) instead of the infrastructure index in equation (10b). Using alternative instruments, such as surface area in square kilometres, density of population or the share of urban population, we find that it is actually the density of the paved road network that seems to matter the most (results upon request).

<sup>11</sup> The anti-trade bias of the import regime  $OTRI_i$  is not statistically significant, suggesting that general equilibrium effects are not a strong determinant of exports.

<sup>12</sup> Guinea and Zimbabwe appear as outliers.

TABLE 2  
Trade Costs and Exports over GDP Ratio

<i>Exports (Without Oil and Minerals)/ GDP</i>	<i>All Developing Countries</i>					<i>Aid for Trade Recipients</i>
	(1)	(2)	(3)	(4)	(5)	(6)
	<i>OLS</i>	<i>2SLS</i>	<i>2SLS</i>	<i>2SLS</i>	<i>2SLS</i>	<i>2SLS</i>
<i>Infrastructure</i>	0.641 (0.262)**	1.812 (0.455)***	2.077 (0.569)***	1.981 (0.604)***	2.069 (0.579)***	2.114 (0.568)***
<i>Time</i>	-0.312 (0.124)**	0.112 (0.455)	0.299 (0.534)	-0.113 (0.544)	0.275 (0.545)	0.154 (0.441)
<i>GDP/Pop</i>	-0.195 (0.079)**	-0.384 (0.122)***	-0.378 (0.136)***	-0.496 (0.130)***	-0.386 (0.135)***	-0.473 (0.147)***
<i>Pop</i>	-0.172 (0.035)***	-0.174 (0.038)***	-0.140 (0.042)***	-0.176 (0.049)***	-0.147 (0.046)***	-0.178 (0.049)***
<i>MA-OTRI</i>	-0.541 (0.244)**	-0.799 (0.298)***	-0.860 (0.362)**	-0.918 (0.446)**	-0.866 (0.363)**	-1.032 (0.366)***
<i>Volat</i>			0.364 (0.131)***	0.307 (1.425)	0.081 (1.322)	-0.305 (0.911)
<i>Otri</i>				0.065 (0.180)		
<i>Constant</i>	6.978 (0.889)***	6.001 (2.471)**	4.532 (2.954)	7.062 (3.186)**	4.796 (2.993)	5.911 (2.485)**
Observations	96	91	81	62	79	67
<i>R-squared</i>	0.41	0.28	0.14	0.28	0.13	0.20
First-stage <i>F</i> -stat for Infrastructure		47.27	38.83	29.43	38.99	29.58
First-stage <i>F</i> -stat for Time		9.47	8.81	6.25	8.92	10.23
Outliers (HADI) ( <i>p</i> -value = 0.05)					Guinea Zimbabwe	

## Notes:

(i) Robust standard errors in parentheses. (ii) Instruments used are documents needed to export for the institutional variable and the proportion of land area within 100 km of the coast or a navigable river in 1995 for the infrastructure variable. All variables are in logarithmic form.

(iii) OLS, ordinary least squares; 2SLS, two-stage least squares.

(iv) \*Significant at 10%; \*\*Significant at 5%; \*\*\*Significant at 1%.

Finally, it should be noticed that these results are robust to the inclusion of landlocked and regional dummies (results upon request).

Regarding the other explanatory variables,  $(GDP_i)/Pop_i$  has a negative and statistically significant sign, suggesting that richer countries exhibit an exports over GDP ratio that is relatively lower than that of poorer ones. The negative and significant sign for  $Pop_i$  also indicates that countries with larger markets export relatively less. The restrictiveness faced by exporters in the rest of the world,  $MA-OTRI_i$ , has a negative impact on exports. The business climate,  $Volat_i$ , does not seem to be a significant determinant of export performance once we control for outliers.

In order to assess the robustness of our results further, we use alternative measures of our institutional variable (see Table A2). As the reverse causality might still be an issue and as using the number of documents needed to export might seem less appropriate for alternative institutional variables, we had to find alternative instruments. We decided to rely on the work of La Porta et al. (1999) by using binary variables for French, English, German and Scandinavian legal origins as instruments.

The time to export measure was replaced by the efficiency of the clearance process by border control agencies, including customs *Customs\_Lpi<sub>i</sub>*, from the Logistic Performance Index (LPI). The LPI has been widely used in recent studies on trade facilitation (Portugal-Perez and Wilson, 2008; Gamberoni and Newfarmer, 2009; Hoekman and Nicita, 2010). We do not find any significant impact on exports. Following Anderson and Marcouiller (2002) and Sequeira and Djankov (2009, unpublished manuscript), we also use two variables of control for corruption; the first from the Polity IV database *Pol4\_corrupt<sub>i</sub>* and the second *Icrg\_corrupt<sub>i</sub>* from the International Country Risk Guide (ICRG) – but without finding any significant impact. Nevertheless, it should be noted that across all estimations, the infrastructure proxy is positive and highly significant.

## 5. AID FOR TRADE AND INFRASTRUCTURE

### *a. Empirical Analysis*

Since only infrastructure appears to be a determinant of export performance, we now test the effectiveness of aid for trade. First, we want to check that the level of infrastructure is indeed the channel through which aid for trade has an impact on exports. In order to do so, we include the logarithm of aid for trade *per capita* *AfT\_pc<sub>i</sub>* in equation (10b) and sequentially add our infrastructure and institutional variables. As can be seen, in the first column of Table 3, aid for trade seems to have a positive and significant impact on the exports over GDP ratio when we control for neither the infrastructure nor the institution channel. Nevertheless, aid for trade remains significant only in column (3) when we only introduce our trade-related institutional variable. In columns (2) and (4), as soon as we control for the level of infrastructure, the significance on the aid for trade variable disappears. These results seem to confirm that it is only through its impact on infrastructure that aid for trade influences export performance. Thus, aid for trade and more particularly aid for economic infrastructure enhance the exports over GDP ratio. It seems then pertinent to test the impact of aid for infrastructure on our infrastructure index. Indeed, a lack of trade-related infrastructure can discourage investment oriented towards the tradable sector.

TABLE 3  
Aid for Trade, Infrastructure and Institutions

<i>Exports (Without Oil and Minerals)/GDP</i>	(1)	(2)	(3)	(4)
	<i>OLS</i>	<i>2SLS</i>	<i>2SLS</i>	<i>2SLS</i>
<i>GDP/Pop</i>	0.156 (0.069)**	-0.294 (0.126)**	-0.014 (0.155)	-0.298 (0.122)**
<i>Pop</i>	-0.087 (0.043)**	-0.112 (0.048)**	-0.093 (0.044)**	-0.118 (0.077)
<i>MA-OTRI</i>	-0.338 (0.228)	-0.772 (0.295)***	-0.316 (0.215)	-0.702 (0.572)
<i>AfT_pc</i>	0.113 (0.052)**	0.002 (0.058)	0.100 (0.057)*	0.001 (0.060)
<i>Infrastructure</i>		2.058 (0.544)***		1.910 (1.142)*
<i>Time</i>			-0.648 (0.529)	-0.167 (1.189)
<i>Constant</i>	2.623 (1.039)**	4.807 (1.279)***	6.118 (3.219)*	5.704 (6.686)
Observations	96	60	95	60
<i>R</i> -squared	0.22	0.08	0.29	0.12
First-stage <i>F</i> -stat for Infrastructure		36.24		42.81
First-stage <i>F</i> -stat for Time			8.36	2.76

Notes:

(i) Robust standard errors in parentheses. (ii) Instruments used are documents needed to export for the institutional variable and the proportion of land area within 100 km of the coast or a navigable river in 1995 for the infrastructure variable. All variables are in logarithmic form.

(iii) OLS, ordinary least squares; 2SLS, two-stage least squares.

(iv) \*Significant at 10%; \*\*Significant at 5%; \*\*\*Significant at 1%.

In order to investigate this issue further, we follow Canning (1998) and the literature on economic geography, urban economics and the determinants of public investment in infrastructure. The equation to be tested is the following:

$$\begin{aligned}
 \ln(\text{Infrastructure}_i) = & \gamma_0 + \gamma_1 \ln(\text{Infrastructure\_aid\_pc}_i) + \gamma_2 \ln(\text{ODA\_pc}_i) \\
 & + \gamma_3 \ln(\text{Pop}_i) + \gamma_4 \ln\left(\frac{\text{GDP}_i}{\text{Pop}_i}\right) + \gamma_5(\text{area}_i) \\
 & + \gamma_6(\text{pop100km}_i) + \gamma_7(\text{land100km}_i) \\
 & + \gamma_8 \ln(\text{pop\_density}_i) + \gamma_9 \ln(\text{urbanisation}_i) \\
 & + \gamma_{10} \ln(\text{rule\_of\_law}_i) + n_i,
 \end{aligned} \tag{11}$$

where  $\gamma$  are the parameters to be estimated.

We use data averaged over the period 2002–07. The dependant variable is the same infrastructure index  $\text{Infrastructure}_i$  used in the previous analysis.  $\text{Infrastructure\_aid\_pc}_i$  is aid commitments for trade-related infrastructure *per capita*

in constant US\$ of 2000, averaged over the period 2002–07. In our analysis, we use aid commitments as the disbursements are not systematically reported by International Financial Institutions (IFI) in the CRS. This variable contains assistance for transport infrastructure, storage and communications (but not aid for the energy sector) in order to remain consistent with our infrastructure index. Finally, to test for the existence of a different effect of sectoral aid over total aid, we also include total ODA commitments *per capita* in constant US\$ of 2000,  $ODA_{pc_i}$ . The data come from the CRS database collected by the OECD.

Following Randolph et al. (1996), Canning (1998), Esfahani and Ramirez (2003) and Fay and Yepes (2003), we introduce the population  $Pop_i$  and GDP *per capita*  $(GDP_i)/Pop_i$  in order to control for demand effects and the cost of supply. The data are from the World Bank's WDI. We expect a positive influence of these two variables on our infrastructure index. Geography will be captured by two groups of variables related to the shape of a country and to urban economics (Straub, 2008). First, we control for network effects related to the shape of a country using the proportion of land area  $land100km_i$  and population  $pop100km_i$  within 100 km of the coast or a navigable river in 1995 and surface in  $km^2$   $area_i$ . Second, we try to capture economies of scale induced by networks using the average population density (population per  $km^2$ )  $pop\_density_i$  and the degree of urbanisation (the share of population in urban areas)  $urbanisation_i$ ; indeed, the costs of providing infrastructure in cities are lower. Also, Canning (1998) notes that the degree of urbanisation is a good proxy for the sectoral structure of production, since high values for this variable are associated with more manufacturing and less agricultural activities. Considering that the manufacture sector relies highly on infrastructure, we expect this relationship to be positive. Last but not least, we control for the quality of institutions, since Esfahani and Ramirez (2003) explain that production in infrastructure is highly capital intensive and potential investors are concerned about the possibilities of *ex post* expropriation of their quasi-rents through nationalisations or government investments. The institutional quality is approximated by the rule of law variable  $rule\_of\_law_i$  from the Polity IV database.

In order to address the endogeneity problem because of reverse causality, measurement error in the data or any remaining unobserved heterogeneity that may lead to omitted-variable bias, we choose to propose a new instrument for aid for infrastructure: the number of privatisation transactions in the infrastructure sector between 2000 and 2007. Indeed, we can expect a reverse causality problem as aid for infrastructure is almost certainly allocated towards countries that lag behind (Figure A3). The data were retrieved from the World Bank's Privatization Database.<sup>13</sup> This database contains data on the number and sale price of privatisation transactions of over US\$1 million, carried out in develop-

<sup>13</sup> <http://rru.worldbank.org/Privatization/>.

ing countries between 2000 and 2007. It only includes transactions that generated proceeds or monetary receipts for the government resulting from partial and full divestitures, concessions, management contracts and leases. Transactions in infrastructure include those in transportation, telecommunications, water and sewerage, natural gas transmission and distribution and electricity generation, transmission and distribution. To be coherent with our infrastructure index, we only rely on the number of transactions within the two first sectors. The data set covers 99 developing countries.

For the last 25 years, the importance of private investment in infrastructure has been extensively debated in both academic and political circles alike. If it were accepted historically that the supply of water, electricity, roads and telecommunications were solely a public sector responsibility, this view has largely evolved over the past two decades. Indeed, during the 1990s, supported by the very large number of colossal failures of states to deliver what were seen as public services, increased involvement by the private sector appeared to be the only answer, leaving only a residual role to the governments. Sadly, as it appears today, this sequence of quick deregulations and restructurings failed to provide the expected results. The most dramatic and well-known examples come from the Latin American experience in the 1990s. Today, the developing countries are struggling to compensate for this lack of investment in large-scale network expansions and/or in major maintenance of the existing networks that took place in the 1990s.

Nowadays, the public sector is once again seen as the major player in financing many of these expansion needs. Removing the dichotomous choice between public and private involvement, the public sector is now expected to retain an important financing role, while the private sector might bring better efficiency to supply and management. Furthermore, because of the high costs and limited capacity to pay by many of the users, the donor community is expected to be a central actor in the scaling-up of the public investment efforts, at least in the poorer countries (Eustache and Fay, 2007). Hence, privatisation transactions are often followed hand in hand by assistance directed towards sectors that were reformed.

Thus, we expect that the number of privatisation transactions explains the aid for infrastructure received without directly affecting our infrastructure indicator at the macro level. Indeed, today, most of the privatisations are limited in amount and firm sizes. The very important investments needed and the high levels of risk or insufficient returns often discourage large private promoters. In many countries, small providers are taking the lead in serving low-income households and dispersed populations in the rural and periurban areas where large-scale providers are unwilling to go. Furthermore, even if some of the ventures exhibit strong success in terms of coverage extension or efficiency, many privatisation attempts have also failed – mostly where the institutional

environment covering prices and the broader investment climate were not of a sufficient quality (Kenny, 2007). Thus, as demonstrated in the study by Andrés et al. (2008) for Latin America,<sup>14</sup> we do not expect to witness any impact of the number of privatisations at the aggregate level on the output and coverage of infrastructure. These assumptions seem to be corroborated by the lack of statistical correlation between the number of privatisations that took place between 2000 and 2007 and our infrastructure index. Indeed, the correlation coefficient appears to be very low (equal to  $-0.09$ ) and insignificant. Likewise, there are no significant correlations between the instrument and the percentage either of paved roads or of mobile and fixed line subscribers (both equal to  $-0.01$ ). However, there is a significant relationship between aid for infrastructure and the number of privatisation transactions.

Finally, it is important to remember that here again we had no choice but to rely on a cross-sectional analysis. First of all, aid data before 2002 do not have a good coverage ratio. Second, with this reduced time span reinforced by the inadequacy of using yearly panel estimation, it is at best unproductive to rely on GMM estimation techniques. Finally, putting aside data reliability issues, even if aid for infrastructure had existed for a long time, it is highly probable that the new paradigm of aid for trade of the 2000s would have changed the way infrastructure projects were formulated and implemented. Thus, by working on a longer time period, we might witness numerous structural changes in this relationship which could, in turn, blur our results.

### *b. Results*

The results from the estimation of equation (11) are shown in Table 4 using OLS and 2SLS. Across all specifications, once instrumented, the aid for infrastructure *per capita* variable *Infrastructure\_aid\_pc<sub>i</sub>* appears to have a positive and statistically significant effect on infrastructure. As before, we choose to introduce additional controls sequentially. For columns (2)–(5), our coefficient of interest remains remarkably stable both in magnitude and in significance. Indeed, column (5) suggests that an increase in 10 per cent in aid for infrastructure *per capita* leads to an increase in the quantity of infrastructure of 1 per cent. Results are highly significant at the 1 per cent level and robust to outliers (column 5).<sup>15</sup> Furthermore, our instrument seems to perform relatively

<sup>14</sup> Andrés et al. (2008) review the performance of 181 privatised firms in three sectors (telecommunications, electricity distribution, water and sewerage) across 15 Latin American countries. Controlling for existing pre-privatisation and transition-period trends, they conclude that overall there are no significant impacts on output and coverage. Their main conclusion is that regulation is clearly a multidimensional issue, with complex effects on the range of outcomes they analyse.

<sup>15</sup> Outliers are Jamaica, Burundi, Philippines, Sri Lanka, Rwanda, India, Mauritius and Bangladesh.

TABLE 4  
Aid for Infrastructure and Infrastructure

<i>Infrastructure Index</i>	(1)	(2)	(3)	(4)	(5)	(6)
	<i>OLS</i>	<i>2SLS</i>	<i>2SLS</i>	<i>2SLS</i>	<i>2SLS</i>	<i>2SLS</i>
<i>Infrastructure_aid_pc</i>	0.015 (0.018)	0.107 (0.047)**	0.110 (0.040)***	0.114 (0.042)***	0.102 (0.031)***	0.102 (0.036)***
<i>ODA_pc</i>	-0.057 (0.033)*	-0.197 (0.069)***	-0.190 (0.058)***	-0.193 (0.061)***	-0.180 (0.050)***	-0.157 (0.046)***
<i>Pop</i>	0.058 (0.023)**	0.043 (0.029)	0.382 (0.342)	0.339 (0.341)	0.150 (0.308)	0.366 (0.300)
<i>GDP/Pop</i>	0.181 (0.024)***	0.214 (0.026)***	0.171 (0.030)***	0.184 (0.033)***	0.153 (0.033)***	0.206 (0.049)***
<i>Lnd100km</i>	0.055 (0.094)	-0.126 (0.134)	0.541 (0.220)**	0.516 (0.226)**	0.386 (0.207)*	0.656 (0.227)***
<i>Area</i>	-0.116 (0.021)***	-0.132 (0.025)***	-0.460 (0.353)	-0.418 (0.351)	-0.225 (0.319)	-0.443 (0.309)
<i>Pop100km</i>			-0.653 (0.208)***	-0.632 (0.206)***	-0.593 (0.190)***	-0.766 (0.197)***
<i>Pop_density</i>			-0.319 (0.346)	-0.276 (0.345)	-0.097 (0.313)	-0.280 (0.306)
<i>Urbanisation</i>			0.136 (0.101)	0.126 (0.099)	0.212 (0.089)**	0.098 (0.100)
<i>Rule_of_law</i>				-0.052 (0.095)	-0.049 (0.088)	-0.006 (0.077)
Constant	-0.375 (0.417)	0.364 (0.691)	-0.028 (0.590)	-0.029 (0.602)	-0.207 (0.621)	-0.304 (0.554)
Observations	68	68	68	68	60	68
<i>R</i> -squared	0.77	0.61	0.65	0.64	0.65	0.64
First-stage <i>F</i> -stat for <i>Infrastructure_aid_pc</i>		9.22	8.97	8.59	15.40	10.79

Notes:

(i) Robust standard errors in parentheses. (ii) In column (5), eight outliers were dropped using the Hadi procedure (Jamaica, Burundi, Philippines, Sri Lanka, Rwanda, India, Mauritius, Bangladesh). (iii) Aid for infrastructure *per capita* is instrumented by the number of privatisations in the infrastructure sector between 2000 and 2007. (iv) All variables, except *Lnd100km* and *Pop100km*, are in logarithmic form.

(v) OLS, ordinary least squares; 2SLS, two-stage least squares.

(vi) \*Significant at 10%; \*\*Significant at 5%; \*\*\*Significant at 1%.

well. As can be seen in Table A3, the number of privatisation transactions has a positive and very significant impact on the logarithm of aid for infrastructure. The first-stage *F*-statistics are also in most cases very close to 10. Even if we cannot provide the statistic of the overidentification test, as we only have one instrument, these results tend clearly to confirm our theoretical predictions.

Regarding the other explanatory variables, *GDP per capita* ( $GDP_i$ )/ $Pop_i$  appears with a positive and statistically significant sign, suggesting that infrastructure supply increases with revenue. As Canning (1998) notes, geographical variables have the stronger explanatory power. The surface in  $km^2$   $area_i$  and the



proportion of population within 100 km of the coast or a navigable river in 1995  $pop100km_i$  are highly significant. The degree of urbanisation  $urbanisation_i$ , proxy for the cost of supply of infrastructure and for the manufacture sector, is also positive. The institutional variable  $rule\_of\_law_i$  does not appear to be a determinant of infrastructure.

Finally, we observe that assistance to infrastructure has a clearly different effect from total ODA *per capita*  $ODA\_pc_i$  on our dependent variable. In every specification, total ODA seems to have a fairly robust negative influence on the level of infrastructure. However, this result might almost certainly be due to the well-known reverse causality problem extensively documented and debated in the literature over the last decade. As a robustness check, we try to instrument total ODA by the voice and accountability variable from the Polity IV database (results upon request). In this special case, it turns out that the coefficient related to total ODA *per capita* loses its significance, whereas the results for the other variables remain the same.

As an additional robustness check, we run the same regression (11) by using aid disbursements instead of commitments (column 6, Table 4). These results need to be considered with caution because, as explained earlier, IFI do not report their disbursements to the CRS. Nevertheless, the aid for infrastructure variable still appears positive and highly significant.

## 6. CONCLUDING REMARKS

The actual slow down of multilateral talks has highlighted the relevance of trade facilitation measures as a complementary economic policy for developing countries. Indeed, recent empirical studies confirm that benefits from a reduction in internal trade costs can be as large as a tariff reduction within the Doha Round (Ikenson, 2008; Hoekman and Nicita, 2010, 2011).

Nevertheless, despite the attractiveness of the aid for trade initiative for policymakers, there is only scarce evidence on the effectiveness of such assistance. We fill this gap by proposing a two-step analysis that allows us to disentangle the channel by which aid for trade enhances export performance. Our results indicate that a 10 per cent increase in aid for infrastructure commitments leads to an average increase in the exports over GDP ratio of an aid recipient of 2.34 per cent.<sup>16</sup> Accordingly, considering the coefficient of the MA-OTRI variable in Table 2 for our preferred specification, it is also equivalent to a 2.71 per

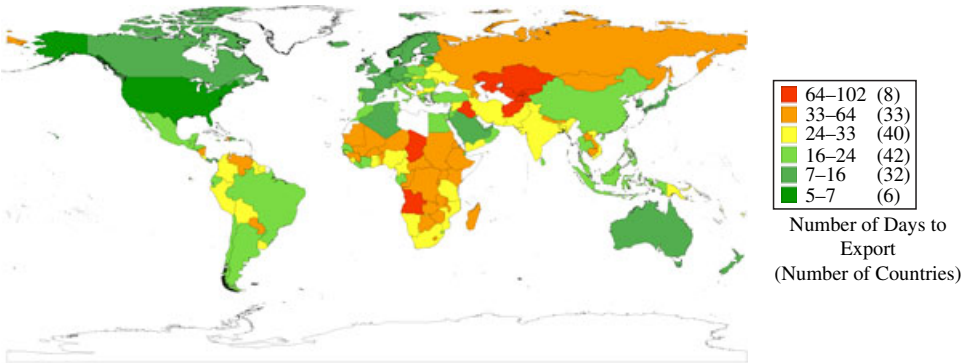
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<sup>16</sup> We observed in Table 2, column (5) that an increase in 10 per cent of the infrastructure index leads to an average increase of 10.7 per cent in export performance. Furthermore, an increase in 10 per cent in aid for infrastructure commitments leads to an average increase in the infrastructure index of 1.14 per cent (Table 4, column 5).

cent reduction in the tariff and nontariff barriers. This highlights the very high economic impact throughout the channel of infrastructure. Thus, our analysis seems to support the view that aid for trade might be a powerful instrument for assisting developing countries in their attempt to enhance export performance and integration into the global economy, while the multilateral talks within the Doha Round linger on.

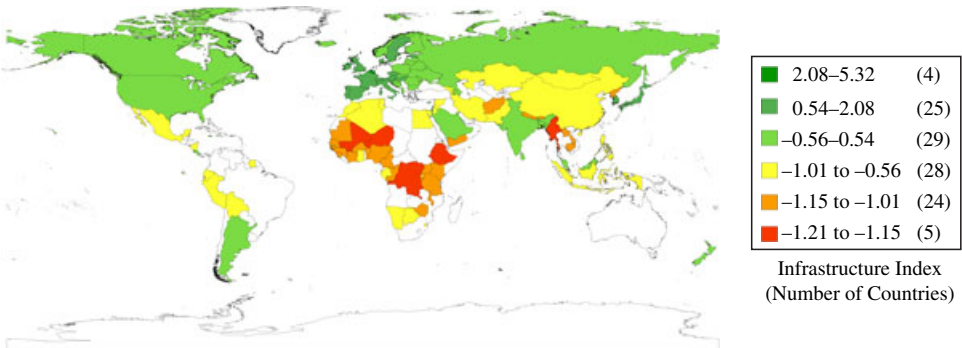
APPENDIX

FIGURE A1  
Number of Days to Export (2005–07)



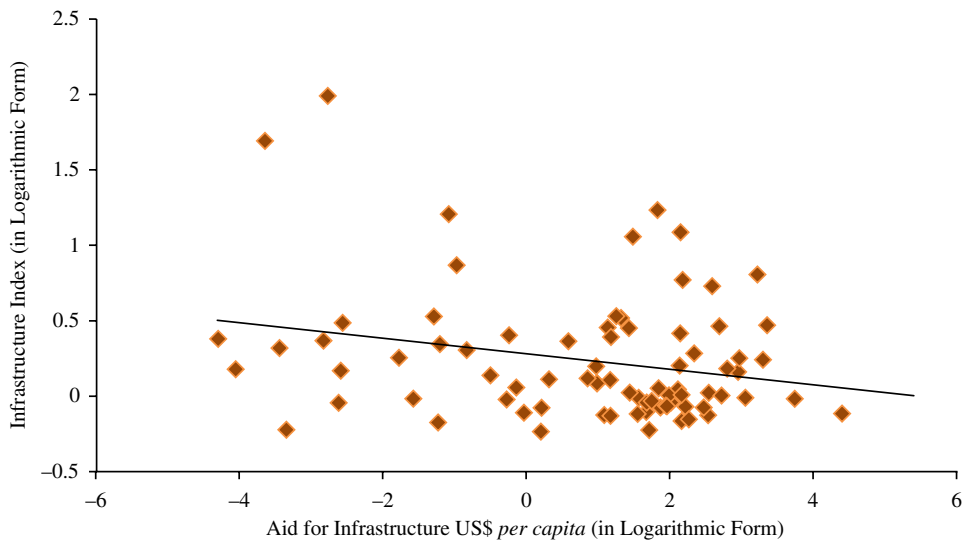
Source: Authors' calculations.

FIGURE A2  
Infrastructure Index (2002–07)



Source: Authors' calculations.

FIGURE A3  
Correlation Between Infrastructure and Aid for Infrastructure (2002–07)



Source: Authors' calculations.

FIGURE A4  
Correlation Between Number of Days to Export and Aid for Trade-related Institutions (2002–07)



Source: Authors' calculations.

TABLE A1  
Instrumentation of Equation (10b)

	(1)	(2)
	<i>Infrastructure</i>	<i>Time</i>
<i>GDP/Pop</i>	0.199 (0.021)***	-0.187 (0.037)***
<i>Pop</i>	0.013 (0.015)	-0.013 (0.022)
<i>MA-OTRI</i>	0.109 (0.088)	0.103 (0.121)
<i>Lnd100km</i>	0.004 (0.001)***	-0.001 (0.001)
Documents	-0.133 (0.099)	0.698 (0.227)***
Constant	-0.972 (0.389)**	3.697 (0.845)***
Observations	91	91
<i>R</i> -squared	0.84	0.76

Notes:

(i) Robust standard errors in parentheses. (ii) All variables except *Lnd100km* are in logarithmic form.

(iii) \*\*Significant at 5%; \*\*\*Significant at 1%.

TABLE A2  
Robustness on Exports over GDP Ratio

<i>Exports (Without Oil and Minerals)/GDP</i>	(1)	(2)	(3)
	<i>2SLS</i>	<i>2SLS</i>	<i>2SLS</i>
<i>Infrastructure</i>	1.884 (0.372)***	1.332 (0.279)***	1.627 (0.336)***
<i>Customs_Lpi</i>	-0.640 (1.003)		
<i>Icrg_corrupt</i>		-0.183 (0.345)	
<i>Pol4_corrupt</i>			-0.748 (0.734)
<i>GDP/Pop</i>	-0.363 (0.145)**	-0.269 (0.113)**	-0.224 (0.183)
<i>Pop</i>	-0.132 (0.061)**	-0.168 (0.041)***	-0.173 (0.045)***
<i>MA-OTRI</i>	-0.845 (0.291)***	-0.642 (0.296)**	-0.765 (0.301)**
<i>Volat</i>	-0.166 (1.454)	0.050 (0.574)	0.247 (0.151)
Constant	5.972 (1.194)***	6.144 (0.842)***	5.903 (0.871)***
Observations	71	69	76

Table A2 *Continued*

<i>Exports (Without Oil and Minerals)/GDP</i>	(1)	(2)	(3)
	2SLS	2SLS	2SLS
<i>R</i> -squared	0.10	0.28	0.13
First-stage <i>F</i> -stat for infra	36.31	45.75	43.72
First-stage <i>F</i> -stat for institutions	9.73	4.52	4.94
Outliers (HADI)	Guinea Zimbabwe	Guinea Zimbabwe	Guinea Zimbabwe

Notes:

(i) Robust standard errors in parentheses. Instruments for institutions variables in columns (1) (2) and (3) are four dummy variables for French, English, German and Scandinavian legal origins as in the study by La Porta et al. (1999).

(ii) 2SLS, two-stage least squares.

(iii) \*\*Significant at 5%; \*\*\*Significant at 1%.

TABLE A3  
Instrumentation of Equation (11)

	<i>Infrastructure_aid_pc</i>
<i>ODA_pc</i>	1.436 (0.261)***
<i>Pop</i>	-0.862 (2.671)
<i>GDP/Pop</i>	-0.308 (0.247)
<i>Lnd100km</i>	1.214 (1.508)
<i>Area</i>	1.072 (2.752)
<i>Pop100km</i>	0.773 (1.464)
<i>Pop_density</i>	0.787 (2.672)
<i>Urbanisation</i>	-0.841 (0.580)
<i>Rule_of_law</i>	1.070 (0.689)
<i>Privatisations_00_07</i>	0.019 (0.006)***
Constant	-3.301 (4.290)
Observations	68
<i>R</i> -squared	0.71

Notes:

(i) Robust standard errors in parentheses. All variables except instruments are in logarithmic form except *Privatisations\_00\_07*.

(ii) \*\*\*Significant at 1%.

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