Aide au commerce et intégration: nouvelles perspectives pour les pays en développement

Mariana M. Vijil

RÉSUMÉ

Le lancement de l'initiative Aide au Commerce (AaC) en 2005 suscita un fort intérêt quant à sa capacité à améliorer l'insertion des pays en voie de développement (PVD) dans le commerce mondial. Au travers de cinq essais, cette dissertation vise à proposer de nouvelles perspectives en matière d'intégration aux échanges et d'efficacité de l'AaC. Un nouvel indicateur d'intégration est proposé, composé de plusieurs dimensions telles que l'ouverture, la diversification, la variété, la qualité et la performance. Le manque d'infrastructures est identifié comme un des principaux obstacles à l'insertion au commerce, justifiant une augmentation de l'aide envers ce secteur. Par la suite, le lien de causalité entre l'ouverture aux échanges et la croissance est revisité en intégrant, en plus du ratio d'ouverture, la qualité et la variété des exportations. Les résultats mettent en évidence une relation non-linéaire, soulignant l'intérêt de poursuivre des stratégies de diversification et d'augmentation de la qualité des exportations pour les PVD. L'efficacité de l'AaC est par la suite testée sur la performance à l'exportation. Les résultats indiquent que ce soutien est efficace et que l'impact transite au travers des infrastructures. Finalement, un lien de complémentarité entre l'AaC et les accords commerciaux préférentiels est mit en évidence au travers d'un modèle de gravité, indiquant que l'AaC est d'autant plus efficace que le pays receveur partage un certain degré d'intégration avec ses partenaires.

ABSTRACT

The launch of the Aid for Trade (AfT) initiative in 2005 created high expectations as regards to its capacity to enhance developing countries' trade integration. This dissertation is an attempt to provide new perspectives on trade integration and AfT effectiveness through five essays. Firstly, a new trade indicator is proposed that combines different dimensions, including concepts such as openness, diversification, variety, quality and performance. A lack of infrastructure is identified as an obstacle for increasing such integration, suggesting that assistance towards this sector is needed. Then, the causality between trade openness and growth is revisited taking into account, besides the usual trade ratio, the quality and the variety of exports. Evidence suggests that this relationship is not linear and that improving the quality and widening the variety of exports is crucial for developing countries; investments that can be provided through AfT. Accordingly, the effectiveness of such assistance as regards to trade performance is tested. Estimates indicate that it does enhance export performance, and that the impact transits via the infrastructure channel. Finally, looking for complementarities between AfT and preferential trade agreements using a gravity model, results indicate that aid effectiveness is improved when the recipient shares some level of economic integration with his partners.

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Aide au commerce et intégration : nouvelles perspectives pour les pays en développement

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CONTENTS

TABLES AND FIGURES

INTRODUCTION

Au début des années 1960, la perspective selon laquelle les flux d'échanges internationaux, en croissance rapide, ne seraient jamais dépassés par les flux d'Aide Publique au Développement (APD) donna naissance au slogan défendu par de nombreux pays en développement : « du commerce et non de l'aide ». Encouragé par le décollage économique observé dans les pays d'Asie de l'Est qui menaient alors une stratégie de développement tournée vers l'extérieur, cet appel fut lancé dans un contexte où l'ouverture aux échanges était considérée comme le principal déterminant du développement économique, contrairement à l'aide qui souffrait déjà de nombreuses critiques concernant son efficacité. Dès lors, le débat académique porta principalement sur l'identification d'une stratégie optimale pour les donateurs vis-à-vis des deux instruments de développement à disposition, à savoir, une augmentation de l'aide publique au développement et une promotion des échanges internationaux, l'objectif final étant l'augmentation du bien-être dans les pays bénéficiaires. Cette réflexion donna naissance au Système généralisé des préférences en 1971, initiative selon laquelle les pays développés accordaient un accès préférentiel et unilatéral de marché aux importations en provenance des pays en développement. Cette époque fut également marquée par une participation accrue des pays en développement dans le système commercial multilatéral.

L'entrée en vigueur des dispositions du Cycle d'Uruguay en 1995 marqua un tournant dans la relation de substituabilité persistant entre l'aide et l'accès au marché. En effet, les pays en développement réalisèrent que l'extension des règles du commerce international à des sujets tels que les droits de propriété intellectuelle ou la facilitation des échanges impliquait des coûts difficiles à surmonter. Des travaux empiriques commençaient également à démontrer que certains pays, notamment les économies les moins avancées, se trouvaient dans l'incapacité de saisir les opportunités offertes par des accès préférentiels de marché, du fait de l'existence d'obstacles internes au commerce. Un changement majeur s'opéra alors dans la notion de substituabilité entre l'aide et l'accès au marché : la logique évolua de «du commerce et non de l'aide » vers la notion « d'aide pour le commerce ». Le lancement de l'Initiative Aide pour le Commerce lors de la Conférence ministérielle de Hong Kong de l'Organisation Mondiale du Commerce (OMC) en 2005 fut l'apogée de ce débat. A cette occasion, les membres œuvrèrent pour une augmentation des flux d'assistance pour le commerce de manière à «aider les pays en développement, en particulier les pays les moins avancés, à se doter de la capacité du côté de l'offre et de l'infrastructure liée au commerce dont ils ont besoin pour […] mettre en œuvre les Accords de l'OMC et en tirer profit et, plus généralement, pour accroître leur commerce». Ils déclarèrent également que cette augmentation de l'aide « ne peut pas se substituer aux avantages en matière de développement qui résulteront d'une conclusion positive du Programme de Doha pour le développement, en particulier sur l'accès aux marchés». De nos jours, cette notion d'aide qui va de pair avec le commerce influence également la libéralisation des échanges au niveau bilatéral, étant donné que les accords de libre échange Nord-Sud incluent de plus en plus de dispositions en matière d'aide pour le commerce dans leurs agendas de négociation.

La déclaration ministérielle de 2005 s'est suivie d' une augmentation des flux d'aide publique au développement alloués aux différents secteurs en lien avec les échanges internationaux, notamment sous forme d'aide aux institutions et aux infrastructures liées aux échanges, au renforcement des capacités productives et à la couverture des coûts d'ajustements engendrés par la libéralisation. Ensemble, ces flux ont représenté 40 milliards de dollars et 33 % de l'aide sectorielle en 2009. Ainsi, en tant que partie intégrante de l'aide publique au développement, l'aide pour le commerce a toujours existé an tant que telle. Cependant, le débat politique autour de cette nouvelle initiative a encouragé une augmentation de ses flux et a généré d'importantes attentes autour de son efficacité. Le débat a également soulevé de nombreuses interrogations, notamment vis-à-vis du lien entre l'aide pour le commerce et la réduction de la

pauvreté, cette dernière étant le but ultime de toute intervention d'aide publique au développement.

En effet, la réduction de la pauvreté reste, depuis les années 1990, l'objectif principal de l'aide publique au développement. Par conséquent, une allocation de l'aide vers les secteurs sociaux devint la priorité, telle qu'illustrée par la réduction continue de la part de l'aide pour le commerce dans le total de l'aide jusqu'en 2006. De plus, l'arrivée du concept de gestion axée sur les résultats dans les stratégies de développement, conduisant à l'adoption des Objectifs du Millénaire pour le Développement en 2000, justifia davantage de concentrer les efforts d'action envers les secteurs sociaux qui étaient alors jugés prioritaires. Néanmoins, avec l'évolution de la mesure de l'efficacité de l'aide au milieu des années 2000, passant d'une vision axée sur un objectif final (la réduction de la pauvreté) vers une vision axée sur des objectifs intermédiaires (la croissance durable), les cibles intermédiaires telles que l'augmentation des exportations et leur diversification prirent de l'importance. La communauté internationale augmenta alors les flux d'aide publique au développement destinés aux secteurs en lien avec les échanges internationaux.

S'intéresser à l'aide pour le commerce implique de considérer l'ouverture aux échanges comme un des déterminants, sinon le déterminant majeur, de la croissance économique. Or, à la fin des années 1990, deux autres potentiels déterminants profonds du développement avaient été identifiés par la littérature académique, à savoir, la géographie et les institutions. D'ailleurs, les travaux mettant en avant l'importance de ce dernier facteur gagnèrent rapidement en crédibilité au sein de la communauté des bailleurs, allant même jusqu'à influencer leurs priorités en termes d'allocation de l'aide publique au développement. Les conclusions défendues par ce courant institutionnaliste reposaient cependant sur une stratégie empirique souffrant de deux principales limites. D'une part, la manière dont l'ouverture aux échanges était mesurée ne faisait guère l'objet d'un consensus dans le milieu académique. D'autre part, le biais d'endogénéité liée au problème de causalité inverse et de variables omises pouvant persister entre l'ouverture aux échanges et la croissance économique n'était pas correctement traité par les stratégies empiriques.

Enfin, la pénurie de ressources publiques induite par la récente crise financière provoqua une contraction des budgets d'aide publique au développement chez les bailleurs de fonds. En outre, les contribuables exigent désormais de plus en plus de preuves substantielles concernant

l'efficacité de cette dépense. Or, les économistes peinent à produire des preuves solides et convaincantes de l'existence d'un lien positif et significatif entre l'aide et la croissance économique, notamment du fait de difficultés techniques liées au problème de simultanéité et d'hétérogénéité des instruments de l'aide aussi bien que de leurs cibles à atteindre. De ce fait, afin de contourner les difficultés inhérentes à l'étude de la relation entre l'aide et la croissance, les chercheurs ont récemment identifié une nouvelle démarche, à savoir, analyser l'impact de l'aide sectorielle (l'aide pour le commerce) sur des cibles plus étroites (la performance commerciale).

Dans ce contexte, cette thèse vise à proposer de nouvelles perspectives sur l'analyse de l'insertion aux échanges comme stratégie de développement et d'alimenter la littérature naissante sur l'efficacité de l'aide pour le commerce. Ses cinq chapitres peuvent être rassemblés en deux parties distinctes s'intéressant, d'une part, aux problèmes liés à la mesure de l'insertion aux échanges internationaux et à sa relation avec la croissance économique et d'autre part, à l'efficacité de l'aide pour le commerce. Les cadres théoriques sur lesquels reposent les différentes analyses sont empruntés à la théorie de la croissance endogène et à la nouvelle économie internationale. Une attention toute particulière est portée au traitement de l'endogénéité à l'aide de techniques économétriques innovantes.

La première partie de la thèse vise à caractériser le positionnement des pays en développement sur les marchés internationaux, mettant en avant les principaux obstacles aux échanges et revisitant par la suite le lien entre ouverture aux échanges et croissance économique. Dans le premier chapitre, un nouvel indicateur d'ouverture aux échanges est proposé, construit à l'aide de méthodes statistiques de classification. Cet indicateur a la particularité de prendre en compte l'aspect multidimensionnel de l'intégration: une plus grande ouverture au commerce, une augmentation de la marge extensive des exportations et des importations, un accroissement de la valeur ajoutée des produits exportés et une amélioration de la compétitivité des exportations et de la performance à l'importation. En s'inspirant des développements récents de la théorie du commerce international, ces dimensions ont été choisies compte-tenu de leur importance pour le développement économique. Les principaux obstacles à l'amélioration de cette insertion sont ensuite identifiés. En ce sens, les résultats mettent en évidence l'importance des investissements en matière d'infrastructures et de l'accès au marché afin d'améliorer la participation des pays dans le commerce international. Or, ces facteurs peuvent faire l'objet d'une amélioration au travers d'instruments de développement déjà existants, à savoir, l'aide pour le commerce et l'ouverture préférentielle de marché.

A partir d'un modèle de croissance endogène, la relation entre l'ouverture aux échanges et la croissance économique est ensuite analysée dans un deuxième chapitre. Outre le traditionnel ratio des exportations sur le produit intérieur brut, deux dimensions additionnelles de l'insertion aux échanges sont considérées, à savoir, la qualité et la variété des exportations. Les résultats tendent à montrer que les pays exportant des produits de meilleure qualité croissent plus rapidement, mais surtout, d'intéressantes non-linéarités sont mises en évidence. Ainsi, une forte dépendance de l'économie envers le commerce international peut engendrer un ralentissement de la croissance si le pays en question est spécialisé dans l'exportation de produits de faible qualité. De même, certaines complémentarités entre la variété de produits exportés et la dépendance vis-à-vis des échanges internationaux semblent expliquer les niveaux de croissance observés dans les pays en développement. Ces résultats appellent à une plus grande diversification des exportations et à une amélioration de la qualité du panier exporté, si les pays en développement envisagent de poursuivre une stratégie de croissance tournée vers l'extérieur.

La première partie de cette thèse se concentre ainsi sur des perspectives d'amélioration de la mesure de l'insertion aux échanges ainsi que sur certaines caractéristiques du commerce international susceptibles d'accélérer la croissance. La seconde partie de ce travail vise quant à elle à mesurer l'efficacité de l'aide pour le commerce vis-à-vis de son impact sur des indicateurs de performance commerciale. En effet, un des principaux constats mis en lumière dans le premier chapitre est la similitude des obstacles rencontrés par des pays partageant un faible niveau d'insertion aux échanges. Or, certains de ces obstacles peuvent être ciblés par de l'aide pour le commerce.

Ainsi, la seconde partie de cette thèse vise à mesurer l'efficacité de l'aide pour le commerce au travers de trois chapitres. Un des chapitres propose d'analyser l'étendue de la connaissance sur l'aide pour le commerce, notamment au travers d'un passage en revue des principaux faits stylisés et d'une sélection d'études empiriques s'intéressant à l'impact de l'aide pour le commerce sur la performance à l'exportation des pays receveurs. Parmi les principales conclusions, davantage d'études empiriques semblent nécessaires afin d'approfondir la compréhension de l'aide pour le commerce et de pouvoir identifier les moyens susceptibles d'améliorer son efficacité.

En effet, peu d'études empiriques s'intéressent à l'efficacité de l'aide pour le commerce vis-à-vis de la performance commerciale. Par ailleurs, les travaux existants ne testent pas les canaux de transmission via lesquels cet impact transite. Le chapitre quatre s'intéresse à cette question au travers d'une approche empirique en deux étapes. En se basant sur un modèle de performance à l'exportation, il convient tout d'abord de vérifier que les institutions et les infrastructures, les deux principaux canaux de transmission, sont des déterminants significatifs de la performance à l'exportation. L'impact des flux d'aide pour le commerce sur ces déterminants est ensuite mesuré. Concernant la première étape, les résultats suggèrent que le canal des infrastructures est un déterminant très significatif de la performance à l'exportation alors que le canal institutionnel ne semble avoir qu'un impact limité. Concernant la deuxième étape du raisonnement, l'aide aux infrastructures améliore de manière significative le niveau des infrastructures. Ainsi, une augmentation de 10 % des engagements par habitant en matière d'aide aux infrastructures dans les pays en développement conduirait à une augmentation moyenne de 2,34 % du ratio des exportations sur le produit intérieur brut. Ceci serait équivalent à une réduction de 2,71 % des barrières tarifaires et non-tarifaires. Ces résultats mettent en lumière l'impact potentiellement très important de l'aide pour le commerce sur la performance à l'exportation des pays en développement, au travers du canal des infrastructures.

Les pays en développement commencent à utiliser l'intégration bilatérale et régionale comme principal instrument d'ouverture aux échanges. Or, les accords de libre-échange d'aujourd'hui tendent à couvrir des questions qui vont au-delà de la politique commerciale traditionnelle, tels que des engagements en matière de facilitation des échanges. De ce fait, le dernier chapitre de cette thèse s'intéresse à la complémentarité entre l'aide pour le commerce et les accords préférentiels. Cette question est analysée à l'aide d'un modèle de gravité. Les résultats indiquent que l'aide pour le commerce est efficace en termes d'augmentation des flux d'échanges lorsqu'elle est combinée à de l'intégration économique, aussi bien pour les relations commerciales Sud-Sud que pour les relations Nord-Sud. En ce sens, les résultats suggèrent que la combinaison de l'aide pour le commerce et de l'accès préférentiel de marché a été particulièrement efficace pour accroître les exportations des pays en développement vers les pays industrialisés. De plus, une analyse des différentes catégories d'aide pour le commerce indique que l'aide aux institutions liées au commerce est susceptible de générer le plus fort supplément d'échanges lorsqu'elle s'accompagne d'une intégration économique.

In the early 1960s' "trade, not aid" was emerging as a popular slogan among developing countries. The rationale behind this was that trade revenues were increasing dramatically and could never be surpassed by Official Development Assistance (ODA) flows. Supported by the take-off of East-Asian countries that were conducting an outward-oriented development strategy, trade started to be considered as the main determinant of development while aid was already suffering from early critiques on its effectiveness. Thus, the academic debate focused mainly on finding the optimal donor assistance strategy between these two development instruments for enhancing welfare in developing countries. This period gave birth to the generalized system of preferences in 1971, whereby developed economies granted improved market access to exports from developing countries; and many developing countries started to become full participants of the multilateral trading system.

The Uruguay Round coming into effect in 1995 marked a turning point on this common belief that aid and trade were substitutes, as developing economies realized that the extension of international rules to new areas such as intellectual property rights and custom administration had high costs of compliance they could not face. Empirical evidence also suggested that some countries, specifically the least developed ones[1], were unable to take advantage of the increased market access due to internal obstacles to trade. The logic evolved thus from "trade, not aid" to "aid for trade" and the launch of the Aid for Trade (AfT thereafter) initiative at the World Trade Organization (WTO) Hong Kong Ministerial Conference in 2005 is the pinnacle of this debate; trade ministers called for an expansion of AfT to "help developing countries, particularly LDCs, to build the supply-side capacity and trade-related infrastructure that they need to implement and benefit from WTO Agreements and more broadly to expand their trade". They also declared that this increase in assistance couldn't be a "substitute for the development benefits that will result from a successful conclusion to the Doha Development Agenda, particularly on market access". Today, this philosophy has also spread to bilateral negotiations, as North-South preferential trade agreements are increasingly including trade-related assistance in their negotiation agenda.

This declaration resulted in an increase in ODA flows directed towards trade-related sectors; namely, trade policy and regulations, economic infrastructure, building productive capacity and trade-related adjustment. Together, these flows represented around 40 billion USD in 2009 and 33 per cent of overall sector allocable ODA. Thus, as part of foreign development assistance, AfT has always existed per se; but the political debate around the initiative fuelled an increase in aid flows and shed light on their high potential impact. However, the intense political

[1] The Least Developed Countries (LDCs) is a group of countries sharing a common handicap in terms of poverty, lack of human capital and a high economic vulnerability. This category comes from the United-Nations.

expectations around AfT still face numerous interrogations regarding principally the link between AfT and the actual ultimate goal of poverty reduction.

Indeed, poverty reduction has been the most important target of aid since the 1990s' and aid allocation has been biased toward social sectors since then (the share of AfT in total allocable ODA has been decreasing until 2006). The implementation of the management for results approach in the development sector, leading to the adoption of the Millennium Development Goals in 2000, justified even more to concentrate ODA efforts in those social priorities. However, as the assessment of the aid effectiveness within this management approach evolved from focusing on a final outcome (i.e. poverty reduction) to intermediate outcomes (e.g. sustainable growth) by mid-2000s', intermediate targets such as increased exports and diversification started to receive greater interest among the development community, thus advocating for an increase in ODA flows towards trade-related sectors.

Calling for a rise in AfT implicitly assumes that trade openness is a determinant, if not the main one, of economic growth. Yet, by the end of the 1990s two other factors, namely institutions and geography, were also pointed out by academicals as the real deep determinants of development; and the former was particularly gaining credibility among donors, influencing their priorities in terms of aid allocation across sectors. Nevertheless, this debate was based on empirical evidence suffering from, at least, two serious shortcomings: the way trade openness was measured and the treatment of endogeneity, related to the potential double causality between trade and growth and the omitted variable bias.

Finally, the scarcity of public resources following the financial crisis has led to a squeeze of donors' budget allocated to ODA and today, tax-payers are increasingly calling for substantial proofs of its effectiveness. While the rationale for the idea that developing countries benefit from aid is quite straightforward, the empirical evidence has failed to provide so far strong and convincing results that foreign assistance has a positive and significant impact on growth, mainly due to technical difficulties linked to simultaneity concerns or to the heterogeneity of aid instruments and targets. In order to avoid these caveats in the aid-growth nexus, the research community recently pointed out that focusing on the impact of sectoral aid (e.g. AfT) on narrower targets (e.g. trade performance) may be the way to go for assessing the effectiveness of ODA.

Those changes of development policy call thus for further evidence on the impact of AfT on trade-related targets and on the capacity of trade to enhance growth in developing countries. Within this context, this dissertation is an attempt to provide new perspectives on trade

integration as a development strategy and to contribute to the scarce evidence in the AfT effectiveness literature through five essays. The five chapters can be clustered in two distinct parts, addressing respectively issues related to the measurement of trade integration and its relationship with growth, and to the efficacy of trade-related assistance as regards to trade performance. Theoretical frameworks supporting the analysis are borrowed from the endogenous growth theory and from the new international economics. A special attention is given to the treatment of endogeneity through all chapters by using state of the art econometrical techniques.

The first part of the dissertation focuses on characterizing the positioning of developing countries in international markets, highlighting the main constraints to trade and reassessing the link between trade openness and economic growth. In the first chapter, using statistical classification techniques, a new openness indicator is proposed that takes into account a multidimensional aspect of trade integration: a greater openness to trade, an increase in the extensive margin of exports and imports, an enhancement of the value-added exported and an increase in the export competitiveness and the import performance. Following the recent developments in trade theory, these trade dimensions were chosen according to their relevance for development. Thereafter, the main obstacles to trade integration are revealed. Results suggest that further investment in infrastructure and additional market access is crucial, factors that can be addressed by existing development instruments; namely AfT and preferential market access.

Following previous results on how to improve the measurement of trade integration, the link between trade openness and growth is reassessed in the second chapter with an endogenous growth model including, besides the traditional exports over Gross Domestic Product (GDP) ratio, two additional dimensions of countries' trade integration: the quality and the variety of exports. Results confirm that countries exporting higher quality products grow more rapidly. More importantly, interesting non-linearities are revealed, suggesting that a high dependency of the economy on trade may impact growth negatively if countries are specialized in low quality exports. Also, there seems to be some complementarities between the trade dependency and the exported variety for developing countries. These results call for an export diversification and export quality upgrading strategy for developing economies if trade openness is to be pursued.

As the first part of this dissertation focus on how to improve the measurement of trade integration and which kind of trade features raise growth, the second part turns to measuring the effectiveness of AfT in terms of trade performance. Indeed, an interesting finding previously highlighted is that countries with a low level of trade integration in the world economy also share common obstacles to trade, some of them actually addressed by trade-related assistance.

Thus, through three chapters, the second part of this dissertation deals with AfT efficacy. The third chapter provides an overview of what we currently know about Aid for Trade and proposes a selected survey of empirical studies quantifying the impact of trade assistance on recipient countries' trade performance. One of the features highlighted is that more empirical evidence is needed in view of better understanding and assessing AfT's impacts and increasing its effectiveness.

Indeed, there are few empirical studies estimating the effectiveness of AfT as regards trade performance. Furthermore, existing work does not test which are the channels through which the impact transits. Chapter four addresses this question by using a two-step empirical analysis. Relying on an export performance model, whether institutions and infrastructure, the two potential channels of transmission, are significant determinants of export performance is tested. Secondly, the impact of AfT sectoral flows on the previously detected determinants of export performance is measured. As part of the first step, results suggest that the infrastructure channel is a highly significant determinant of export performance whereas the institutional channel turns out to have a limited positive impact. Furthermore, from the second step, aid for infrastructure has a strong and positive effect on the infrastructure level. As a result, a 10 per cent increase in aid to infrastructure commitments per capita in developing countries leads to an average 2.34 per cent increase in the exports over GDP ratio. It is also equivalent to a 2.71 per cent reduction in tariff and non-tariff barriers. These results highlight the high potential impact of AfT on developing countries' export performance through the infrastructure channel.

Finally, as developing countries have recently started using bilateral and regional integration as one of the main tools when pursuing a trade-led growth strategy; and that today, modern Preferential Trade Agreements (PTAs) tend to cover trade facilitation issues, the last chapter test whether complementarities exist between AfT and PTAs. This question is addressed with a gravity model; results tend to indicate that AfT has been effective in increasing trade flows when combined with economic integration. Both South-South and North-South trade have benefited from these complementarities; and the combination of AfT and preferential market access has been particularly successful in enhancing developing countries' exports to the North. Also, breaking down AfT into categories, evidence suggests that assistance to trade-related institutions seems to generate the strongest complementarities with economic integration.

PART I: TRADE INTEGRATION: NEW PERSPECTIVES ON THE MEASUREMENT ISSUE

Chapter 1: Developing Countries Integration in International Trade: Measurements and Determinants

1. Introduction

In the empirical literature it has been demonstrated that trade can be a powerful engine to enhance economic development and poverty reduction (Sachs and Warner, 1995; Frankel and Romer, 1999; Dollar and Kraay, 2004; Winters *et al.,* 2004). Thus, outward-oriented growth has been a popular development strategy within low income countries since structural adjustments plans. Nevertheless, as Brun *et al.* (2005) noted, evidence is consistent with the claim that poor countries have been marginalized by the recent wave of globalization. Also, the share of the poorest developing countries in global trade has not increased.

Therefore, the development dimension has become the main issue within the Doha Round multilateral negotiations at the World Trade Organisation (WTO). The aim is to re-equilibrate trade rules in favour of developing countries needs, to reinforce their participation in international trade and to make them fully benefit from trade liberalisation. Considering its impacts on development, these questions are particularly important as regards the achievement of the anti-poverty Millenium Development Goals by 2015.

Thus, there is a need to increase developing countries trade integration. In this respect, two development instruments have been widely used by the international community: preferential trade schemes accorded by industrialized partners and aid for trade. Nowadays, evidence suggests that the combination of these two policies is essential. Indeed, market access seems not enough for some countries facing internal obstacles to trade, as a lack of knowledge, excessive red tape, insufficient financing and poor infrastructure (Hoekman and Nicita, 2008; Portugal-Perez and Wilson, 2008; Huchet-Bourdon *et al.*, 2009). However, before analyzing the impact of these two development instruments on trade integration, there is a need to define the exact objective that these instruments aim to achieve.

Actually, international market participation is a multidimensional concept that can translate into different outputs: a greater openness to trade, an increase in the intensive or the extensive margin of exports and imports, a rise in the value-added exported or an increase in export competitiveness or import performance. We are not considering here other features more related to a broader concept of openness, like distortive economic policies in the vein of trade-related policy variables. Indeed, we believe that the latter are instruments for trade integration and not a measure of it. Thus, we will focus exclusively on quantitative trade outputs.

This objective follows the evidence that international trade raises income (Frankel and Romer, 1999; Irwin and Tervio, 2002; Noguer and Siscart, 2005; Feenstra and Kee, 2008; Freund and Bolaki, 2008; Kee *et al.* 2009) and that different kind of improvements in international trade indicators will have different impacts on development. Indeed, an increase in the extensive margin of trade does not have the same effect as an increase in the volume of existing flows. Thus, measuring trade openness by a dependency ratio ($\frac{X+M}{GDP}$), as it is usually done in the literature on trade and growth, appears as a reductive approach. Our goal is then to build within a unique framework a snapshot of the position of each country in each of these dimensions of international trade in order to have a broader concept of trade integration.

In that matter, we rely on the well known openness ratio, on an export concentration index, on the extensive margin of trade, on an export quality indicator and on a trade performance measure. As far as we know, the study of all these dimensions of trade integration within a single framework has never been done[2]. Furthermore, some important aspects on this

[2] Note that this question differs from the well know debate on trade-policy measures. We do not attempt to analyse countries in terms of their political-induced trade integration. In that matter, there is an abundant debate that has been summarized in Rodriguez and Rodrik (2001), which refers to the work of Sachs and Warner (1995), Harrison (1996), Pritchett (1996) and Edwards (1998) attempts to confront diverse trade-policy indicators in order to asses if lower policy-induced barriers to international trade are desirables.

concept, like export and import performance using constant market shares techniques, have been largely under-considered by researchers.

An analysis of the different dimensions of trade integration presented above in a single framework can easily reveal country priorities. In fact, the extensive empirical literature on trade costs (Wilson *et al.*, 2003) offers us a variety of obstacles potentially explaining the level of trade integration observed by each country group. Thus, a classification of developing countries using the indicators cited above can reveal homogeneous groups that also share similar obstacles to trade, like a distortive trade and economic policy, unfavorable geographic characteristics or a lack of institutions and infrastructures. Because a major part of these costs can be addressed by development instruments, it will be interesting to test what kind of trade cost reduction allows a country to move from one cluster to another. Therefore, this analysis can be a guide to improve the allocation of aid for trade and preferential trade agreements between developing economies.

To do so, we will start by using clustering techniques in order to construct clusters of countries that share similar values in their trade indicators. It turns out that these clusters can be ordered, representing some increasing degree of trade integration. Thereafter, using an ordered probit approach we will be able to test the impact of aid for trade and preferential schemes on the probability that a country belongs to the highest or the lowest integrated group of countries. Finally, marginal effects derived from the ordered probit will allow us to quantify how much is needed for a country to graduate from his cluster.

In order to measure de multidimensionality of trade for developing countries, we start with a literature review that justifies the choice of indicators in terms of their proximity with trade integration and their impact on economic development. We then use statistical classification techniques to construct clusters of countries using the trade output measures justified above, providing thus a new indicator of trade integration. Finally, we try to reveal the main trade costs and internal characteristics that explain the fact that a country belongs to a particular cluster using an ordered probit. This original approach allows us to use an integrated framework to evaluate the impact of diverse trade costs on a multidimensional trade integration measure.

2. Literature review on trade integration and development

The abundant debate on trade integration and growth has been alimented by a large variety of openness indicators that can be classified in three branches: widely used GDP-related openness ratios (Frankel and Romer, 1999; Frankel and Rose, 2002, Dollar and Kraay, 2004), trade-policy indicators (Leamer, 1988; Harrison, 1996; Pritchett, 1996; Guillaumont, 2001; Kee *et al.* 2009) and economic policy measures that include broader aspects related to trade (Sachs and Warner, 1995). Because we want to be apart from the debate on trade-policy measures (Frankel and Romer, 1999; Rodriguez and Rodrik, 2001), we will focus on the trade to GDP ratio as a measure of dependence of the economy on international trade.

Indeed, Frankel and Romer (1999) evidence suggests that countries that are more open tend to be richer. In a cross-country regression over 105 countries in 1985, they find that a greater trade over GDP ratio enhances income per capita, controlling for the neoclassical determinants of growth and for the endogeneity problem. This result is corroborated by Irwin and Terviö (2002) over a larger period and the robustness of the results are also proven by Noguer and Suscart (2005). Frankel and Rose (2002) also use a similar specification over 210 countries between 1960 and 1996. They find that openness to trade increases the growth rate of per capita income, even after controlling for neoclassical determinants, institutions and geography. Using regressions of changes in decadal growth rates on instrumented changes in trade and institutional quality, Dollar and Kraay (2003) tend to confirm the previous results and highlight the complementarities between trade and institutions. More recently, using broader databases, cross-section and panel-data estimations, Freund and Bolaky (2009) and Chang *et al.* (2009) also suggest that the positive effect of openness on income is enhanced by policy complementarities.

As regards to trade diversification, the natural resource curse empirical literature review highlights the negative impact of export concentration in primary products on growth (Auty, 2000; Sachs and Warner, 1999; Lederman and Maloney, 2008). This trend in the literature claims that export diversification away from natural resources is one of the most important economic policies for developing countries. Indeed, considering the deterioration of terms of trade observed the last decades (Prebisch, 1950; Singer, 1950; Harvey *et al.* 2010), a concentration in primary commodities exports worsen the trade balance deficit (Guillaumont, 1980). Also, the price volatility that characterizes this kind of products tends to increase macroeconomic instability, resulting in economic and political fragility, underinvestment, short-time planning and inflation, between other consequences (Guillaumont, 1987). Finally, a concentration in a limited

range of trade partners also tends to intensify the business cycles synchronisation (Calderon *et al.*, 2007). This phenomenon can deepen macroeconomic instability and then affect pro-cyclical variables like social spending, investment, credit and productivity (Fatas, 2002).

Nevertheless, there is evidence that export diversification follows the pattern of development. Indeed, Klinger and Lederman (2004, 2006) and Cadot *et al.* (2011) find that exports tend to diversify and then re-concentrate with income per capita. Moreover, it seems that this evolution mainly comes from the extensive margin (Cadot *et al.*, 2011)[3]. This subject has become a matter of careful analysis in recent years. Contributions like the ones of Hummels and Klenow (2005) and Cadot *et al.* (2011) decompose cross-country trade variations in intensive and extensive margins and study the contribution of each one on trade growth. Using a cross-section approach in 1995, Hummels and Klenow (2005) find that about two-third of the differences in the amount of trade between countries is explained by import and export extensive margins. Cadot *et al.* (2011) also find that diversification of exports in developing countries occurs mainly at the extensive margin, especially in their first stages of development.

As Hummels and Klenow (2005) state, these results "can be extremely important in determining the welfare consequences of access to trade". Indeed, because of the theoretical implications of an increase in the extensive margin of trade, also called the variety of products traded, this issue appears as an important policy indicator and a key element on the pathway to economic development (Cadot *et al.*, 2011). In fact, there are three main sources of gain from trade related to product variety, predicted by monopolistic competition models (Feenstra, 2010): first, an increase in consumer welfare arising from the rise in the variety of available products; second, and improvement in industry or country productivity due to an increase in the variety of imported inputs; and finally, an increase in industry or country productivity arising from an increase in export variety.

The first prediction is that trade will allow consumers to access new imported varieties of differentiated products. And because consumers have a "love of variety", this will induce an increase in welfare. Those gains have recently been measured by Broda and Weistein (2006) for the United States (US) over the period 1972 to 2001, using the methodologies from Feenstra (1994). These authors find that the gain from trade due to the expansion of import varieties amounts to 2.6 percent of GDP in 2001. Feenstra (2010) also finds that the gain from import

[3] The intensive margin refers to the variation in export values among existing lines (existing exports). Nevertheless, the definition of extensive margin differs among authors. In the case of Cadot et al. (2011), the extensive margin reflects variation in the number of new lines (new products exported or existing products exported to new partners), whereas in Hummels and Klenow (2005) it refers to export of new products.

variety in 1996 over all the 146 countries used in the sample vary between 9.4 and 15.4 percent of world GDP, depending on the value of elasticity of substitution used. Nevertheless, Arkolakis *et al.* (2008) find very small gains from increased import variety in the case of Costa Rica between 1986 and 1992.

The second prediction of the monopolistic competition model derives from the endogenous growth model like the one of Grossman and Helpman (1991), were research and development are considered as determinants of growth. In this framework, trade increases the growth rate if it allows the diffusion of international spillover of knowledge via imports of intermediated inputs that increase the variety of inputs available to producers (Feenstra, 2004; 2010). Indeed, an increase in the variety of differentiated inputs is expected to enhance the efficiency of the firm or the industry. Feenstra *et al.* (1999) provide strong evidences for this using the export variety of South Korea and Taiwan. They find that the variation on this variable between 1975 and 1991 had a positive and significant effect on total factor productivity in 9 out of the 16 sectors studied, principally in industries that rely and produce differentiated manufactures, and thus seems to match with endogenous growth predictions. Funke and Ruhwedel (2001a; b; 2002) obtain similar results for OECD and East-Asian countries.

Finally, the third prediction arises from the monopolistic competition model with heterogeneous firms developed by Melitz (2003), where productivity is endogenous trough the self selection of exporters. Within this framework, exporters are more productive on average than domestic firms. This model predicts that a fall in trade costs will raise the number of exporters and increase the average productivity of the country. Since each exporter produces a differentiated variety, an increase in export variety can be associated with rising average productivity and GDP (Feenstra and Kee, 2008). These authors developed a model allowing to link, across countries and over time, relative export variety to total factor productivity using a GDP function. They tested this relationship on the basis of exports to the US for a panel of 48 countries over the period 1980-2000 using three stage least squares regressions. Their results suggest that the 3,3 per cent per annum increase in export variety to the US observed in the data is associated with a 3,3 per cent productivity gain in the exporting countries. It should also be noted that benefits from the producer side seem to be greater than benefits from the consumer side. Indeed, as reminded by these authors, welfare benefits for exporting countries due to an increase in export variety are larger than the welfare improvements founded by Broda and Weistein (2006) for the US due to an increase in its import variety.

As regards to the trade quality dimension, Hausmann *et al.* (2007) provide evidences that the productivity level associated with exports influence positively subsequent economic growth. Indeed, by constructing an index of the quality of the basket exported by each country, they find that exporters that specialize in products of better quality benefits from higher economic growth. This evidence has been corroborated by Guerson *et al.* (2007) for the Argentinean case. Nevertheless, within an industry, developing countries tend to specialize in goods of low value-added (Schott, 2004). Thus, the emergence of new activities of better quality appears to be critical for developing countries.

Finally, considering the positive returns for exports arising from an increase in market shares in world trade, the performance dimension of trade integration seems to be an interesting indicator. Starting from the evolution of growth rates of export market shares, the variance analysis technique allow us to disentangle export performance due to internal country characteristics from effects due to world demand. Using this method, Cheptea *et al.* (2005) analyse the export performance of a large sample of countries for the period 1995-2002 and find a high heterogeneity between developing countries. It is worth to be noted that using constant market shares techniques to evaluate trade performance has been largely under-considered by researchers.

3. Methodology to measure trade integration

3.1. Database

For the construction of the indicators we principally use the trade values in current USD from the BACI international trade database constructed by CEPII at a HS6 desegregated level (among 5 000 lines), except for the market share analysis which is done at the HS2 level. This database is a modified version of COMTRADE, for which trade flows have been corrected for the institutional capacity of both the exporter and the importer. This harmonization procedure gives us more accurate trade values and allows us to extend the number of countries for which data is available (mostly developing countries). Thus, we are able to work with around 199 countries representing all regions and every level of development between 2000 and 2007. Intra European-Union-15 trade has been dropped from the database. We also use the World Development Indicators (WDI) database for the construction of the quality index of Hausmann *et al.* (2007).

In this section, we compute several indicators of trade integration for each country and each year. These variables are the trade to GDP openness ratio, the Herfindahl concentration index at a product level, the extensive margin of trade, the quality of the export basket and the trade performance obtained from a market shares analysis. Indices are then averaged over the 2000-2007 period in order to proceed with the clustering.

3.2. Construction of indicators

3.2.1. Measure of trade openness

In order to measure openness to trade, we rely on the trade over GDP ratio that accounts for the fact that some countries like Singapore are re-export platforms. Indeed, generally the openness ratio is the ratio of the sum of exports and imports to GDP, or $\left(\frac{X+M}{GDP}\right)$. Nevertheless, as Guillaumont (2001) and Combes *et al.* (2002) noted, some countries can appear with an openness ratio higher than 100 per cent because they are re-export platforms and add very low value-added to the imports they re-exports. Indeed, the openness ratio is a ratio of turnover to value-added and to be more accurate we should measure the value-added included in exports. Lacking this, we rather use as proxy for openness the ratio of exports and imports to total available resources: $\left(\frac{X+M}{GDP+M}\right)$. We compute this indicator in a yearly base and we average it over the 2000-2007 period in order to use it as an input in the clustering.

3.2.2. Measure of export concentration / diversification of products

To measure the concentration of exports at a product level, we compute the Herfindahl index, a variable easy to understand and that has been widely used by the literature on trade concentration (Jaud *et al.,* 2009; Cadot *et al.,* 2011). This index, normalized to range between zero and one, is

$$H^* = \frac{\sum_k (s_k)^2 - 1/n}{1 - 1/n}, \quad (1)$$

where $s_k = x_k / \sum_{k=1}^{n} x_k$ is the share of export line *k* in total exports, and *n* is the number of export lines that could be exported[4]. Temporal and individual indices have been omitted for convenience. This index measures the degree of concentration of the export basket, and varies between 0 (totally de-concentrated) to 1 (totally concentrated). One of the advantages of this measure is that it can be read as a percentage of concentration. We compute a yearly Herfindahl index over the 2000-2007 period and we average it over years in order to use it as an input in the clustering.

3.2.3. Measure of export / import variety

In order to allow comparability of the index between countries and time, the export variety (or extensive margin of exports) is constructed following a modified version proposed by Feenstra and Kee (2008) of the Hummels and Klenow (2005) index.

Hummels and Klenow (2005) propose a measure of "extensive margin" of trade that is consistent with product variety for a constant elasticity of substitution function. This indicator can be defined as changes in exports or imports that are due to changes in the number of goods (a change in the variety of products) rather than changes in the amount purchased of each good. Besides the fact that this formula is consistent with trade theory, we choose it among all the definitions of extensive margins available in the literature review because it takes into account the importance of the traded good instead of roughly counting lines. To see the proof of this measure please refer to Feenstra and Kee (2008) and Feenstra (2010), we will present here only the final formula. The construction of the import extensive margin measure is symmetric to the export one.

The construction of the indicator is based on the idea that exports from countries *h* and *F* differ but have some products varieties in common. This common set is denoted by $J \equiv \left(J_{it}^{h} \cap J_{it}^{F}\right) \neq \varnothing$. An inverse measure of export variety from country *h* will be defined by

$$\lambda_{it}^{h}(J) \equiv \frac{\sum_{j \in J} p_{it}^{h}(j) q_{it}^{h}(j)}{\sum_{j \in J_{it}^{h}} p_{it}^{h}(j) q_{it}^{h}(j)} \quad . \tag{2}$$

[4] n varies around 5 000 lines depending on the years.

Therefore, the ratio $\left[\frac{\lambda_{it}^{F}(J)}{\lambda_{it}^{h}(J)}\right]$ measures the export variety of country *h* relative to country *F*. And it increases with the variety exported from country *h*, and decreases with the variety exported from country *F*. Thus, to be measured, this indicator needs a consistent comparison country *F*.

Feenstra and Kee (2008) use the worldwide exports from all countries to the US as a benchmark. Indeed, the US appears as the major partner in terms of imported variety (US imports almost 99 per cent of all the varieties existing) and provides highly desegregated trade databases (until 10 digit codes). Nevertheless, as Feenstra and Kee (2008) noted, it would be preferable to use countries' worldwide imports instead of US imports. Indeed, this restriction makes the measure dependent to the import structure of the US; and for countries that export goods that have a small value in the import structure of this partner, or that do not export some kind of varieties to it (mostly developing countries), the magnitude of their export variety will appear under-evaluated. Thus, in order to correct for these effects we prefer to work with the entire world as the benchmark F, as in Hummels and Klenox (2005), even if this forces us to use only HS-6 desegregated trade data.

Moreover, we need a benchmark *F* that doesn't change thought time, in order to associate any variation in the indicator to a variation in the export variety of the country *h*. So, following Feenstra and Kee (2008) we take the union of all products sold in the world market in any year over the period 2000-2007, and we average real exports sales of each product over years. In this way, $J_i^F \equiv \cup_{h,t} J_{it}^h$ is the total set of varieties imported by the entire world in sector *i* over all years, and $p_i^F(j)q_i^F(j)$ is the average real value of world imports for product *j* (summed over all source countries and averaged across years). Then, comparing country *h* to the world (*F*) allows us to set $\lambda_{it}^h(J)=1$ and the export variety by country *h* takes the form:

$$\mathrm{A}_{it}^{h} \equiv \frac{\lambda_{it}^{F}(J)}{\lambda_{it}^{h}(J)} = \frac{\sum_{j\in J_{it}^h} p_{it}^F(j)q_{it}^F(j)}{\sum_{j\in J_i^F} p_i^F(j)q_i^F(j)} \quad . \tag{3}$$

Thus, export variety only changes due to variations in the numerator, and thus, due to changes in the set of goods sold by the country *h*. This allows us to do comparisons of export varieties across countries and over time. Moreover, this indicator goes beyond a simple count of trade lines, because it takes into account the relevance of the sector *i* (HS-6 line) in world trade.

This is the methodology we use for the construction of our export and import variety. We compute a yearly indicator and we average it over the period in order to use it as an input in the clustering.

3.2.4. Measure of export quality

The quality of the export basket is constructed following Hausmann *et al.* (2007). First, they propose an index called PRODY that attributes a level of productivity to each *k* (HS-6) line. The total exports for a country *i* is,

$$X_i = \sum_{k=1}^{n} x_{ik} \quad (4)$$

And the level of productivity $PRODY_k$ associated to each *k* (HS-6 line) is constructed as

$$PRODY_k = \sum_i \frac{(x_{ik}/X_i)}{\sum_i (x_{ik}/X_i)} Y_i, \quad (5)$$

where Y_i is the GDP per capita in purchasing power parity of each country *i*. This index is a variant of the Balassa's index of revealed comparative advantage, weighted by the level of development of exporters. This way, exports from developed countries are considered as more productive that the ones coming from developing economies.

Finally, the level of productivity associated to the export basket of each country *i* is,

$$EXPY_i = \sum_k \left(\frac{x_{ik}}{X_i}\right) PRODY_k. \quad (6)$$

Thus, it depends on the degree of concentration of the export basket, weighted by the quality of the products exported. The underlying idea behind this indicator is that diversifying its exports basket away from products of low productivity may accelerate subsequent growth. We compute a yearly EXPY*i* indicator and we average it over the 2000-2007 period in order to use it as an input in the clustering.

3.2.5. Measure of export / import performance

Following Berzeg (1978), Jayet (1993) and Cheptea *et al.* (2005), trade performance indicators are derived from a constant market shares technique obtained by weighted variance analysis. Starting from the evolution of growth rates of export market shares, the variance

analysis technique allows us to disentangle the export performance due to internal country characteristics, from effects due to partner demand and product composition of the export basket. This framework also has the additional advantage of providing standard errors for the estimated effects. Moreover, the import performance measure can also be obtained from the same specification.

The average growth rate of sectoral bilateral exports x_{ijk} can be disentangled in three different effects:

$$\begin{cases} x_{ijk} = m + \alpha_i D_i + \beta_j D_j + \gamma_k D_k + \varepsilon_{ijk} & E\varepsilon_{ijk} = 0, V\varepsilon_{ijk} = \dfrac{\sigma^2}{X^0_{ijk}} \\ \displaystyle\sum_i \frac{X^0_{i..}}{X^0_{i..}} \alpha_i = \sum_j \frac{X^0_{.j.}}{X^0_{i..}} \beta_j = \sum_k \frac{X^0_{..k}}{X^0_{i..}} \gamma_k = 0 \end{cases} \quad (7)$$

Thus, the average growth rate of exports from country *i* to partner *j* in sector *k* over the period 2000-20007, x_{ijk}, can be regressed over three dummies which correspond to the export performance α_i, the partner import dynamism β_j and the sectoral world demand γ_k. The constant m roughly represents the average growth rate of world exports. Equation (7) is estimated using a weighted variance analysis technique, weighted by the value of exports at the beginning of the period X^0_{ijk} in order to solve the heteroscedasticity problem (Jayet, 1993). It should be noted that instead of working with annual export growth rates as in Cheptea *et al.* (2005), we decided to work with an average export growth rate over the period. Indeed, results seem very sensitive to the high volatility of exports of highly concentrated developing countries. In fact, some developing countries (mostly island states or countries in conflict) face high volatility in the value of their exports, and when we perform the weighted variance analysis on a year to year basis, we find that this instability is absorbed by the export performance fixed effect. Thus, working with average export growth rates allows us to smooth this instability.

Once equation (7) has been estimated, another weighting is necessary to give more importance to countries that play a prominent role in world markets. Indeed, we need to correct for the fact that China has a higher influence in international trade than Vanuatu, or that agroindustrial trade is more important than the fur one. This is done by weighting each fixed effect coefficient by the country/partner/sector market share in world markets at the beginning of the period. Finally, because of collinearity problems between the constant and the dummies, a country/partner/sector has been automatically dropped from the estimation. Thus, results should be read as deviations from the omitted effect, which is fixed to zero. Instead of this, we

rearrange results in order to interpret each dummy coefficient as deviations from the world average. Finally, we run a Fischer test over results of equation (7) in order to evaluate their statistical significance and confirm the good fit of the decomposition (Jayet, 1993). We see that more than half of the fixed effects are significantly different from zero (Table 1, Appendix 1).

To convert the average growth rate of country *i* exports of good *k* to partner *j*, x_{ijk} , to an average growth rate of total country *i* exports, r_i , we can rewrite equation (7) in the following form:

$$r_i = \hat{m} + \hat{\alpha}_i + \sum_j \frac{X^0_{ij.}}{X^0_{i..}} \hat{\beta}_j + \sum_k \frac{X^0_{i.k}}{X^0_{i..}} \hat{\gamma}_k \ , \tag{8}$$

Where $\hat{\alpha}_i$ is the export performance of country *i* due to its internal characteristics, $\frac{X^0_{ij.}}{X^0_{i..}} \hat{\beta}_j$ his export performance due to the import dynamics of his partners, and $\frac{X^0_{i.k}}{X^0_{i..}} \hat{\gamma}_k$ his export performance due to the dynamics of the sectors where he exports. Thus, we obtain the decomposition we were looking for: average export growth rates are disentangled in a more accurate export performance, a geographical structure effect and a sectoral structure effect.

Finally, because we want to focus on an export performance indicator related to the growth in exports market shares rather than on exports growth, a further computation is needed. A country's exports market share growth can be expressed as follows:

$$g_i = \frac{(1 + r_i)}{(1 + \hat{m})} - 1 \ . \tag{9}$$

Thus, following the equations (7) and (8), the market shares average growth rate can be rewritten as:

$$g_i = \frac{\hat{\alpha}_i}{(\hat{m} + 1)} + \frac{\left[\sum_j \frac{X^0_{ij.}}{X^0_{i..}} \hat{\beta}_j \right]}{(\hat{m} + 1)} + \frac{\left[\sum_k \frac{X^0_{i.k}}{X^0_{i..}} \hat{\gamma}_k \right]}{(\hat{m} + 1)} \ . \tag{10}$$

And thus, the export performance indicator explained by country characteristics becomes:

$$Performance_i = \frac{\hat{\alpha}_i}{(\hat{m}+1)}. \quad (11)$$

We follow equation (11) to construct the export performance indicator. And because by construction the export, import and sectoral effects are independent between each other in equation (7), the import dynamic for each country can be measured by the $\hat{\beta}_j$ from equation (8) (Cheptea *et al.*, 2005). These are the two trade performance indicators that will be used in the future clustering.

In term of interpretation, considering that by construction the export performance indicator is dependent on the export structure of each country at the beginning of the period (partners and sectors in t_0=2000), a positive sign in this variable tells us that the country has been able to increase its competitiveness, or/and that it has been capable to export to more dynamic importing markets or in sectors with a higher world demand. In the case of the import performance indicator, a positive sign tell us that the country has increased its demand for foreign goods, and that this is not explained by a better performance of its exporting partners or by the kind of goods it imports. Finally, now that we have constructed all the trade-related indicators, we can proceed to the clustering analysis.

3.3. Clustering analysis

We use the openness ratio, the Herfindahl export concentration index, the export and import variety measures, the quality of exports, and the export and import performance using market shares, as inputs to construct a classification of countries by implementing hierarchical and non-hierarchical clustering methods.

As Johnson and Wichern (2002) noted, hierarchical agglomerative clustering techniques provide clusters of countries that are similar. Thus, in our case we are able to provide groups of countries that are similar in terms of their degree of trade integration, taking into account the multidimensionality of this concept. This technique also allows us to obtain the optimal number of clusters with respect to the data. Finally, applying a k-means procedure after the hierarchical agglomerative clustering method enables us to enhance the robustness of our results.

We proceed to a clustering of countries based on the value of each of the seven indicators presented above. Note that we have four variables that are related to exports, two to imports and one that address both issues. This means that we weigh more heavily the export performance of countries. Indeed, international trade models and empirical evidence, as the observation of South-Asian countries, tend to indicate that export-led growth is more desirable than further dependence on imports.

The first cluster of countries is obtained using the Ward's hierarchical agglomerative clustering technique. This method allows for the union of the two clusters where fusion results in a minimum increase in "information loss", that is, in a minimum increase in the sum-of-squares. Because Ward's approach is very sensible to outliers, we drop from the sample countries that are too dissimilar. In our case, ten outliers[5] were dropped from our sample. After the Ward's method, we apply the k-means procedure to validate the clustering, allowing countries to move from one cluster to another in an iterative way, until each country is closer to the members of its cluster that to the members of a neighbor one.

We expect that clusters obtained after the k-means could be ordered in an increasing way, from the highest integrated in world trade to the least integrated one, thus creating a new discrete variable reflecting different levels of trade integration. We also think it is likely that countries within a cluster will share similar structural characteristics, like a comparable level of development, a lack of infrastructure, bad quality institutions or a closed trade policy. Indeed, literature review on trade costs argues that these variables are determinants of export volumes and diversification (Limao and Venables, 2001 ; Wilson et *al.*, 2003 ; 2005, Anderson and van Wincoop, 2004 ; Shepherd, 2010, Dennis and Shepherd, 2011). We also anticipate that some groups of countries recognized by the donor community, like the Least Developed Countries (LDCs) or the Small and Vulnerable Economies (SVEs) categories from the United Nations will appear concentrated in some clusters.

Finally, in order to highlight the determinants of trade integration, we will estimate an ordered probit model over the discrete variable created by the clustering. This will allow us to test the impact of structural and policy-induced country characteristics on the probability that a country belongs to the highest or the lowest trade-integrated group of economies. It is worth reminding that the clustering is only constructed using the seven trade indicators; none of the structural and policy-induced determinants are used to cluster countries. Thus, coherent results

[5] Angola, China, Germany, Equatorial Guinea, Hong Kong, Ireland, Japan, Palau, Singapour and the US.

with the literature review on trade costs arising from the probit estimation will tend to confirm a good fit of our clustering analysis.

The level of development is approximated using the log of GDP per capita, and data comes from the World Bank's WDI. This variable allows us to control for a lot of features highly related to the level of development, like education and health. Some geographic characteristics are measured using the log of population, the population density, a landlocked dummy, an oil exporter dummy and a remoteness indicator from the "Fondation pour les Etudes et Recherches sur le Développement International (FERDI)". The quality of institutions is alternatively measured by the "time to export" variable from the Doing Business database (Djankov *et al.* 2007), by the governance indicators from the World Bank and by the institutional database from the International Country Risk Guide (ICRG). Infrastructure quality and quantity are controlled by an index regrouping by Principal Component Analysis (PCA) the following variables: road density and percentage of paved road, and the number of subscribers to mobile and fixed lines (per 100 people).

Finally, we introduce the value added of agriculture in total GDP (in %) and a high-technology exports (% of manufactured exports) variables that measure, respectively, the structure of production of the economy and the content in research and development of the industrial sector. These variables come from the WDI. The trade policy is measured by the trade restrictiveness indices constructed by Kee *et al.* (2009), by the weighted mean tariff applied and by the percentage of tariff lines with peaks. The results from the ordered probit will allow us to tell which set of factors enhances the probability that a country belongs to the highest or the lowest cluster. We will thus be able to quantify the needs of low performing countries in order to graduate from the lowest integrated clusters.

4. Results

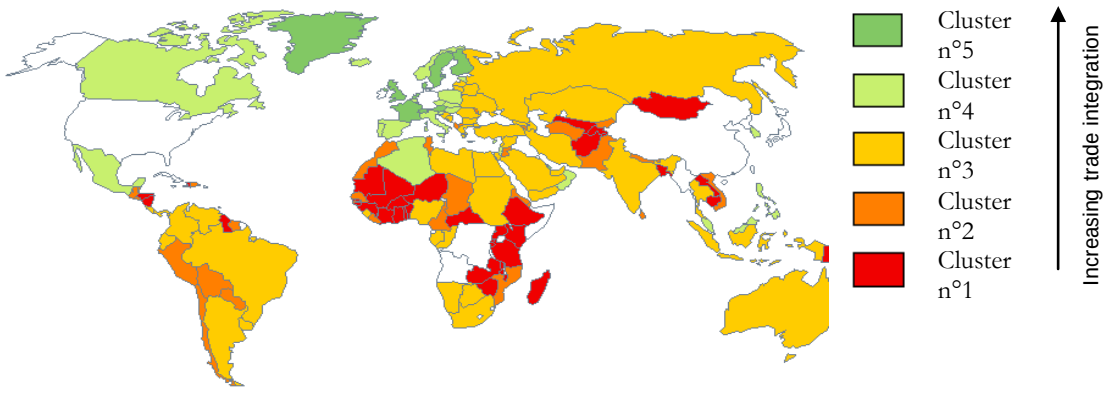
4.1. Clustering

The Ward's clustering technique provides us with five very interesting clusters. Indeed, we observe that the oil exporting countries are automatically placed in a unique cluster. Nevertheless, some of these countries are re-organized within other clusters once we perform the k-means method.

The results of the clustering using hierarchical and k-means techniques can be seen in Table 1 and Figure 1 (list of countries in Table A.2.). The cluster 1 is the category regrouping the lowest integrated countries and 5 the highest integrated ones. We see that almost all the indicators follow a linear evolution among these ordered clusters, except for the Herfindahl index of exports concentration and for the openness ratio. The first result can be explained by the fact that oil exporting countries, which have an export basket highly concentrated in exports of oil, are mainly concentrated in cluster 3. For the second fact, as predicted by theoretical models, larger countries tend to be more closed than smaller ones. Thus, a drop in the openness ratio for the 5th cluster may be explained by the high concentration of rich countries in it. This still holds when the clustering is made only within developing economies: oil exporting countries appear in the same cluster; and the Herfindahl index and the openness ratio are still not linear between categories. Thus, it seems that using the openness ratio as a measure of trade integration, like it is usually done in the research on the impact of trade on the level or the growth of GDP, may be misleading.

Finally, a look at the mean of some variables within each cluster provides a snapshot of the characteristics of the countries that share similar levels of trade integration. We see in Table 1 that the lowest cluster is mainly composed with LDCs and SVEs. We also observe that trade integration seems positively correlated with GDP per capita. Finally, we highlight the fact that India, which is a low income country, belongs to the highest integrated cluster. This certainly should be the case of China if it was not considered as an outlier by our statistical technique.

Figure 1: Ward's and k-means clustering, mean values over the period 2000-2007



Source: author's calculations, BACI and WDI data

* Angola, China, Germany, Equatorial Guinea, Hong Kong, Ireland, Japan, Palau, Singapore and the US are considered as outside values by the clustering procedure. Other missing country is due to missing values.

Table 1: Clustering over all countries (Ward's technique + K-means)

		Quality index	Herfidahl Index	Export Variety	Import Variety	Import Perfomance	Export Perfomance	Openness	LIC	LMIC	UMIC	HIC	LDC	SVE
Cluster n°1	*MIN*	19842	0,036	0,102	0,405	-2,19E-04	-4,32E-04	0,234						
	MAX	76309	0,642	0,638	0,938	-3,08E-05	-1,59E-04	0,938						
N=56	***MEAN***	**47026**	**0,198**	**0,378**	**0,734**	**-5,68E-05**	**-4,07E-04**	**0,519**	**64%**	**23%**	**11%**	**2%**	**66%**	**86%**
	STD	14197	0,134	0,132	0,112	2,34E-05	3,47E-05	0,175						
Cluster n°2	*MIN*	41591	0,013	0,519	0,828	-1,64E-04	-4,45E-04	0,277						
	MAX	92629	0,141	0,955	0,979	9,44E-05	-4,97E-05	0,756						
N=30	***MEAN***	**62695**	**0,060**	**0,729**	**0,919**	**-4,47E-05**	**-3,49E-04**	**0,513**	**23%**	**50%**	**17%**	**10%**	**3%**	**47%**
	STD	14509	0,040	0,125	0,042	5,03E-05	9,82E-05	0,129						
Cluster n°3	*MIN*	62000	0,198	0,397	0,711	-6,53E-05	-4,72E-04	0,412						
	MAX	130899	0,771	0,972	0,987	2,29E-04	-1,51E-05	0,882						
N=18	***MEAN***	**88983**	**0,470**	**0,678**	**0,881**	**1,65E-05**	**-3,88E-04**	**0,625**	**11%**	**33%**	**39%**	**17%**	**6%**	**28%**
	STD	16010	0,180	0,182	0,087	8,84E-05	9,64E-05	0,129						
Cluster n°4	*MIN*	64378	0,004	0,669	0,929	-5,18E-04	-4,13E-04	0,232						
	MAX	142028	0,252	0,999	0,998	5,00E-04	1,26E-03	1,068						
N=38	***MEAN***	**101630**	**0,038**	**0,888**	**0,969**	**4,61E-05**	**-2,86E-05**	**0,694**	**3%**	**24%**	**24%**	**50%**	**0%**	**11%**
	STD	20738	0,048	0,093	0,021	1,76E-04	4,64E-04	0,161						
Cluster n°5	*MIN*	81964	0,003	0,871	0,984	-1,02E-06	-1,29E-04	0,297						
	MAX	142419	0,131	0,998	0,999	1,13E-03	2,93E-03	0,630						
N=14	***MEAN***	**105157**	**0,023**	**0,979**	**0,993**	**4,12E-04**	**1,05E-03**	**0,459**	**7%**	**0%**	**36%**	**57%**	**0%**	**0%**
	STD	19336	0,032	0,032	0,004	2,92E-04	1,05E-03	0,090						

Source: author's calculations, BACI and WDI data. Following the classification provided by the World Bank, LIC=Low Income Country, LMIC=Low Middle Income Country, UMIC=Upper Middle Income Country, LDC=Least Developed Country and SVE= Small and Vulnerable Economy.

4.2. Ordered probit

We did four different clustering: one with the entire sample of countries and performing only the Ward's technique, the same one but adding the k-means technique over the Ward's results (Table 1), and the same procedure for the sample of developing countries only. This will allow us to test the robustness of our results.

When we estimate the ordered probit over the discrete trade integration variable arising from the Ward's clustering, the oil exporting dummy appears highly significant[6]. This comforts our intuition that these countries are highly concentrated in one cluster. Thus, in order to obtain a linear ordering of clusters that represents an increase in trade integration, we had to drop the cluster N° 3 from the explained variable in specifications 1 to 4 (Table 2). We see then that once we control for trade-policy variables, the significance on the fuel dummy disappears (columns 3 and 4, Table 2). We see in these results that infrastructure seems to be an important determinant explaining the probability that a country belongs to the highest or the lowest category. Indeed, this variable appears with a positive sign and highly significant and tells us that an improvement in infrastructure increases the probability that a country belongs to the highest cluster and decreases its probability to belong to the lowest cluster. However, it is puzzling to see that trade-related institutions, approximated by the time to export, do not appear as a significant determinant of trade integration. This may be due to the difficulty to measure this kind of institutions accurately. Other explanatory variables, like the log of GDP per capita, or geographic variables like the log of population and population density appear significant and with the expected sign. Results indicate that richer and larger countries have a higher probability to be in the highest cluster.

These results still hold when we estimate the ordered probit with the clusters created by the Ward's and k-means techniques over the entire sample (columns 5 to 8, Table 2).We observe that previous results still hold, and that the percentage of tariff lines with peaks always appears significant. Finally, the share of agriculture in the economy and the high technology content of exports seem to influence the trade integration. Thus, countries depending heavily on agriculture are more likely to be in the lowest cluster. This is consistent with the idea that countries diversify their production away from agriculture within the development process. Also, countries that invest more in research and development are more likely to be very well integrated in international trade.

[6] Results upon request.

Table 2: Estimation results from the ordered probit

Ordered probit estimations	All Countries – 4 clusters ("Fuel cluster" dropped) Clustering using Ward's method				All Countries – 5 clusters Clustering using Ward's and k-means methods				Developing Countries – 5 clusters Clustering using Ward's and k-means methods			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
GDP per capita (log)	1.050	0.757	0.630	0.879	1.043	0.627	0.759	-0.154	1.117	0.708	0.724	-0.159
	(0.108)***	(0.149)***	(0.167)***	(0.423)**	(0.121)***	(0.164)***	(0.195)***	(0.439)	(0.150)***	(0.183)***	(0.220)***	(0.393)
Population (log)	0.555	0.578	0.503	0.620	0.299	0.385	0.385	0.453	0.376	0.440	0.391	0.377
	(0.066)***	(0.071)***	(0.109)***	(0.136)***	(0.049)***	(0.057)***	(0.091)***	(0.095)***	(0.061)***	(0.075)***	(0.118)***	(0.128)***
Fuel dummy	0.761	0.874	0.416	-0.035	0.467	1.118	1.452	3.324	0.888	1.726	2.023	2.751
	(0.313)**	(0.383)**	(0.425)	(0.624)	(0.327)	(0.421)***	(0.532)***	(0.737)***	(0.419)**	(0.562)***	(0.628)***	(0.609)***
Landlocked dummy	-0.032	0.213	0.115	-0.042	0.186	0.115	0.014	-0.332	0.182	0.281	0.034	-0.302
	(0.285)	(0.353)	(0.351)	(0.618)	(0.244)	(0.325)	(0.388)	(0.621)	(0.281)	(0.366)	(0.423)	(0.607)
Density of population	-0.001	-0.002	-0.002	-0.003	-0.000	-0.003	-0.002	-0.004	-0.001	-0.003	-0.002	-0.003
	(0.001)	(0.001)***	(0.001)**	(0.001)***	(0.001)	(0.001)***	(0.001)**	(0.001)***	(0.000)**	(0.001)***	(0.001)*	(0.001)***
Infrastructure		0.450	0.406	0.802		1.397	1.536	1.859		1.259	1.496	1.265
		(0.194)**	(0.218)*	(0.275)***		(0.272)***	(0.358)***	(0.493)***		(0.340)***	(0.451)***	(0.671)*
Time to export		-0.022	-0.016	-0.046		-0.006	0.008	-0.018		-0.007	0.009	-0.021
(days)		(0.014)	(0.013)	(0.098)		(0.012)	(0.013)	(0.030)		(0.013)	(0.014)	(0.025)
MA-OTRI			-4.139	-4.133			-7.103	0.296			-16.097	-9.783
			(5.001)	(5.526)			(4.301)*	(5.230)			(4.811)***	(5.099)*
OTRI			3.455	-0.680			0.742	-3.357			1.800	-0.059
			(2.506)	(3.128)			(1.703)	(3.412)			(1.711)	(2.504)
Tariff peaks			-0.007	-0.007			-0.021	-0.033			-0.021	-0.029
			(0.011)	(0.013)			(0.010)**	(0.014)**			(0.011)**	(0.012)**
Applied tariff			-0.062	0.044			0.030	0.184			-0.013	0.063
(weighted mean)			(0.068)	(0.029)			(0.042)	(0.070)***			(0.045)	(0.060)
High-tech exports				0.004				0.012				0.009
				(0.002)**				(0.004)***				(0.002)***
Remoteness				-0.004				-0.017				-0.014
				(0.013)				(0.013)				(0.011)
Share of agriculture in				0.001				-0.047				-0.052
GDP				(0.016)				(0.019)**				(0.016)***
Observations	144	129	112	70	157	140	121	78	120	107	92	72
Pseudo R2	0.43	0.45	0.45	0.52	0.39	0.47	0.55	0.58	0.32	0.33	0.43	0.52

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1% Source: author's calculations, BACI and WDI data

We now turn to the specification that uses the clustering made only within the sample of developing countries. We see in column 9 to 12 (Table 2) that previous results still hold. Indeed, infrastructure always appears as a determinant of trade integration; which is consistent with the extensive empirical evidence using the gravity model suggesting that infrastructure-related trade costs are important obstacles to trade. Indeed, marginal effects imply that for a country located at the mean of all the variables used in the estimation (12), Table 2, a unit increase in the index of infrastructure decrease of 42,5 per cent the probability that this country does not belong to the Cluster n°2 and increase of 27 per cent the probability that this economy will be located in Cluster n°3 (Table 3). This is a high economic impact that transits by infrastructure. Considering that it has been demonstrated that aid for trade effectiveness also transits via this channel (Helble *et al.* 2010; Vijil and Wagner, 2012), results seems to conclude that more investment is needed in this feature in order to increase the participation of developing countries in international trade.

Finally, we see that tariff and non-tariff barriers applied by to the rest of the world (MA-OTRI) seems to increase the probability that a developing country belongs to the lowest cluster (columns 11 and 12, Table 2). Considering that this variable didn't appear significant in previous specifications, market access seems to be a matter only for exporters from developing countries. This suggests that preferential schemes should be used as an instrument to increase trade integration. For example, marginal effects suggest that an unit decrease in the MA-OTRI indicator enhance the probability that countries in cluster n°2 move to cluster n°3 of 208 per cent, an decrease the probability that these countries stay in their initial cluster of 329 per cent (Table 3).

Table 3: Marginal effects from the ordered probit

Marginal Effects (%)	Cluster n°1	Cluster n°2	Cluster n°3	Cluster n°4	Cluster n°5
Infrastructures	-0.154	-42.491	26.949	15.695	0.001
MA-OTRI	1.199	328.705	-208.479	-121.42	-0.004
Tariff Peaks	0.003	0.957	-0.607	-0.353	-0.001
High-tech Exports	-0.001	-0.303	0.192	0.112	0.0001
Share of Agriculture in GDP	0.006	1.739	-1.103	-0.642	-0.0001

Source: author's calculations, BACI and WDI data
Marginal effects of each independent variable are calculated holding all covariates at their sample mean. Estimates are calculated according to column (12), Table 2.

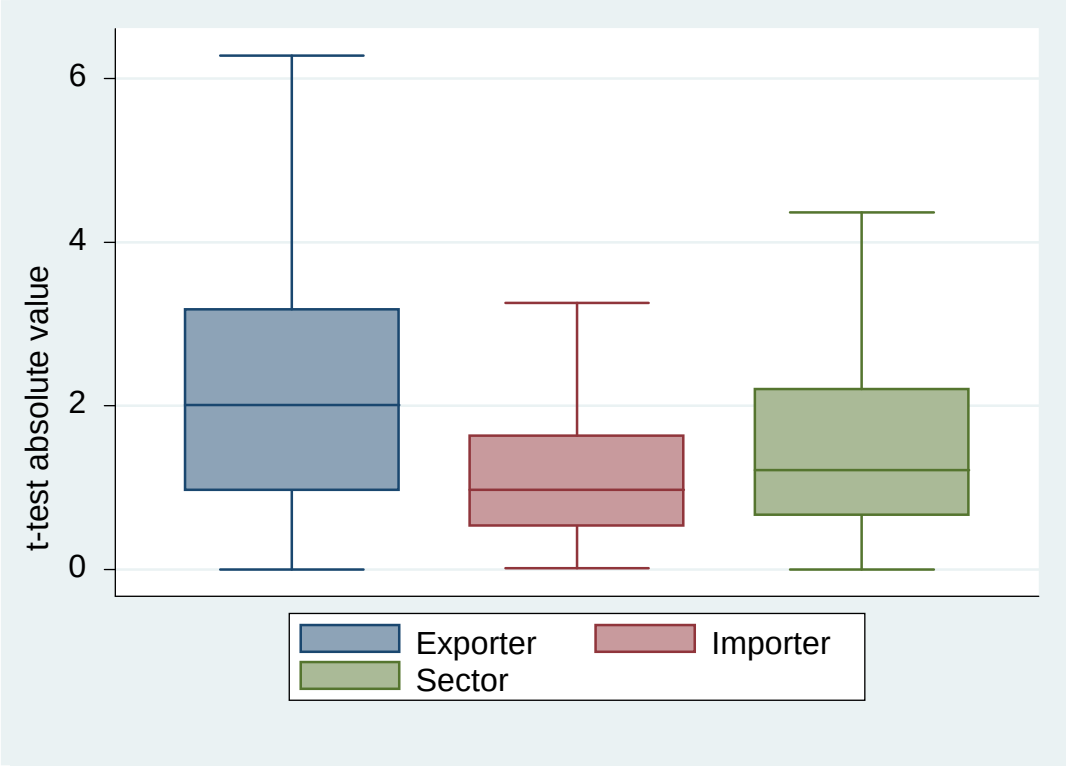
5. Conclusion

Despite the fact that the concept of trade integration is extensively used in development debates, there is still little consensus on the definition of this subject and its measurements. However, this seems particularly important in order to improve the allocation of aid for trade and preferential market access. Using clustering techniques, this work proposes a new trade indicator that combines, within a unique framework, the position of each country in different dimensions of overall international trade participation; including concepts such as openness, diversification, variety, quality and performance. It must be noted that the trade openness ratio seems to have a non-linear evolution compared to the other dimensions of trade, suggesting that relying only on this variable when analyzing trade integration may be misleading.

Then, an ordered probit performed on this new multidimensional indicator reveals the main obstacles to trade that can be addressed by existing development instruments. We find that investment in infrastructure and further market access for exports from the South are needed. This is an interesting result, considering that evidence suggests that aid for trade effectiveness in terms of export performance transits via the infrastructure channel (Vijil and Wagner, 2012). For future research, it seems then pertinent to test the effectiveness of such assistance on the different dimensions of trade integration highlighted in this analysis. Furthermore, the new indicator proposed here can be used to revisit the research on trade and development.

Appendix

Table A.1.: Absolute values of the Student test statistics on fixed effects from the weighted variance analysis



Source: author's calculations, BACI and WDI data
Outside values not shown

Table A.2. : List of countries by cluster

Cluster n°1		Cluster n°2	Cluster n°3		Cluster n°4	Cluster n°5
Afghanistan	Madagascar	Albania	Argentina	Latvia	Algeria	Austria
Bangladesh	Malawi	Antigua and Barbuda	Australia	Lebanon	Bahrain	Denmark
Benin	Maldives	Armenia	Azerbaijan	Libyan Arab Jamahiriya	Belgium/Luxembourg	Finland
Burkina Faso	Mali	Bahamas	Barbados	Lithuania	Canada	France
Burundi	Mauritania	Belize	Belarus	Nigeria	Cyprus	Netherlands
Cambodia	Mongolia	Bhutan	Bosnia and Herzegovina	Panama	Czech Republic	Qatar
Central African Republic	Nicaragua	Bolivia	Brazil	Romania	Estonia	Sweden
Comoros	Niger	Cameroon	Bulgaria	Russian Federation	Hungary	Switzerland
Côte d`Ivoire	Papua New Guinea	Cape Verde	Colombia	Saint Lucia	Iceland	United Kingdom
Ethiopia	Rwanda	Chad	Congo	Saudi Arabia	Israel	
French Polynesia	Solomon Islands	Chile	Costa Rica	Seychelles	Italy	
Gambia	Tajikistan	Djibouti	Croatia	Sierra Leone	Korea	
Ghana	Tanzania	Dominica	Ecuador	Southern African Customs Union	Malaysia	
Guinea	Togo	Dominican Republic	Egypt	Sudan	Mexico	
Guinea-Bissau	Tonga	El Salvador	Gabon	Syrian Arab Republic	New Zealand	
Guyana	Uganda	Eritrea	Georgia	Thailand	Norway	
Haiti	Uzbekistan	Fiji	Greece	Turkey	Oman	
Honduras	Vanuatu	Guatemala	Grenada	Ukraine	Philippines	
Kenya	Zambia	Jordan	India	United Arab Emirates	Poland	
Kiribati	Zimbabwe	Kyrgyzstan	Indonesia	Uruguay	Portugal	
Lao People`s Democratic Republic		Liberia	Iran	Venezuela	Slovakia	
		Mauritius	Kazakstan	Yemen	Slovenia	
		Moldova, Rep.of			Spain	
		Morocco			Trinidad and Tobago	
		Mozambique				
		Nepal				
		Pakistan				
		Paraguay				
		Peru				
		Saint Vincent and the Grenadines				
		Samoa				
		Senegal				
		Sri Lanka				
		Suriname				
		Macedonia				
		Tunisia				
		Turkmenistan				
		Viet Nam				

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Chapter 2: The Relationship between Trade Openness and Economic Growth: Some New Insights on the Openness Measurement Issue[7]

1. Introduction

In spite of the wave of liberalizations undertaken during the last 30 years, the debate on the links and causality between trade openness, growth and income distribution is still open (Rodriguez and Rodrik, 2001). Empirical evidence tends to show that in the long run more outward-oriented countries register higher economic growth (e.g., among others, Sachs and Warner, 1995; Edwards, 1998; Frankel and Romer, 1999; Dollar and Kraay, 2004; Lee *et al.*, 2004). More recently, using broader databases and cross-section or panel-data estimations, Freund and Bolaky (2008) and Chang *et al.* (2009) also show that trade openness has a positive impact on income and that this positive relationship is enhanced by complementary policies. According to some authors however (e.g., Rodriguez and Rodrik, 2001) most of this work suffers from, at least, two serious shortcomings that make their results to be questioned: the way trade openness is measured and the retained estimation methods.

[7] This chapter has been co-authored with Marilyne Huchet-Bourdon and Chantal Le Mouël.

Reviewing the existing literature on trade and growth shows that there is not a clear definition of trade openness. For many authors trade openness implicitly refers to trade policy orientation and what they are interested in is to assess the impact of trade policy or trade liberalization on economic growth. For other authors however, trade openness is a more complex notion, covering not only the trade policy orientation of countries but also a set of other domestic policies (such as macroeconomic policies or institutional ones) which altogether make the country more or less outward oriented. In such a case, what the authors are interested in is to measure the impact of global policy orientation on economic growth. Finally, one may adopt an even more global view of trade openness covering not only the policy dimension but also all other non-policy factors that clearly have an impact on trade and on the outward orientation of countries. Factors such as geography and infrastructures, for instance, do affect trade and the outward orientation of countries, whatever their policy orientation is.

Many different measures of trade openness have been proposed and used in empirical analyses of the relationship between openness and growth. They more or less relate to the three alternative definitions of openness mentioned above. In line with the trade policy orientation definition, some authors have retained measures based on trade restrictions/distortions, such as average tariff rates[8], average coverage of quantitative barriers, and frequency of non-tariff barriers or collected tariff ratios (see, e.g., Pritchett, 1996; Harrison, 1996; Edwards, 1998, Yanikkaya, 2003). Obviously, these indicators are very imperfect and partial measures of the overall restrictions/distortions induced by trade policies. Furthermore, data required to compute such indicators are often available for only a limited set of countries and years.

In terms of the global policy orientation definition, various "qualitative" indices allowing for classifying countries according to their trade and global policy regime have been proposed (see, e.g., the 1987 World Development Report outward orientation index or the openness indices proposed by both Sachs and Warner, 1995, and Wacziarg and Welch, 2003). Such measures unfortunately provide only a very rough classification of countries (from rather closed to rather open). Also many of the data required to construct these indices are available only for a few countries and at one point in time.

Finally, measures based on trade flows, which have been commonly used in empirical analyses, rather relate to the most global definition of trade openness. Trade dependency ratios are the most popular of these measures (see, e.g., Frankel and Romer, 1999; Irwin and Tervio, 2002;

[8] And/or other characteristics of the tariff distribution: tariff dispersion, frequency of tariff picks, etc.

Frankel and Rose, 2002; Dollar and Kraay, 2004 and Squalli and Wilson, 2011; for a recent contribution). Their main advantage is that the data required to compute them are available for nearly all countries and over a rather long period. Their main weakness is that they are mainly outcome-based measures, and as such, are the result of very complex interactions between numerous factors so that it is not clear what such measures exactly capture. Another limitation of these trade dependency ratios lies in their endogeneity in growth regressions, which requires specific estimation techniques (such as instrumental variables techniques as in Frankel and Romer, 1999; and Irwin and Tervio, 2002; or identification through heteroskedasticity techniques as in Lee *et al.*, 2004).

This last limitation may in fact be extended to all trade openness measures, and constitutes the second shortcoming in existing empirical evidence that has been pointed out by Rodriguez and Rodrik (2001). As argued by Lee *et al.* (2004), all measures of openness are generally closely linked to the growth rate. Hence, it is likely that all measures of openness are jointly endogenous with economic growth, which may cause biases in estimation resulting from simultaneous or reverse causation. Various methods have been used to remedy this problem and there is still a debate among scientists about which method is the most appropriate (see, e.g., Dollar and Kraay, 2004; and Lee *et al.*, 2004).

In this paper, our aim is to contribute to the on-going debate on the growth effect of trade by enriching the most global definition of trade openness. We argue that trade openness is a multidimensional concept that cannot be summarized to a single measure such as the commonly used trade ratio. Thus, following recent developments in growth theory and in international economics, we propose a more elaborated way of measuring trade openness taking into account two additional dimensions of countries' integration in world trade: the quality and the variety of the exported basket. Indeed, according to the existing literature both these factors are likely to affect positively growth, which call for considering them when measuring countries' trade openness in view of examining the relationship between trade and growth.

On the one hand, endogenous growth theory has provided a framework for a positive growth effect of trade through innovation incentives, technology diffusion and knowledge dissemination (see, e.g., Young, 1991; Grossman and Helpman, 1991). Inspired from these theoretical developments, Hausmann *et al.* (2007) proposed an analytical framework linking the type of goods (as defined in terms of productivity level) a country specializes in to its rate of economic growth. In order to test empirically for this relationship, they defined an index aiming at capturing the productivity level (or the quality) of the basket of goods exported by each country.

Using various panel data estimators during the period 1962 – 2000, their growth regressions showed that countries exporting goods with higher productivity levels (or higher quality goods) have higher growth performances. These results suggest that what countries export matters as regards the growth effect of trade. Hence, our measurement of trade openness should consider this quality dimension as a complement to the trade ratio (or the dependency) dimension.

On the other hand, monopolistic competition trade models with heterogeneous firms and endogenous productivity provide theoretical support for a positive impact of trade openness on growth. Indeed, the theory predicts a productivity improvement in the country due to the exit of less efficient firms after trade liberalization -or a reduction in transport costs for example- (e.g., Melitz, 2003). Furthermore, a higher share of the most productive firms will start exporting, which translates into an increase in the variety of exports. As exporters are more productive on average than domestic firms, an increase in exports variety can be associated to rising country productivity.

Based on this literature, Feenstra and Kee (2008) developed a model allowing to link, across countries and over time, relative export variety to total factor productivity using a GDP function. They tested this relationship on the basis of exports to the United States (US) for a panel of 48 countries over the period 1980-2000 using three stage least squares regressions. Their empirical results indicated that there is a positive and significant relationship between export variety and average productivity. Furthermore, computing the gains from trade in the monopolistic competition model of Melitz (2003), Feenstra (2010) shows that countries with a greater export over GDP ratio will experience higher gains in terms of GDP per capita growth, from export variety. Once again, these results suggest that, in addition to the trade dependency ratio, the structure of countries' exports matters regarding the growth effect. Hence, our measurement of trade openness should also consider this variety dimension.

Our empirical application draws on the Barro and Lee (1994)'s model, which has been extended to take into account our set of three indicators of trade openness: trade dependency ratio, quality index and variety index. Barro and Lee (1994) study empirical determinants of growth. They are in line with the endogenous growth theory. Unlike the usual neoclassical growth model for a closed economy (Solow, 1956), endogenous growth models take into account the sources of technological progress (human capital, role of government for instance). Thus, we include some proxies for trade openness in our empirical model as potential sources of technological change.

Estimations are performed on 5-year averaged data over the period 1980-2004 for an unbalanced panel of 158 countries. We use a Generalized Method of Moments (GMM) estimation approach developed for dynamic panel data models in order to deal with the potential endogeneity bias due to omitted variables, simultaneity and measurement error.

Our results confirm that countries more open to trade and exporting higher quality products experience higher growth. More importantly, we point out an interesting pattern of non linearity in the growth effect of the trade ratio: the higher the quality of the export basket of the country, the greater the positive impact of trade on economic growth. In addition, there is a minimum level of export quality under which trade can be detrimental to growth. This non-linear pattern in the trade to growth relationship is found for the whole sample and for various sub-samples of developing countries. It has particularly important implications for developing countries since as they often exhibit low quality export baskets, they are more likely to experience a negative trade impact on growth.

From our estimation results we also confirm a non linear relationship between the export variety and the trade ratio with growth. Export variety has often a positive impact on growth per se; but this relationship seems to exist until a certain degree of dependency of the economy on trade. As most developing countries are below this threshold, export diversification appears as an important strategy for them.

The remainder of the article is organized as follows. In the next section, we present the specification of performed growth regressions and the retained econometric methodology. Section 3 reports and discusses empirical results, while section 4 concludes.

2. Specification of growth regressions and econometric methodology

Inspired from Barro and Lee (1994)'s approach we retain the following specification:

$$\ln\left(\frac{GDP}{pop}\right)_{i,t} = \alpha \ln\left(\frac{GDP}{pop}\right)_{i,t-1} + \beta_1\, education_{i,t-1} + \beta_2 \ln(life)_{i,t-1} + \beta_3\left(\frac{I}{GDP}\right)_{i,t} + \beta_4\left(\frac{X}{GDP}\right)_{i,t} + \mu_i + \gamma_t + \nu_{i,t} \quad (1)$$

where the dependent variable is the logarithm of GDP per capita of country *i* for period *t*, with *GDP* corresponding to Gross Domestic Product and *pop* to the total population. Explanatory variables are the following. First, the initial level of GDP per capita is included to test for the impact of initial conditions. Countries' endowments in production factors are controlled for using

the initial level of human capital investment, which is approximated through the level of education (*education*) and the life expectancy at birth (*life*); and the physical investment as measured by the investment over GDP ratio $\left(\frac{I}{GDP}\right)$ [9]. The effects of education, life expectancy and investment ratio are likely to be positive. Finally, in order to test for the impact of trade on income per capita, we choose as a measure of trade openness the export ratio ($\frac{X}{GDP}$, i.e., exports over GDP), an export quality index $(Quality)$, an export variety index $(Variety)$ and the combined effect of the export ratio with each of these indices. We decided to choose the export ratio instead of the usual trade ratio ($\frac{X+M}{GDP}$, i.e, sum of exports and imports over GDP) in order to keep consistency with the quality and the variety indices which are concerned with growth mechanisms arising from the export side.

Thus, our two alternative specifications are:

- an extended specification including the export quality index (*Quality*) and its cross impact with the export ratio:

$$\ln\left(\frac{GDP}{pop}\right)_{i,t} = \alpha \ln\left(\frac{GDP}{pop}\right)_{i,t-1} + \beta_1\, education_{i,t-1} + \beta_2 \ln(life)_{i,t-1} + \beta_3\left(\frac{I}{GDP}\right)_{i,t} + \beta_4\left(\frac{X}{GDP}\right)_{i,t} + \beta_5 \ln(Quality)_{i,t} + \beta_6\left(\frac{X}{GDP}\right)_{i,t} * \ln(Quality)_{i,t} + \mu_i + \gamma_t + \nu_{i,t} \quad (2)$$

- an extended specification with the alternative export variety index (*Variety*) and its cross impact with the export ratio:

$$\ln\left(\frac{GDP}{pop}\right)_{i,t} = \alpha \ln\left(\frac{GDP}{pop}\right)_{i,t-1} + \beta_1\, education_{i,t-1} + \beta_2 \ln(Life)_{i,t-1} + \beta_3 \ln\left(\frac{I}{GDP}\right)_{i,t} + \beta_4\left(\frac{X}{GDP}\right)_{i,t} + \beta_5 (Variety)_{i,t} + \beta_6\left(\frac{X}{GDP}\right)_{i,t} * (Variety)_{i,t} + \mu_i + \gamma_t + \nu_{i,t} \quad (3)$$

The model includes time-specific effects (γ_t) accounting for period-specific effects such as productivity changes that are common to all countries or the global effect of US dollar

[9] Due to the lack of available data, general government final consumption expenditure ratio, black market premium and revolution variables used by Barro and Lee (1994) are not introduced here.

appreciation, country-specific fixed-effects (μ_i) that take into account country-specific features that are constant in time, such as geography, and an error term ($\nu_{i,t}$).

Our empirical estimation is run on an unbalanced panel of 158 countries for the period 1980-2004 using 5-year averaged data (except for initial GDP per capita, education and life expectancy that take the first observation within each period). As most explanatory variables are likely to be jointly endogenous with economic growth while important variables, e.g., the country-specific effects, are not observable and omitted in the estimation, estimating this model by Ordinary Least Squares (OLS) or Within group estimations would potentially lead to biased results. Thus, we use the System-GMM estimator developed for dynamic panel data models (Arellano and Bover, 1995; Blundell and Bond, 1998). The main advantage of this estimator is that it does not require any external instrument to deal with endogeneity.

Within the GMM approach, one may choose the first-differenced estimator, which considers regression equations in first-differences instrumented by lagged levels of explanatory variables. Taking first-differences eliminates country-specific fixed-effects, thus solving the problem of the potential omission of time invariant country specific factors that may influence growth. Nevertheless, the first-differenced GMM estimator (Arellano and Bond, 1991) is not suitable when time series are persistent and the number of time series observations is small, like in the case of empirical growth models where data has to be averaged[10] in order to avoid modelling cyclical dynamics (Bond *et al.*, 2001). Under these conditions, lagged levels of explanatory variables tend to be weak instruments for subsequent first-differences, thus producing biased estimates. Therefore, Arellano and Bover (1995) and Blundell and Bond (1998) suggest to retain the System-GMM approach, which combines - into one system - regression equations in first-differences and in levels, where instruments used for level equations are lagged first-differences of the series.

[10] Data is usually averaged over 5 years.

Hence, departing from this general model:

$$y_{i,t} = \alpha\, y_{i,t-1} + \beta' X_{i,t} + \tau_t + \eta_i + \nu_{i,t} \quad \text{for } i =,\ldots, \text{N and } t =2,\ldots, \text{T} \tag{4}$$

where

$\varepsilon_{i,t} = \eta_i + \nu_{i,t}$ has the standard error component structure:

$$\text{E}[\eta_i] = \text{E}[\nu_{i,t}] = \text{E}[\eta_i, \nu_{i,t}] = 0 \text{ for } i =,\ldots, \text{N and } t =2,\ldots, \text{T} \tag{5}$$

y is the dependent variable, X is the vector of explanatory variables, η_i and τ_t denote respectively unobserved country- and time-effects and $\nu_{i,t}$ is the idiosyncratic disturbance term.

We perform the following transformation to remove the unobserved individual effect:

$$y_{i,t} - y_{i,t-1} = \alpha\,(y_{i,t-1} - y_{i,t-2}) + \beta'(X_{i,t} - X_{i,t-1}) + (\tau_t - \tau_{t-1}) + (\nu_{i,t} - \nu_{i,t-1}) \tag{6}$$

Nevertheless, instead of using a "first-difference transformation" as is usually done, we perform a "forward orthogonal deviation". Thus, instead of subtracting the previous observation from the contemporaneous one, we subtract the average of all future available observations of a variable[11]. This way of dealing with heterogeneity allows us to preserve sample size in our unbalanced panel while still being able to use past values of explanatory variables as instruments (Arellano and Bover, 1995; Roodman, 2006).

Under the assumption of absence of serial correlation in the idiosyncratic disturbance terms on the one hand:

$$\text{E}[\nu_{i,t} \,.\, \nu_{i,s}] = 0 \text{ for } i = 1, \ldots., \text{N and } s \neq t\,, \tag{7}$$

that the initial conditions are predetermined on the other hand:

$$\text{E}[y_{i,1} \,.\, \nu_{i,t}] = 0 \text{ for } i =,\ldots,\text{N and } t =2,\ldots, \text{T}, \tag{8}$$

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[11] That is, for a variable w the transformation will be: $w_{i,t+1} \equiv c_{it}\left(w_{it} - \frac{1}{T_{it}} \sum_{s\rangle t} w_{is} \right)$ where the sum is taken over all available future observations T_{it}, and the scale factor c_{it} is $\sqrt{T_{it}/(T_{it}+1)}$.

the differenced equation (6) can be instrumented by lagged levels of explanatory variables (Arellano and Bond, 1991), using the following $m = 0.5(T-1)(T-2)$ moment conditions:

$$\mathrm{E}\left[y_{i,t-s} \,.\, \left(\nu_{i,t} - \nu_{i,t-1}\right)\right] = 0 \tag{9}$$

$$\mathrm{E}\left[X_{i,t-s} \,.\, \left(\nu_{i,t} - \nu_{i,t-1}\right)\right] = 0 \tag{10}$$

For t =3,…, T and $s \geq 2$

Furthermore, according to Blundell and Bond (1998), when combining equations (4) to (8) with two additional assumptions:

$$E\left[\eta_i \,.\, \left(y_{i,2} - y_{i,1}\right)\right] = 0 \tag{11}$$

$$E\left[\eta_i \,.\, \left(X_{i,2} - X_{i,1}\right)\right] = 0 \text{ for } i =,\ldots, \mathrm{N} \tag{12}$$

which are restrictions on the initial conditions of the data generating process[12]; $T-2$ additional moment conditions can be used:

$$\mathrm{E}\left[\varepsilon_{i,t} \,.\, \left(y_{i,t-1} - y_{i,t-2}\right)\right] = 0 \tag{13}$$

$$\mathrm{E}\left[\varepsilon_{i,t} \,.\, \left(X_{i,t-1} - X_{i,t-2}\right)\right] = 0 \text{ for } i =,\ldots, \mathrm{N} \text{ and } t =3,\ldots, \mathrm{T} \tag{14}$$

This allows the use of lagged first-differences of the series as instruments for equation in levels, as suggested by Arellano and Bover (1995).

[12] In our context, assumption (11) means for example that deviations of $y_{i,1}$ from long-run steady-state values must not depend on unobserved fixed-effects, even if the latest can affect the level of steady-state outputs. Bond *et al.* (2001) argue that this assumption may be valid in growth model frameworks, thus allowing us to use the System-GMM estimator in our model.

Thus, System-GMM estimator implies running a GMM procedure on the following system of equations:

$$y_{i,t} - y_{i,t-1} = \alpha\,(y_{i,t-1} - y_{i,t-2}) + \beta'(X_{i,t} - X_{i,t-1}) + (\tau_t - \tau_{t-1}) + (\nu_{i,t} - \nu_{i,t-1}) \quad (6)$$

and

$$y_{i,t} = \alpha\, y_{i,t-1} + \beta' X_{i,t} + \tau_t + \eta_i + \nu_{i,t} \quad (15)$$

In order to test for the appropriateness of our retained instruments, we consider two specification tests. The first one is the Hansen test of over-identification for which the null hypothesis is that the chosen instruments are valid. The second one examines whether the idiosyncratic disturbance term $\nu_{i,t}$ is serially correlated. The test is performed on the first-differenced error term (that is, the residual of equation (6)) and the null hypothesis is that the latter is second-order uncorrelated. In both cases, failure to reject the null hypothesis gives support to our retained specification.

3. Data and results

3.1. Data

To reduce the impact of business cycles, we use a total of five-year averaged data between 1980 and 2004 for an unbalanced panel of 158 countries (Appendix A provides the full list of countries in the sample). Most required data are extracted from the World Bank World Development Indicators (WDI) database, as it is the case for the following variables. The dependent variable is computed using the GDP per capita based on purchasing power parity (expressed in constant 2005 USD). The investment ratio is proxied through the gross fixed capital formation in percentage of GDP; the life expectancy at birth is the number of years one is expected to stay alive when birthing; and the education level is measured as the gross secondary school enrolment ratio. The export ratio is computed using GDP as well as values of exports of goods and services in current US dollars.

The export quality index is computed according to the Haussmann *et al.* (2007)'s approach and the variety indicator according to Feenstra and Kee (2008) and Feenstra (2010). They are both

computed based on export values in current US dollars extracted from the CEPII international trade database BACI (at a SITC2 disaggregated level). Further details on the definition and computation of these indicators can be found in Appendix B. Table 1 summarizes some basic descriptive statistics for all variables used in growth regressions.

Table 1: Descriptive statistics for variables used in the model

Variables	Obs	Mean	Std. Dev.	Min	Max
GDP per capita (constant 2005 USD)	756	9308.66	11578.08	108.21	94734.24
Education (%)	896	60.14	32.74	2.40	161.74
Life expectancy (years)	1147	64.62	10.21	30.47	81.08
Investment / GDP (%)	709	21.62	7.84	2.53	86.79
Exports / GDP (%)	736	35.22	24.03	2.76	199.12
Export quality (current USD)	756	7808.01	3681.57	1771.54	27594
Export variety (%)	756	66.94	27.02	5.11	1

Source: Authors' calculations

3.2. Empirical results

In this section we examine whether trade openness can be considered as a main determinant of growth. Results of the first regression (1) are reported as a benchmark in Table 2 since they refer to the specification including the export ratio as the single measure of trade openness. The quality and the variety index as additional measures of trade openness are presented in columns (2) and (4) respectively. Results of the regressions including in addition the cross effect of the export ratio with the quality and with the variety index are reported in columns (3) and (5) respectively.

As far as the first specification is concerned, Table 2 indicates that when trade openness is measured by the export ratio only, it does not appear as a significant determinant of growth. In line with Rodriguez and Rodrick (2001), this could be caused by two technical issues ; the first one being the endogeneity of trade as regard to growth and the second one being the way openness to trade is measured. We are confident that our empirical strategy allows us to deal properly with any kind of endogeneity. What we are interested in is then to check if this lack of statistical impact is originating from a wrongly specified measure of trade integration.

Interestingly, column (2) shows that when trade openness is measured by both the export ratio and the export quality index, the latter only has a positive and significant impact on GDP per capita growth. This result confirms Hausmann *et al.* (2007)'s result that a higher quality of exports enhances growth.

Finally, column (3) reveals an interesting non-linear pattern between trade openness and growth once the export ratio is crossed with the quality index, as both this variable and the export ratio appear statistically significant. Our estimation results suggest that trade may have a negative impact on growth when countries have specialized in low quality products; trade clearly enhances growth once countries have specialized in high quality products and their export basket exhibits a minimum required level of quality. The corollary is also true, as the higher the quality of the export basket, the greater the impact of the export ratio on growth. More specifically, Table 2 indicates that, all other things being unchanged, one percentage point increase in the export ratio would raise the 5-years average GDP per capita by (-0.057 + 0.006*Ln*Quality*). Hence, a minimum level of quality of the export basket is required (13 360 current USD) for the impact of the export ratio starts to be positive. As indicated by Table 1, this threshold is much higher than the average of the export quality index over the whole sample (7 808 current USD) suggesting that trade is likely to enhance growth only for countries which are used to exhibit high quality export baskets.

Once we exclude major oil exporting countries from the sample (column (3_o)), [13] results remain similar to those of specification (3), suggesting no specific behaviour for these countries. It is interesting to note that the minimum level of quality of the export basket required for a positive impact of the export ratio on the GDP per capita growth remains unchanged at 13 360 current USD.

Turning now to the variety dimension, specification (4)'s results show that when trade openness is measured by both the export ratio and the export variety index, the latter only has a positive and significant impact on GDP per capita. This result is in line with Feenstra and Kee (2008) and Feenstra (2010) which suggest that a higher variety of exports contributes to enhance growth.

However, the cross effect of the export ratio and the variety index does not appear statistically significant (column 5), while the impact of export variety remains so. Hence our results seem to suggest that when the variety of exports is considered, there are no complementarities between this and the export ratio; only the variety has a positive impact on growth. Nevertheless, results could be biased by the presence in our sample of oil exporting countries which exhibit particularly low export variety indices and high export ratios.

[13] A country is considered to be a major oil exporting country if on average, over the 1980-2004 period, the value of its oil exports account for more than 2/3 of the value of its total exports (these countries represents 10 per cent of the whole sample). One must underline that results are robust to changing this oil over total exports threshold to 50 per cent.

Indeed, when major oil exporting countries are excluded from the sample (specification (5_o)), one recovers the non-linear impact of trade on growth: the cross effect of the export ratio and the variety index becomes negative and statistically significant, and both the variety index and the trade ratio appear positive and significant. Results indicates that, all other things being unchanged, one percentage point increase in the export ratio would raise the 5-years average GDP per capita by (0.010 - 0.011*$Variety$). Hence, a maximum level of variety of the export basket is required (0.90) for the impact of the export ratio to remain positive. Since, as indicated by Table 1, most observations of our sample are below this threshold, we can conclude that the export ratio has nearly always a positive effect on GDP per capita. The corollary would be that the impact of an increase in the export variety on growth is positive until a certain degree of dependency of the economy on exports (the export ratio has to remain below 51 per cent). As indicated by Table 1, this threshold is higher than the average of the export ratio over the whole sample (35.22 per cent).

Regarding control variables, Table 2 shows that initial GDP per capita exhibit an expected positive and close to 1 statistically significant coefficient. Among the main growth determinants considered by Barro and Lee (1994), the investment ratio has an expected positive and significant impact in most of the specifications. In terms of human capital, nor the secondary enrolment ratio nor the life expectancy at birth have a significant impact on GDP per capita growth. This is puzzling but may be due to the fact that these variables have a long term impact on development and not a contemporaneous one. Finally, it should be noted that for all estimations, Hansen and AR(2) specification tests give support to our retained GMM-System estimator. The lagged variables that are chosen appear as good instruments in the present context.

Table 2: Growth regressions results using a System-GMM estimator

	Total sample					Without oil	
Ln (GDP/pop) final	(1)	(2)	(3)	(4)	(5)	(3_o)	(5_o)
Ln (GDP/pop) init.	1.089***	0.983***	0.924***	1.022***	1.019***	0.930***	0.993***
	(0.076)	(0.054)	(0.041)	(0.064)	(0.042)	(0.043)	(0.031)
Education	-0.002	-0.001	-9.35e-05	-0.007	-0.000	0.000	-0.000
	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
I/GDP	0.026**	0.010	0.011	0.025**	0.022***	0.0070**	0.002
	(0.012)	(0.007)	(0.007)	(0.01)	(0.007)	(0.003)	(0.004)
Ln (life expec.)	-0.809	-0.512	-0.160	-0.622	-0.678*	-0.174	-0.297
	(0.603)	(0.456)	(0.184)	(0.43)	(0.347)	(0.194)	(0.199)
X/GDP	0.002	0.001	-0.057*	0.000	0.006	-0.038*	0.010**
	(0.003)	(0.001)	(0.032)	(0.001)	(0.005)	(0.022)	(0.004)
Ln (quality)		0.297**	0.117			0.130	
		(0.124)	(0.107)			(0.112)	
X/GDP* Ln (quality)			0.006*			0.004*	
			(0.003)			(0.002)	
Variety				0.299*	0.566*		0.562**
				(0.181)	(0.310)		(0.242)
X/GDP* variety					-0.008		-0.011**
					(0.006)		(0.004)
Constant	2.004	-0.481	0.105		1.778*	0.039	0.819
	(1.764)	(1.287)	(0.829)		(1.069)	(0.964)	(0.688)
Observations	636	636	636	636	636	575	575
Number of countries	158	158	158	158	158	140	140
AR(2) test p-value	0.144	0.224	0.204	0.12	0.134	0.439	0.532
Hansen test p-value	0.583	0.199	0.172	0.25	0.373	0.229	0.106

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Estimation method: two-step GMM system (Arellando and Bover, 1995; Blundell and Bond, 1998) with Windmeijer (2005) correction and orthogonal deviation. Weakly exogenous variables used as instruments are education and life expectancy 2nd lag (3rd lag for column (3_o)) and investment, export ratio, export quality and multiplicative interaction terms 3rd lag. Exogenous variables used as instruments are year dummies (Roodman, 2006) for the system; and the predetermined variable initial GDP per capita which is only used for the level equation.

Source: Authors' calculations.

To check the robustness of our results we performed the same regressions on various sub-samples covering different groups of developing countries defined according to the 2005 World Bank classification (Table 3). We work first with the sub-sample of Developing Countries (DC)[14]; and within it, with Low Income Countries (LIC) and Lower Middle Income Countries (LMIC)[15]. As done previously, we also consider the corresponding sub-samples excluding the major oil exporting countries.

For the estimations with the quality index crossed with the export ratio, results obtained for these sub-samples are similar to previous one. In particular, we recover the non-linear pattern

[14] Countries with a real GDP per capita in 2005 below 10 065 USD.
[15] Countries whit a real GDP per capita in 2005 below 3 255 USD.

between trade openness and growth. Estimates indicates that the minimum level of quality of the export basket required for the impact of the export ratio starts to be positive are 4 649 USD, 4 914 USD and 3 966 USD for respectively DC without major oil exporting countries, LIC&LMIC and LIC&LMIC without major oil exporting countries. Taking the last period of our sample (2000-2005), countries below this threshold are mainly African least developed countries[16]. This suggest that increasing the dependency of their economy to trade without ensuring an improvement of the quality of their exports may have negative consequences in terms of growth. Thus, a strategy to add value-added to trade seems crucial for them.

As for estimations with the variety index crossed with the export ratio, results are robust for LIC&LMIC; estimates confirm the non-linear relationship between trade dependency, export variety and growth. Indeed, specifications (5'_o), (5") and (5"_o) show that while the export variety index has no longer a significant impact on GDP per capita alone, the cross effect with the export ratio is now positive and significant; indicating that for the LIC&LMIC group, trade dependency and variety contribute jointly to increase GDP per capita.

[16] Burundi, Benin, Burkina Faso, Central African Republic, Comoros, Ethiopia, Guinea, Mali, Malawi, Solomon Islands, Chad, Uganda, and Congo, Dem. Rep.

Table 3: Robustness analysis using various sub-samples of developing countries

	DC		LIC&LMIC		DC without oil		LIC&LMIC without oil	
Ln (GDP per capita final)	(3')	(5')	(3")	(5")	(3'_o)	(5'_o)	(3"_o)	(5"_o)
Ln (GDP per capita init.)	1.297***	1.227***	0.954***	0.988***	0.944***	1.026***	0.922***	0.998***
	(0.409)	(0.151)	(0.060)	(0.074)	(0.087)	(0.093)	(0.056)	(0.096)
Education	-0.008	-0.004	-0.005**	-0.002	-0.004**	-0.003	-0.006***	-0.005*
	(0.016)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)	(0.003)
I/GDP	0.023	0.008	0.012***	0.013***	0.014***	0.013***	0.012***	0.013***
	(0.014)	(0.014)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ln (life expec.)	-1.858	-3.205**	0.557**	-0.227	0.331	-0.246	0.591**	-0.266
	(1.261)	(1.253)	(0.245)	(0.590)	(0.373)	(0.686)	(0.237)	(0.800)
X/GDP	0.025	0.016	-0.051**	-0.002	-0.076***	-0.000	-0.058***	0.001
	(0.059)	(0.010)	(0.024)	(0.003)	(0.021)	(0.002)	(0.020)	(0.003)
Ln (quality)	0.263		-0.096		-0.137		-0.135	
	(0.432)		(0.083)		(0.088)		(0.102)	
X/GDP* Ln (quality)	-0.002		0.006**		0.009***		0.007***	
	(0.006)		(0.002)		(0.002)		(0.002)	
Variety		2.091**		0.031		0.127		0.235
		(0.881)		(0.176)		(0.225)		(0.236)
X/GDP* variety		-0.007		0.008**		0.005		0.008*
		(0.014)		(0.004)		(0.005)		(0.004)
Constant	2.651	9.859**	-1.166	0.746	0.116	0.529	-0.817	0.742
	(2.762)	(4.003)	(1.032)	(1.813)	(1.296)	(2.153)	(1.031)	(2.485)
Observations	462	462	265	265	420	420	239	239
Number of panelid	120	120	74	74	107	107	65	65
AR(2)test p-value	0.108	0.289	0.128	0.099	0.353	0.253	0.332	0.291
Hansen test p-value	0.158	0.779	0.108	0.146	0.053	0.001	0.167	0.116

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Estimation method: two-step GMM system (Arellando and Bover, 1995; Blundell and Bond, 1998) with Windmeijer (2005) correction and orthogonal deviation. All instruments are collapsed (Roodman, 2006).
All estimations are run using the 1rts lag and further of weakly exogenous variables (as defined in Table 2)[17]. Exogenous variables used as instruments are year dummies (Roodman, 2006) for the system and the predetermined variable initial GDP per capita for the level equation. Source: Authors' calculations.

[17] Except for specifications (3')-(5') that use only the 3rd lag for all instruments and (5"_o) which uses only the 1rst lag for the investment ratio, export ratio, export variety/quality and the multiplicative interaction term as instruments.

4. Conclusion

This paper investigates the relationship between trade openness and growth. Starting from the idea that trade openness cannot be fully characterized through trade flows only, we propose to account for two additional dimensions of countries' trade integration: export quality and export variety. Then, following Barro and Lee (1994), standard growth regressions are performed where, among the explanatory variables, the commonly used trade ratio (here the export ratio) is complemented by the Haussmann *et al.* (2007)'s export quality index or the Feenstra and Kee (2008)'s export variety index. Our empirical application is based on annual data over the period 1980-2004 for an unbalanced panel of 158 countries. As most explanatory variables are likely to be jointly endogenous with economic growth, we use the System-GMM estimator developed for dynamic panel data models.

Our empirical results are in line with New International Economics insights that regarding the relationship between trade openness and growth in addition to the trade ratio, the quality and the variety of the export basket matter. We point out an interesting non-linear pattern between trade openness and growth when export quality is taken into account: trade may have a negative impact on growth when countries have specialized in low quality products; trade clearly enhances growth once countries have specialized in high quality products and their export basket exhibits a minimum required level of quality. Therefore, there is some pattern of complementarity between trade dependency and trade in quality so that the higher the quality of the export basket, the greater the impact of the export ratio on growth.

Estimation results also suggest a non-linear relationship between trade and growth when the variety of exports is taken into account, as the impact of an increase in the export variety on growth seems positive until a certain degree of dependency of the economy on exports. For most developing countries, we find some pattern of complementarities between trade dependency and variety: the export ratio has a positive impact on GDP per capita and the higher the variety of the export basket, the higher the impact of the trade ratio. It is interesting to note that the cross effect of the trade ratio and trade in variety clearly relates to changes at the intensive margin and at the extensive margin of trade (even if our export ratio cannot be properly disentangled between the two margins). Hence, further investigations are required to clarify the role of trade dependency and trade in variety as regards the relationship between trade and growth.

From an economic policy perspective, these results advocate for investing in productive capacity to move developing countries' exports up the quality chain. Also, they suggest that facilitating access to the export market for new exporters, through export promotion agencies for example, can have important implications for development. As aid for trade, and in particular aid for building productive capacity, intends to focus on these matters, further evidence on its link with the quality and the variety of exports seems to be necessary.

Appendix

Appendix A: list of countries

Afghanistan
Angola
Albania
United Arab Emirates
Argentina
Armenia
Antigua and Barbuda
Australia
Austria
Azerbaijan
Burundi
Benin
Burkina Faso
Bangladesh
Bulgaria
Bahrain
Bahamas, The
Belarus
Belize
Bolivia
Brazil
Barbados
Brunei Darussalam
Bhutan
Central African Republic
Canada
Switzerland
Chile
China
Cote d'Ivoire
Cameroon
Congo, Rep.
Colombia
Comoros
Cape Verde
Costa Rica
Cyprus
Czech Republic
Germany
Djibouti
Dominica
Denmark
Dominican Republic
Algeria
Ecuador
Seychelles
Syrian Arab Republic
Chad
Togo
Thailand
Tajikistan
Tonga
Trinidad and Tobago
Egypt, Arab Rep.
Eritrea
Spain
Estonia
Ethiopia
Finland
Fiji
France
Gabon
United Kingdom
Georgia
Ghana
Guinea
Gambia, The
Guinea-Bissau
Equatorial Guinea
Greece
Grenada
Guatemala
Guyana
Hong Kong SAR, China
Honduras
Croatia
Hungary
Indonesia
India
Ireland
Iran, Islamic Rep.
Iceland
Israel
Italy
Jamaica
Jordan
Japan
Kazakhstan
Kenya
Kyrgyz Republic
Cambodia
Kiribati
Korea, Rep.
Lao PDR
Lebanon
Liberia
Libya
St. Lucia
Tunisia
Turkey
Tanzania
Uganda
Ukraine
Uruguay
United States
Uzbekistan
Sri Lanka
Lithuania
Latvia
Morocco
Moldova
Madagascar
Maldives
Mexico
Macedonia, FYR
Mali
Mongolia
Mozambique
Mauritania
Mauritius
Malawi
Malaysia
Niger
Nicaragua
Netherlands
Norway
Nepal
New Zealand
Oman
Pakistan
Panama
Peru
Philippines
Papua New Guinea
Poland
Portugal
Paraguay
Qatar
Romania
Russian Federation
Rwanda
Sudan
Senegal
Solomon Islands
Sierra Leone
El Salvador
Suriname
Slovak Republic
Slovenia
Sweden
St. Vincent and the Grenadines
Venezuela, RB
Vietnam
Vanuatu
Yemen, Rep.
South Africa
Congo, Dem. Rep.
Zambia

Appendix B: The quality and the variety indices

The quality index

The quality of the export basket is constructed following Haussman *et al.* (2007). First, they propose an index called PRODY that attributes a level of productivity to each *k* (HS-6) line. The total exports for a country *i* is,

$$X_i = \sum_{k=1}^{n} x_{ik}$$

And the level of productivity $PRODY_k$ associated to each *k* (HS-6 line) is constructed as

$$PRODY_k = \sum_i \frac{(x_{ik}/X_i)}{\sum_i (x_{ik}/X_i)} Y_i, \quad (1B)$$

where Y_i is the GDP per capita in Purchasing Power Parity of each country *I*, $\sum_i (x_{ik}/X_i)$ is the sum of the share of product *k* exported in all countries.

This index is a variant of the Balassa's index of revealed comparative advantage. This way, exports from developed countries are considered as more productive that the ones coming from developing economies.

Finally, the level of productivity associated to the export basket of each country *i* is,

$$EXPY_i = \sum_k \left(\frac{x_{ik}}{X_i}\right) PRODY_k. \quad (2B)$$

Thus, it depends on the degree of concentration of the export basket, weighted by the quality of the products exported. The underlying idea behind this indicator is that diversifying its exports basket away from products of low productivity may accelerate subsequent growth. We compute a yearly EXPY*i* indicator.

The variety index

In order to allow comparability of the index between countries and time, the export variety (or extensive margin of exports) is constructed following a modified version proposed by Feenstra and Kee (2008) of the Hummels and Klenow (2005) index.

Hummels and Klenow (2005) propose a measure of "extensive margin" of trade that is consistent with product variety for a constant elasticity of substitution function. This indicator can be defined as changes in exports or imports that are due to changes in the number of goods (a change in the variety of products) rather than changes in the amount purchased of each good. Besides the fact that this formula is consistent with trade theory, we choose it among all the definitions of extensive margin available in the literature review because it takes into account the importance of the traded good instead of roughly counting lines.

The construction of the indicator is based on the idea that exports from countries *h* and *F* differ but have some products varieties in common. This common set is denoted by $J \equiv \left(J_{it}^{h} \cap J_{it}^{F}\right) \neq \varnothing$. An inverse measure of export variety from country *h* will be defined by

$$\lambda_{it}^{h}(J) \equiv \frac{\sum_{j \in J} p_{it}^{h}(j) q_{it}^{h}(j)}{\sum_{j \in J_{it}^{h}} p_{it}^{h}(j) q_{it}^{h}(j)} \quad . \tag{3B}$$

Therefore, the ratio $\left[\frac{\lambda_{it}^{F}(J)}{\lambda_{it}^{h}(J)}\right]$ measures the export variety of country *h* relative to country *F*. It increases with the variety exported from country *h*, and decreases with the variety exported from country F. Thus, to be measured, this indicator needs a consistent comparison country F.

Feenstra and Kee (2008) use the worldwide exports from all countries to the United States (US) as benchmark. Indeed, the US appear as the mayor partner in terms of imported variety (US imports almost 99 per cent of all the varieties existing) and provides highly disaggregated trade databases (until 10 digit codes). Nevertheless, as Feenstra and Kee (2008) noted, it would be preferable to use countries' worldwide exports instead of US imports. Indeed, this restriction makes the measure dependent to the import structure of the US. And for countries that export goods that have a small value in the import structure of this partner, or that do not export some kind of varieties to it (mostly developing countries), the magnitude of their export variety will appear under-evaluated. Thus, in order to correct for these effects we prefer to

work with the entire world as the benchmark *F*, as in Hummels and Klenow (2005), even if this forces us to use only HS-6 desegregated trade data.

Moreover, we need a benchmark *F* that doesn't change thought time, in order to associate any variation in the indicator to a variation in the export variety of the country *h*. So, following Feenstra and Kee (2008) we take the union of all products sold in the world market in any year over the period 1980-2004, and we average real exports sales of each product over years. In this way, $J_i^F \equiv \cup_{h,t} J_{it}^h$ is the total set of varieties imported by the entire world in sector *i* over all years, and $p_i^F(j)q_i^F(j)$ is the average real value of world imports for product *j* (summed over all source countries and averaged across years). Then, comparing country *h* to the world (*F*) allows us to set $\lambda_{it}^h(J) = 1$ and the export variety by country *h* takes the form:

$$\mathrm{A}_{it}^h \equiv \frac{\lambda_{it}^F(J)}{\lambda_{it}^h(J)} = \frac{\sum_{j \in J_{it}^h} p_{it}^F(j) q_{it}^F(j)}{\sum_{j \in J_i^F} p_i^F(j) q_i^F(j)} \quad . \tag{4B}$$

Thus, export variety only changes due to variations in the numerator, and thus, due to changes in the set of goods sold by the country *h*. This allows us to do comparison of export varieties across countries and over time. Moreover, this indicator goes beyond a simple count of trade lines, because it takes into account the relevance of the sector *i* (HS-6 line) in world trade.

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PART II: AID FOR TRADE EFFECTIVENESS

Chapter 3: Aid for Trade, a Selected Survey[18]

1. Introduction

Although the debate is still ongoing among economists, a wide share of existing theoretical and empirical literature supports the idea that trade can be a powerful engine to enhance economic development and poverty reduction (Winters *et al.*, 2004). Relying on this view, the aim of the World Trade Organisation (WTO) is to promote and enforce rules which favour trade between countries. Reducing tariff and non-tariff barriers in order to increase market access to foreign exporters is part of these rules. However, it has been shown that some countries, specifically the least developed ones, are not able to take advantage of increased market access due to internal obstacles to trade, such as a lack of knowledge, excessive bureaucracy, insufficient financing or poor infrastructure, weak productive capacity and low competitiveness (Hoekman and Nicita, 2008; Portugal-Perez and Wilson, 2008; Huchet-Bourdon *et al.*, 2009). Based on this feature, at least partly, development issues have emerged as a key element in the

[18] This chapter has been co-authored with Marilyne Huchet-Bourdon and Chantal Le Mouël. It is available as a working paper from the French Development Agency.
Vijil, M., Huchet-Bourdon, M. and Le Mouël C., (2011). "Aid for Trade: A Survey" Working Paper 110, Agence Française de Développement, April.

discussions and debates within the Doha Round of multilateral trade negotiations under the WTO.

In that context, the importance of Aid for Trade (AfT hereafter) was officially endorsed at the 6th Ministerial Conference in Hong Kong in December 2005. Since then, AfT has been increasingly pointed to as a promising new development tool for helping developing countries to benefit from WTO agreements and more broadly for expanding their trade (OECD, 2006, 2009; Helble *et al.*, 2009). At the same time, AfT definition has been enlarged to include support to trade-related infrastructures, productive capacities and trade related adjustment.

Even if trade-related aid has always existed as part of Official Development Assistance (ODA) flows[19], the official creation of aid for trade has put a new light on these specific aid flows and launched discussions and debates on their effectiveness[20]. The concept, the definition and the effectiveness of the aid for trade category have been widely discussed in the literature (OECD, 2006, 2009; Hoekman and Wilson, 2010). On the other hand, some studies deal with the effectiveness issue empirically, by providing methods to identify the needs of potential recipient countries as regards aid for trade (Gamberoni and Newfarmer, 2009; Huchet-Bourdon *et al.*, 2009). The general insight that emerges from these existing studies is that it is very difficult to get a clear picture of both what aid for trade actually is and how it should be distributed across countries from an economic point of view. In addition, the fact that there is only few available work providing empirical results on the aid for trade impact on recipient countries' trade does not help to make the picture clearer. There are however some studies, not directly dealing with aid for trade but concerned with trade costs, which provide useful insights as regards the aid for trade issue (Hoekman and Nicita, 2008; Portugal-Perez and Wilson, 2008, for instance).

The objective of this chapter is not to bring answers to all the above mentioned questions on aid for trade but to contribute to clarifying the issue by providing a picture, as comprehensive as possible, of what is currently known about aid for trade.

For that purpose, in the following section we propose, inspired from OECD (2006, 2009) but updated with our own computations, an overview of what aid for trade is both formally and from an empirical perspective. In section 3, we review existing empirical studies that bring information on the extent to which aid for trade may impact recipient countries' trade. We

[19] See the glossary in Appendix for more details.
[20] According to the OECD, aid effectiveness is about improving the management, delivery and complementarity of development co-operation activities to ensure the highest development impact.

distinguish studies that analyse directly the effects of AfT on trade flows from those which measure these effects indirectly, through some identified transmission channels that will be assimilated to "trade costs". These costs are linked to the AfT categories discussed in section 2. Finally, section 4 concludes.

2. Definition and overview of Aid for Trade

2.1. The origins and definition of Aid for Trade

2.1.1. Definition

During the Uruguay Round negotiations, many developing countries started to be full participants of the multilateral trading system, and agreed as part of the Single Undertaking to submit schedules of concessions and commitments on market access, intellectual property rights and the service sector (OECD, 2006). To help developing countries to address the challenge of monitoring their trade and trade policy in order to meet their WTO commitments, the 1994 Marrakesh declaration and several agreements explicitly acknowledge the need and the best way to provide trade-related technical assistance to these countries, particularly the least developed ones. Nevertheless, Uruguay Round commitments appeared quickly hard to apply because of a lack of institutional capacities in developing countries. Moreover, these countries finally realised that the Uruguay Round agreement could not address their main concerns. One may recognise here that the lack of experience of developing countries in WTO talks, and their limited capacity for identifying their trading interests, build a strong negotiation position and promote it during negotiations diminished their influence on the design of the new trading rules.

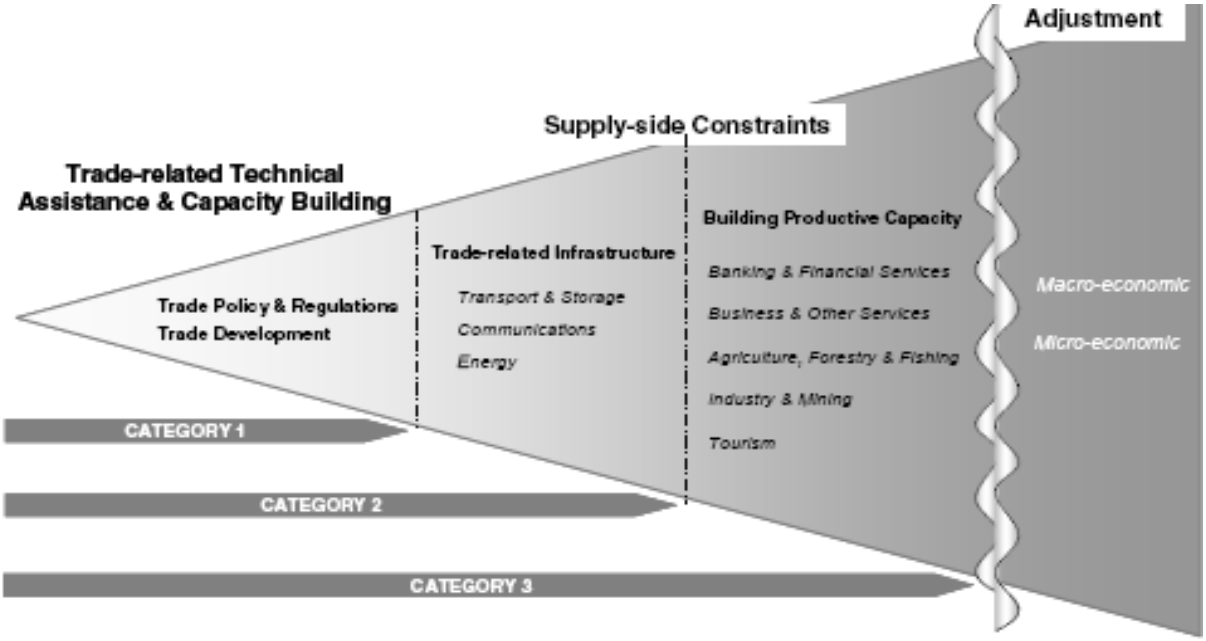
In response to this, immediately after the end of the Uruguay Round Agreement was established the Joint Integrated Technical Assistance Program (JITAP) aimed at helping African countries participate in WTO negotiations and take advantage of new trade opportunities arising from the globalisation of markets. Furthermore, in 1997 WTO members adopted the Integrated Framework (IF) for Trade-Related Technical Assistance to the Least Developed Countries, an initiative for straightening Least Developed Countries (LDC)'s trade capacities by integrating this issue into national development plans such as the Poverty Reduction Strategy Paper (PRSP)[21]. It

[21] Following the IMF definition, Poverty Reduction Strategy Papers (PRSP) describe a developing country's macroeconomic, structural and social policies and programs over a three year or longer horizon to promote broad-based growth and reduce poverty, as well as associated external financing needs and major sources of financing.

should be noticed that this program can be considered as a turning point, since it introduced important aspects of aid for trade in the debate, like coordination and demand-driven responses to developing countries' needs. Finally, these two programs gave birth to what is called the "narrow" definition of aid for trade, which includes only the technical assistance package.

Later, during the 2005 Hong Kong Ministerial Conference of the Doha Development Agenda, the World Bank (WB) and the International Monetary Fund (IMF) proposed a framework named "Aid for Trade" initiative, aimed at promoting an engagement of both donors and developing countries to support the development of trade in developing countries. The Task Force group bringing together donors and developing countries worked on AfT and concluded that to support effectively developing countries, especially LDCs, the definition of AfT had to be widened, including traditional instruments such as trade-related technical assistance but also trade-related infrastructure developments, supply-side capacity aid and trade-related adjustments cost, named the "broad" definition of aid for trade (Figure 1). Within this enlarged framework, it should be noticed that G8 countries in Gleneagles committed to double 2005 volumes of aid for trade before the year 2010, which is significant considering that volumes of this kind of assistance had been stagnant since several past years. Lastly, WTO members recognised the major role played by this initiative as a complement of the Doha Round, not as a substitute for market access during negotiations. Different pledges were made by donor countries: the G8, the European Union and Japan. Some pledges concern only ODA, others include other instruments such as concessional loans not eligible for ODA.

Figure 1: Narrow and broad definition of Aid for Trade



Source: OECD (2006)

To be considered as part of the aid for trade agenda, projects and programs need to be linked to trade-related development priorities in the partner country's national development strategy. For the purpose of this study, assistance flows will be analysed within the framework of the broad definition of aid for trade and considering only ODA flows.

2.1.2. Database information

There are only two sources of data to track aid for trade flows: the trade related technical assistance and capacity building database (TCB) constructed jointly by OECD/WTO, and the Credit Report System (CRS) database from the OECD employed to monitoring ODA. The first one gives us more detailed information, but is available only since 2000 and covers only the trade policy and regulation and trade development component (that is category 1 in Figure 1) of aid for trade. Moreover, this database does not follow precise rules of reporting, does not include ODA and non ODA financing and has been stopped in 2006. By contrast, the CRS provides us with data since 1995 covering the overall ODA. In addition the CRS database reports amounts of

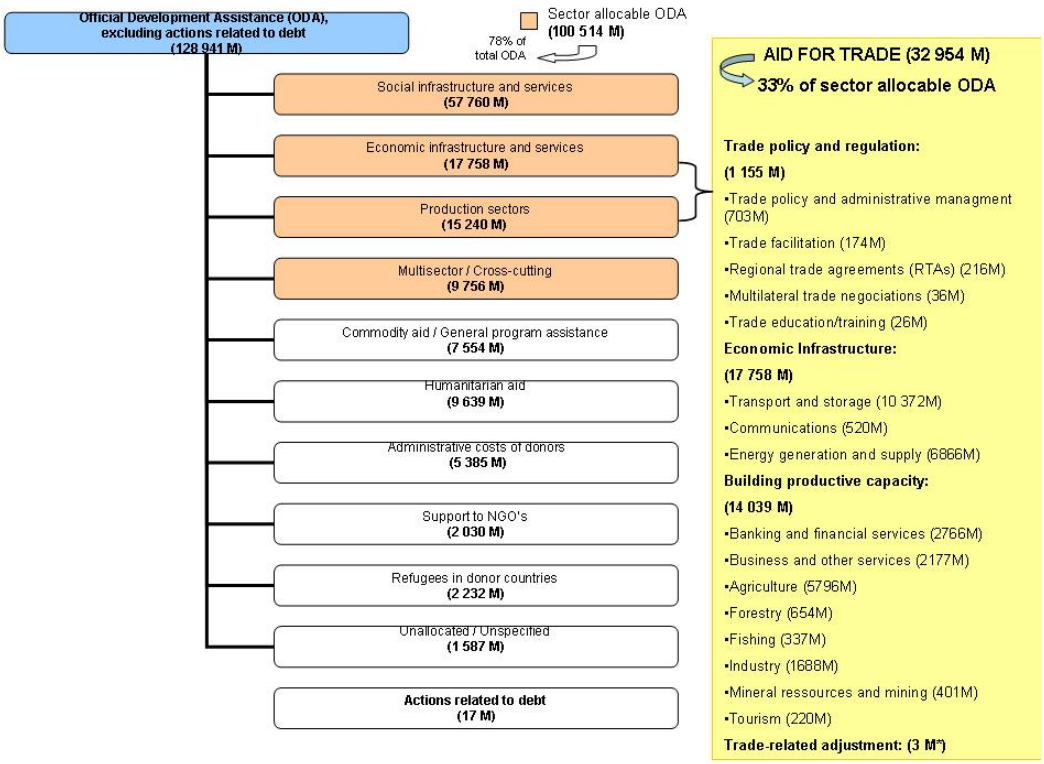
both aid commitments and aid disbursements.[22] Thus, the CRS database contains the data relating to the broad definition of AfT (categories 1, 2 and 3 and the trade-related adjustment costs of Figure 1) and such data are comparable across countries and over time. As the CRS database covers the overall ODA, it also offers the possibility to address the issue of the additionality of aid flows.[23] Nevertheless this database does not cover aid flows allocated by countries that aren't members of the Development Assistance Committee, like China. Moreover, in order to be accounted, aid flows need to be given at concessional financial terms (if it is a loan, it needs to have a grant element of at least 25 per cent).

For this study we retain the CRS database. As shown in Figure 2, in this database ODA is organised in 11 categories. Among these 11 categories, 4 report what is called "sector allocable aid" flows: "social infrastructure and services", "economic infrastructure and services", "production sectors" and "multisector/cross-cutting". The remaining 7 categories report aid flows that are not related to any sectors. Consequently, these 7 categories cover the so called non-sector allocable aid. Figure 2 indicates that over the 2006-2008 period, the overall ODA flows commitments (excluding actions related to debt) reached in average 129 billion (constant 2008) USD per year. Among these 129 billion, nearly 100.6 billion corresponded to sector allocable aid.

[22] Figures provided in this chapter relate to commitment flows. The main reason for this choice is that in the CRS database commitment data are more complete and of better quality than disbursement data. See the glossary in Appendix for definitions of commitment and disbursement.

[23] When the amount of one aid category increases, it can be due to an absolute increase of the total amount of aid or to a reallocation of flows within a constant total amount. The first case corresponds to what is called additionality.

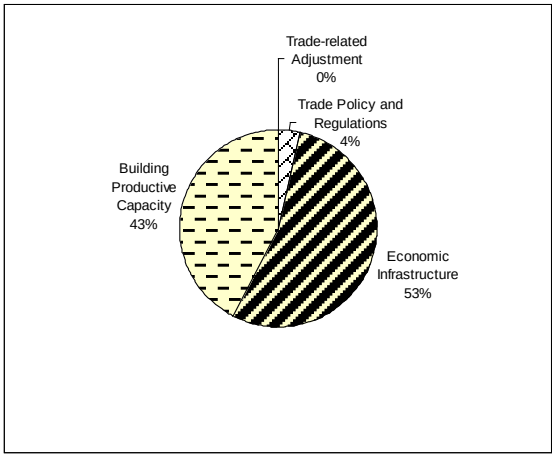
Figure 2: 2006-2008 average official development assistance commitments in millions (constant 2008) USD



*2007-2008 average amounts due to the inexistence of this category before 2007.
Note : The Credit Reporting System introduced recently a "trade development policy marker" for the donors to report information on the share of their "productive capacity building" aid that effectively enhance trade. This marker allows us to identify quantitatively the "trade development" component of Figure 1. Nevertheless, over the 41 donors only 13 used the trade marker in 2007 and 21 in 2008. Thus, this study will not include "trade development" amounts.
Source: OECD Credit Reporting System, 2010

As the CRS database was created prior to the official birth of AfT, it is not surprising that the 11 ODA categories do not include an AfT category *per se*. However, as shown by Figure 2, it is possible to recover AfT flows, whatever the narrow or the broad AfT definition retained, since all categories composing AfT are identified as categories of 2 ODA sector allocable categories "economic infrastructure and services" and "production sectors". Figure 2 shows that over the 2006-2008 period the overall AfT flows accounted in average for 33 billion USD per year, that is 33 per cent of the 100.6 billion USD ODA sector allocable aid and 25 per cent of the 129 billion USD average ODA aid flows.

Figure 3: Aid for Trade commitments distribution by category (2006-2008 average in %)



Source: OECD Credit Reporting System, 2010

In the CRS database, overall AfT flows are split into the 4 categories corresponding to the broad definition of AfT as reported in Figure 1: "trade policy and regulation" (named trade policy and regulation in figure 1), "economic infrastructure" (named trade-related infrastructure in figure 1), "building productive capacity" which also includes the "trade development" in Figure 1, and "trade-related adjustment". Figure 2 indicates that over 2006-2008, on average 1 billion USD per year were devoted to the "trade policy and regulation" category, 17.7 billion to the "economic infrastructure" category, 14 billion to the "building productive capacity" category and 0.003 billion to the "trade-related adjustment" category. In other words, the largest share of AfT flows (53 per cent) was distributed through programmes and projects contributing to economic infrastructures (including transport and storage, communication and energy generation and supply) while programmes and projects directed to trade and policy regulation (including, among others, trade facilitation and trade agreements) and to trade-related adjustment accounted for the lowest shares of AfT flows (4 per cent and nearly 0 per cent respectively) (Figure 3). Programmes and projects aimed at building productive capacity were devoted 43 per cent of the overall AfT flows. At this stage, two remarks are in order. Firstly the marginal share of AfT flows devoted to trade-related adjustment, as reported in 2006-2008 average figures, may result from the fact that this category was created in the CRS database in 2007 only and until now only 3 donors have notified their commitments in this category (Australia, Canada and the European Commission), and not in a systematic way. Secondly, one must be aware that above mentioned AfT flow shares do not automatically reflect donor countries' priorities, but are likely to indicate

that projects and programmes in the "economic infrastructure" and the "building productive capacity" categories are generally more capital-intensive than those from the two other categories.

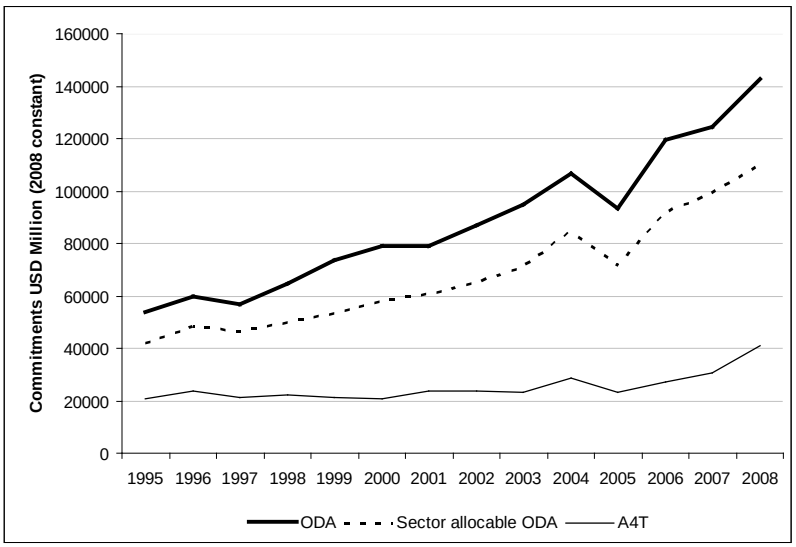
2.1.3 Evolution of Aid for Trade commitments

Figures 4 and 5 show that total ODA and sector allocable ODA commitments have more than doubled in volume over the period 1995-2008, with a substantial increasing trend since 2000 and the Paris Declaration on Aid Effectiveness.[24] Moreover, aid for trade also doubled in volume since 1995. Peaks observed in all 3 reported series between 2003 and 2008 seem to be caused both by the three years programme cycles in force in some important donor countries and by the evolution of the euro-dollar exchange rate.[25] Nevertheless, even if the volume of AfT has been rising over the 1995-2008 period, Figure 5 indicates that its share in total sector allocable ODA has declined from 49 per cent in 1995 to 37 per cent in 2008. In other words, the AfT increase in volume did not result from a diversion of resources to the expense of other social or economic sectors. This observed trends illustrate the crucial importance of paying attention to the share evolution of AfT in total and sector allocable ODA in addition to the evolution in volumes.

[24] The Paris Declaration endorsed on 2 March 2005 is an international agreement according 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 using a common set of monitorable actions and indicators (OECD, 2005).

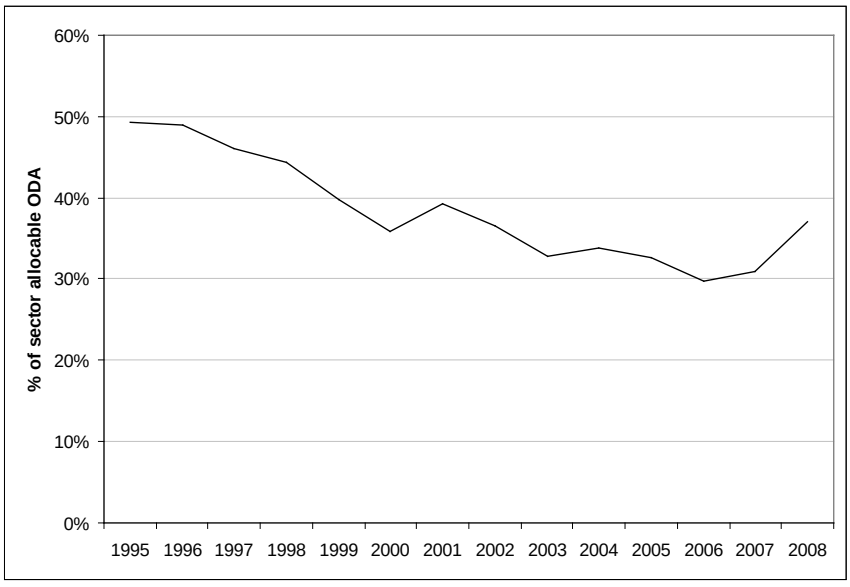
[25] The dollar has been depreciating against the euro over this period.

Figure 4: Medium-term trends in ODA and Aid for Trade (million constant 2008 USD)



Source: OECD Credit Reporting System, 2010.

Figure 5: Aid for Trade in total sector allocable ODA (%)

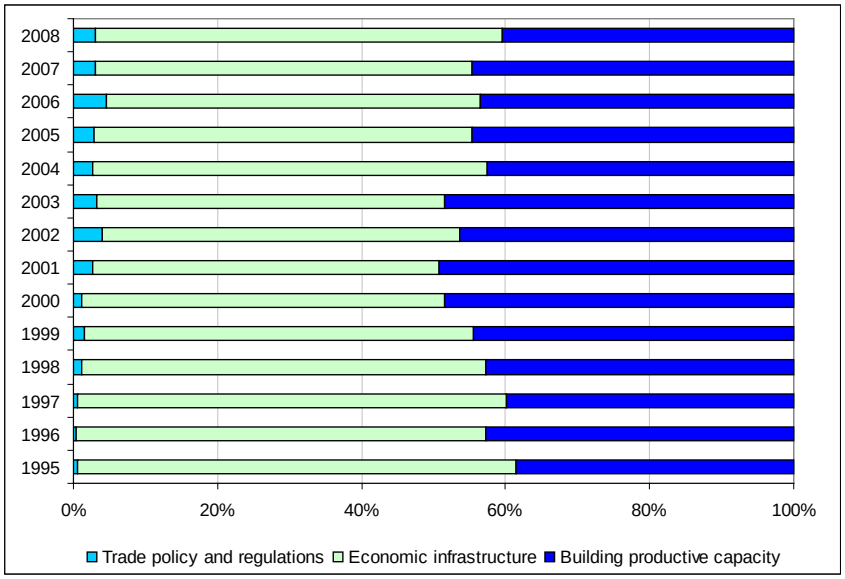


Source: OECD Credit Reporting System, 2010.

As shown by Figure 6, the shares of the various categories of AfT have been rather stable over the 1995-2008 period. The "building productive capacity" category accounts for around 40 per cent of total AfT while the "economic infrastructure" category represents roughly 60 per

cent. One may notice that if the share of the "trade policy and regulation" category remains marginal, this share is increasing over the period, and especially since 2000.

Figure 6: Commitments by Aid for Trade category (% of total AfT)



Note : The "trade related adjustment" category is not reported because of its inexistence in the CRS database before 2007.

Source: OECD Credit Reporting System, 2010

2.2. Focusing on Aid for Trade by category[26]

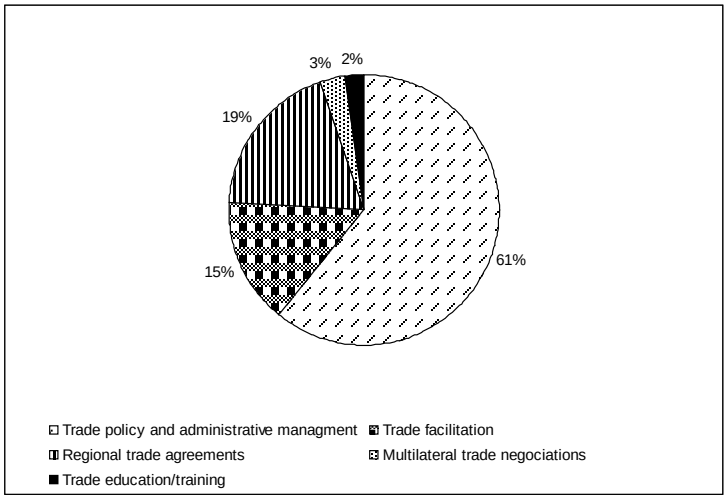
2.2.1. Trade policy and regulation category

The "trade policy and regulation" category includes five items: projects and programs oriented to trade policy and administrative management, trade facilitation, regional trade agreements, multilateral trade negotiations and trade education/training. For instance, as part of this category, one finds flows aimed at helping countries to develop trade strategies, negotiate trade agreements and implement their outcomes. Assistance from this category is delivered almost exclusively by technical assistance.

[26] The trade-related adjustment category is not analysed in this paragraph. It takes the form of a budget support aimed at assisting countries in the implementation of their trade policies, mitigating some adjustment costs, and at managing shortfalls in their balance of payments due to changes in the world trading environment. Today, only Australia, Canada and the European Commission have reported their share of flows in this category which was introduced in 2007 into the CRS database. Considering that this is a new category that is still weakly reported by donors, it is difficult to analyse and predict its evolution.

We observe that in average from 2006 to 2008, 61 per cent of the "trade policy and regulation" flows are allocated to trade policy and administrative management programmes, which primarily consist in technical assistance to trade ministries and governments of beneficiary countries (Figure 7). The regional trade agreements programmes are in 2nd position (19 per cent) certainly boosted by the proliferation of North-South bilateral trade agreements and South-South regional integration. Finally, trade facilitation programmes, which consist in a simplification and harmonisation of import/export procedures, support to custom services and tariff reform also account for 15 per cent of the total.

Figure 7: Category distribution inside the "trade policy and regulation" category, mean shares 2006-2008 (%)



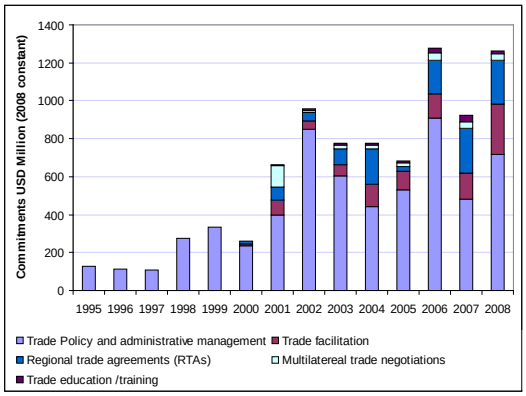
Source: OECD Credit Reporting System, 2010

Figure 8 shows that the "trade policy and regulation" category exhibits an increasing trend over the period. Increases in volumes are particularly strong on key dates like the opening of the Doha negotiations in 2001 and after the Hong Kong Ministerial Conference in 2005, illustrating the common idea that the lack of institutional capacities is an important obstacle faced by developing countries to connect to global markets. From 1995 to 2000, trade policy and regulation flows were exclusively distributed through policy and administrative management programmes. Since 2001 other types of programmes appeared, especially trade facilitation and regional trade agreement programmes. The increasing importance of such programmes is consistent with, respectively, the rising importance of the trade facilitation issue in the WTO

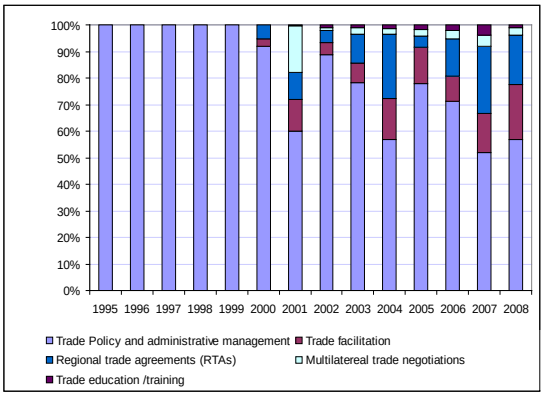
negotiations[27] and the rising number of regional agreements. However, Figure 8 indicates that even over the end of the period, policy and administrative management programmes still account for more or less 60 per cent of the total trade policy and regulation category.

Figure 8: Trend in trade policy and regulation distribution

8.a. Volumes from 1995 to 2008



8.b. Shares from 1995 to 2008



Source: OECD Credit Reporting System, 2010

2.2.2. Economic infrastructure category

This category includes 3 items: aid for transport and storage, aid for communications and aid for energy generation and supply. Projects or programmes under this category range from technical cooperation on policy planning for ministries to heavy constructions of roads, power plants or airports.

The economic infrastructure category should be considered as an imperfect proxy for projects and programmes specifically devoted to trade-related infrastructure. Indeed, this aid relates to infrastructures that may benefit foreign trade, domestic markets and people transportation. The World Bank and the United States have tried to isolate the share of their "economic infrastructure" aid that specifically enhances foreign trade. Nevertheless, considering the strong linkages between economic and social sectors, it is often difficult to disentangle the part of the aid which effectively enhances foreign trade from the part which benefits the domestic market of a recipient country. For example, an increase in imports of intermediate goods explained by an infrastructure project benefit foreign trade by increasing trade flows, but

[27] See also Helble *et al.* (2009).

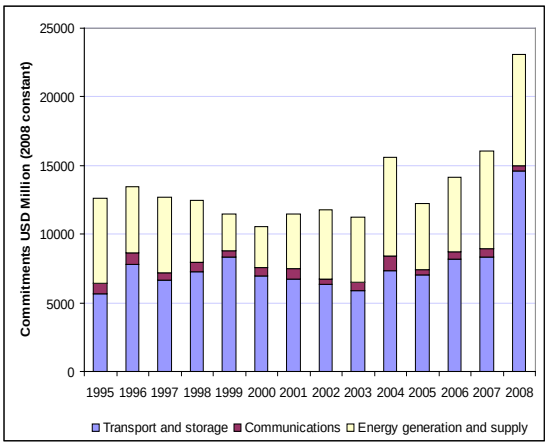
can also impact the domestic market by enhancing the productivity of a firm that serves local consumers.

Figure 9.a indicates that the total amount of aid distributed through the "economic infrastructure" category has declined from 1995 to 2001. Then, it has been growing, recovering the 1995 level ten years later. The decreasing trend observed over 1995-2001 may result from the decreasing interest for investing in large infrastructure programmes observed among donor countries in late 90's.

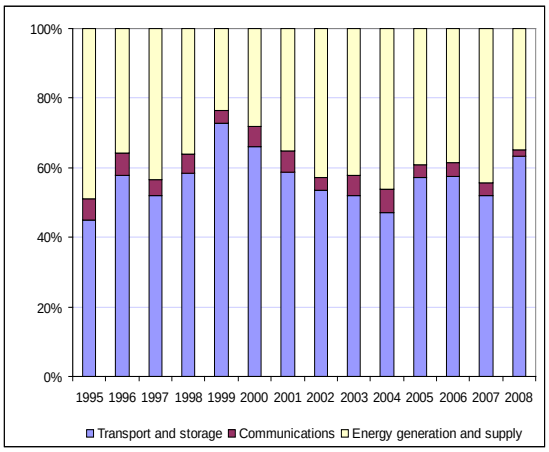
In average, from 1995 to 2008, aid devoted to transport and storage infrastructure accounts for over half of total assistance to economic infrastructure (Figure 9.b). Energy generation and supply projects and programmes rank 2nd with nearly 40 per cent of the whole "economic infrastructure" category. The residual share devoted to communication (around 4 per cent) seems in line with the extremely fast return on investment observed in this sector, which is consequently mainly financed by private capital.

Figure 9: Trend in economic infrastructure distribution

9.a. Volumes from 1995 to 2008



9.b. Shares from 1995 to 2008



Source: OECD Credit Reporting System, 2010

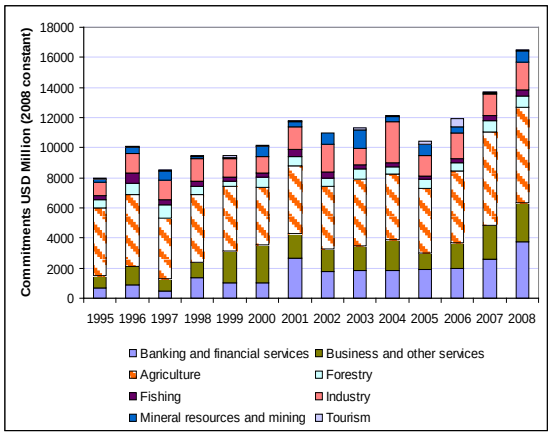
2.2.3 Building productive capacity category

The "building productive capacity" category includes, for example, support devoted to various economic sectors in recipient countries in order to help them to exploit their comparative advantage and diversify their exports. In the agricultural sector, programmes can range from technical assistance for policy planning for agriculture ministry's to microfinance for small farmers, for instance. Nevertheless, as discussed earlier, it is often very difficult to disentangle which part of the aid distributed under this category actually benefits foreign trade, probably explaining why few donors use the "trade development policy marker".

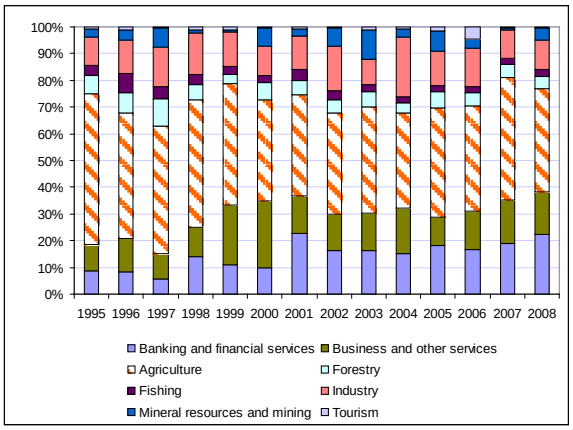
Figure 10.a shows that assistance to building productive capacity has increased over the 1995-2008 period, from 8 billion (constant 2008) USD in 1995 to 16 billion (constant 2008) USD in 2008. From Figures 10.a and 10.b, we observe that agriculture has always received the biggest share of this support over the period (around 40 per cent of the total building productive capacity assistance), followed by banking and financial services (from 10 to 20 per cent across years), business and other services and industry (both around 12 per cent). It must be noticed that amounts and shares reported in these figures are most probably larger than those specifically devoted to foreign trade enhancement.

Figure 10: Trend in building productive capacity distribution

10.a. Volumes from 1995 to 2008



10.b. Shares from 1995 to 2008



Source: OECD Credit Reporting System, 2010

2.3. Aid for Trade: from whom to whom?

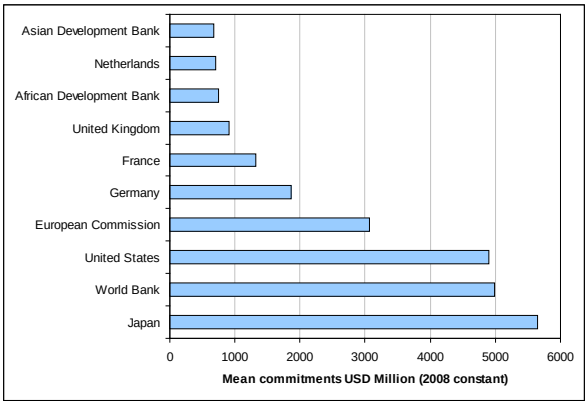
2.3.1. From a donor's perspective: who gives what?

The picture of the most important donors varies slightly every year. Thus, a ranking according to mean values for the 2003-2008 period seems to be consistent (Figure 11).[28] The top-ten donors during that period gave 87 per cent of the total 40.8 billion (constant 2008) USD of aid for trade allocated in 2008. Moreover, within this group four donors dominate the picture: Japan, the United States, the European Commission and the World Bank account for more than half the AfT distributed over the 2003-2008 period. In 2008, they gave 65.1 per cent of total AfT: Japan ranks first with 8.7 billion (constant 2008) USD (21.4 per cent of total AfT in 2008), followed by the United States with 6.4 billion USD (15.7 per cent), the European Commission with 5.9 billion USD (14.4 per cent) and finally the World Bank with 5.6 billion USD (13.6 per cent).

The two more important bilateral donors are Japan and the United States, with aid for trade flows even higher than development banks. The multilateral agencies working actively in trade programmes are the World Bank, the Asian Development Bank and the African Development Bank. As can be seen from Figure 12, the share of economic infrastructure programmes is particularly high for all main donors except the Netherlands and the United Kingdom which are mainly involved in building productive capacity projects and programmes. Finally, one may underline that it is difficult and probably misleading to compare trend in bilateral versus multilateral aid since an increasing number of bilateral institutions are channelling their aid for trade through multilateral actors.

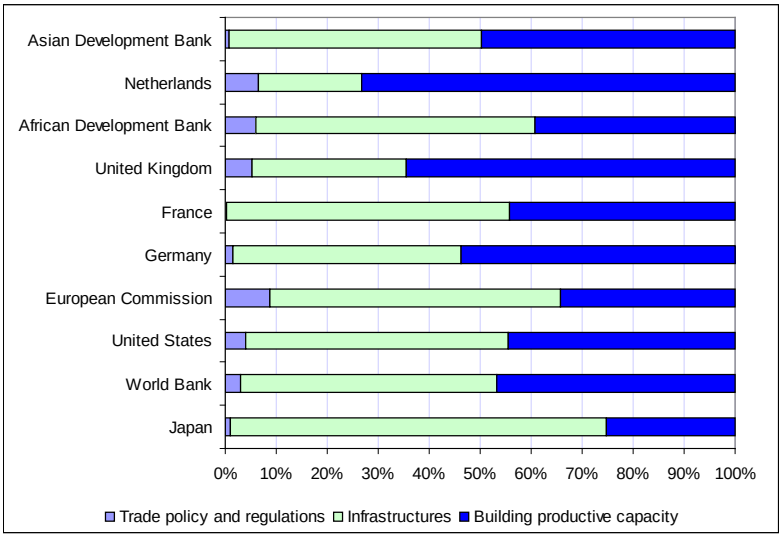
[28] For more details on the top 20 donors in the 2002-2007 period, see OECD (2009).

Figure 11: Aid for Trade top-10 donors, mean values over the 2003-2008 period, USD million



Source: OECD Credit Reporting System, 2010

Figure 12: Aid for Trade categories distribution for the top-10 donors (% mean shares 2003-2008)



Note: The "trade related adjustment" category is not reported because of its inexistence in the CRS database before 2007.

Source: OECD Credit Reporting System, 2010

2.3.2. From a recipient's perspective: who receives what?

AfT recipients are far less concentrated than donors: there are numerous recipient countries, some of them receiving very small amounts of aid. In addition, different criteria of AfT

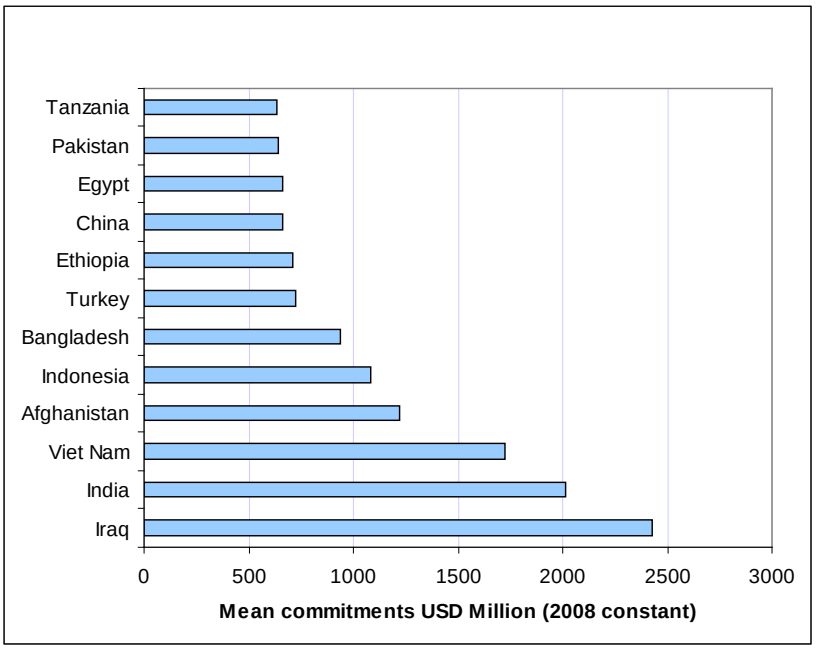
distribution lead to different rankings of recipient countries. Hence, in order to provide the most complete picture of AfT distribution across recipient countries we retained 3 different criteria: total amount of AfT received, received AfT per capita and received AfT per unit of export value. We also use rankings according to mean values for the period 2003-2008.

According to this criterion, the top-ten recipients of aid for trade for the period 2003-2008 received 41.2 per cent of total AfT in 2008.[29] Most of major recipients are Lower Middle Income Countries (7 UMIC).[30] Nevertheless, as already mentioned, it is likely that not all the total amount of AfT is specifically directed to enhance trade capacities in recipient countries. For instance, one may imagine that AfT flows to Afghanistan and Iraq, two very important recipients during the period, have rather as their main purpose reconstruction more than trade. That is the reason why Figure 13 reports the top-12 recipients of AfT (which received 47 per cent of total AfT in 2008). Given the high heterogeneity of the 12 countries receiving the largest shares of AfT, this first ranking reveals the great difficulty of drawing a clear picture of the main characteristics of the median recipient of aid for trade. We also noted that most of the top-12 recipients are populous developing countries. Furthermore, Sub-Saharan and Asian regions, two populous regions, are also the biggest recipients. Thus, it could be more consistent to see ranking according to AfT per capita and per export value.

[29] For more details on the top-20 recipients in 2002-2007, see OECD (2009).

[30] The World Bank classifies countries according to their yearly Gross National Income (GNI) per capita, computed using the World Bank Atlas method. For 2008, the groups are: low income (LIC) with a $975 GNI per capita or less; lower middle income (LMIC) with a $976 to $3 855 GNI per capita; upper middle income (UMIC) with a $3 856 to $11 905 GNI per capita and high income (HIC) with a $11 906 or more GNI per capita. The United Nations use the Least Developed Countries (LDC) classification for low income countries with human resource weakness and economic vulnerability.

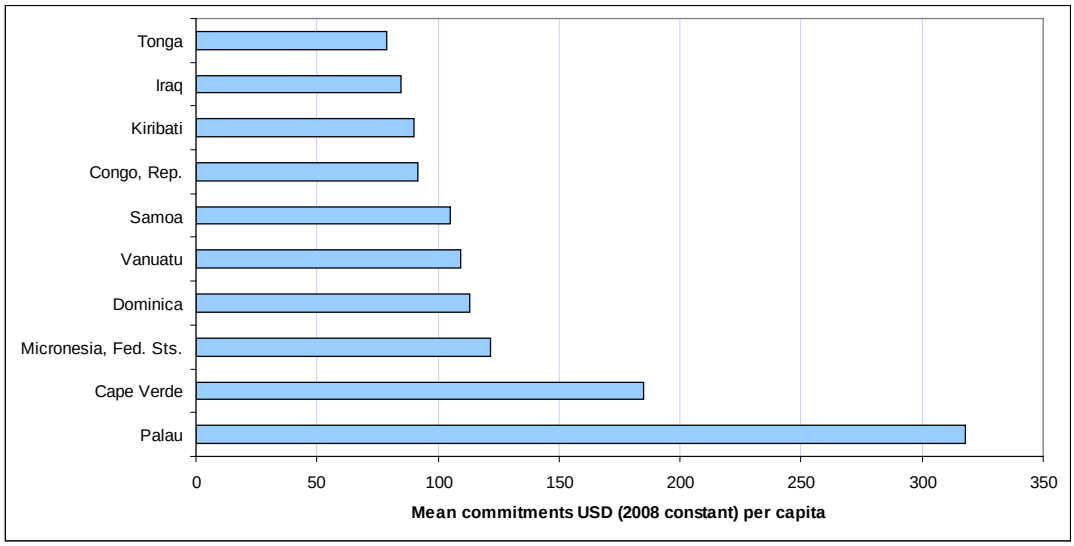
Figure 13: Aid for Trade top-12 recipients, mean values 2003-2008



Source: OECD Credit Reporting System, 2010

Unsurprisingly, based on the aid for trade per capita criterion, the 8 major recipients over the 2003-2008 period are Islands States mainly located in Oceania (Figure 14). As a result, the 2003-2008 average AfT received per capita is higher for Oceania than for other regions in the world, almost 35.5 USD per capita *vs* 2 to 15 USD per capita for the other regions (Figure 15.a.). As regards the ranking of recipients by income groups (Figure 15.b.), the Least Developed Countries (LDCs) received the highest aid for trade per capita with a 11.3 USD per capita average over 2003-2008 period, followed by the Other Low Income Countries (OLICs) with 7.5 USD per capita. The Lower Middle Income and Upper Middle Income Countries (LMICs and UMICs) received slightly the same amount: around 3.5 USD per capita. However, over the whole 1995-2008 period, except the OLIC which received less, no other income group received substantially more AfT per capita than the others.

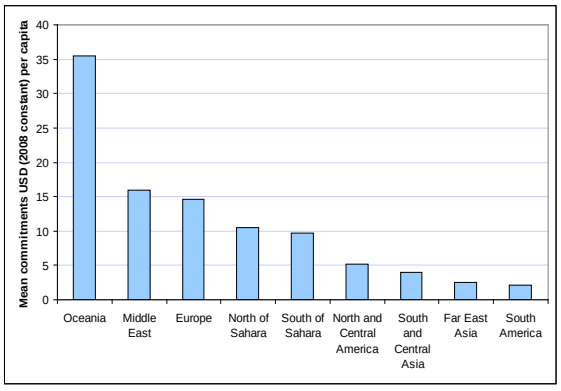
Figure 14: Aid for Trade per capita top-10 recipients, mean values 2003-2008



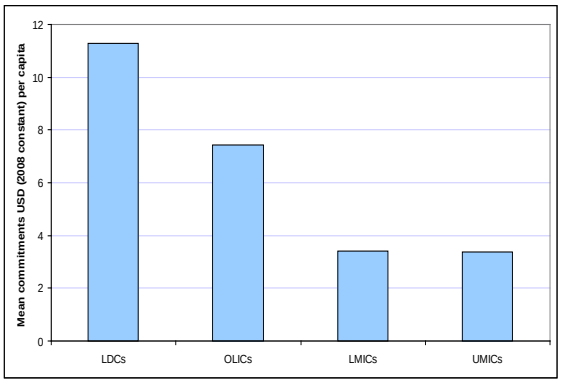
Source: OECD Credit Reporting System, 2010

Figure 15: Aid for Trade per capita distribution, mean values 2003-2008

15.a. Across regions



15.b. Across income groups

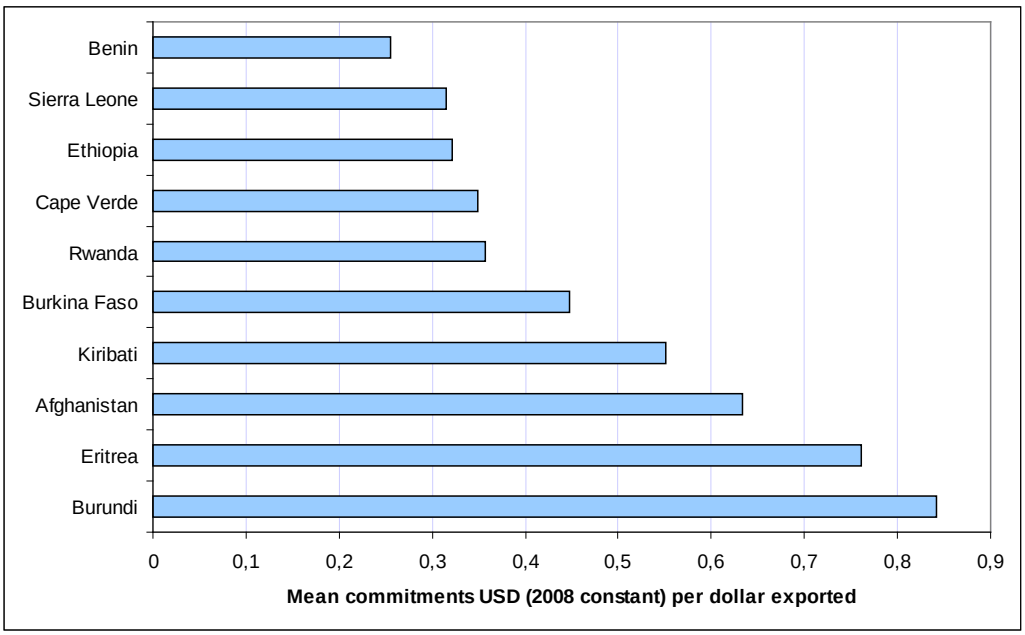


Source: OECD Credit Reporting System, 2010

Based on the AfT per export criterion, the ranking of the top-10 recipients is fairly different: 8 recipients are Sub-Saharan African countries (Figure 16). Over the 2003-2008 period, Sub-Sahara African region received in average 2.7 cents of AfT per unit value of exports. Middle East and South and Central Asia exhibited approximately the same ratio. This is substantially

higher than other regions which reached less than 1 cent per unit value of exports (Figure 17.a.). The AfT per export ratios of Sub-Sahara Africa and South and Central Asia didn't change a lot over the 1995-2008 period by contrast to most of other regions which registered a decreasing trend. In the case of Sub-Saharan countries, given that they benefited from increasing aid for trade amounts over the period, observed stability in their AfT per export suggests that the increase in their export capacity potentially induced by AfT did not compensate for the decrease in the value of their exports due to falling prices. Finally, as regards AfT per export distribution across income groups, Figure 17.b. indicates that the LDCs group received on average 7 cents per dollar exported between 2003 and 2008, which is significantly higher than the corresponding ratio exhibited by other income groups. It should be noted that even if the LDCs category is not recognised by all donors, AfT allocation seems to clearly benefit these countries.

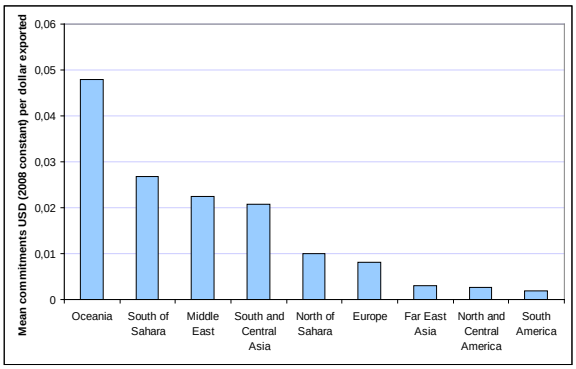
Figure 16: Aid for Trade per exports top-10 recipients, mean values 2003-2008



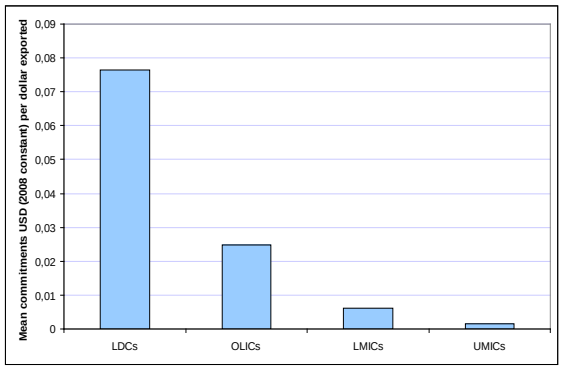
Source: OECD Credit Reporting System, 2010

Figure 17: Aid for Trade per exports, mean values 2003-2008

17.a. By region



17.b. By income groups



Source: OECD Credit Reporting System, 2010

3. Empirical studies on the effect of Aid for Trade on trade flows: a survey

There is an abundant literature dealing with the AfT concept and definition and with the potential effectiveness of AfT.[31] By contrast there are very few studies providing empirical assessments of the impacts of AfT in recipient countries. In the following section, we first review the few existing studies which have tried to quantify directly the impact of AfT on trade performance of recipient countries. Secondly, we propose a survey of empirical studies that are not directly concerned with AfT but may provide insights regarding the AfT effectiveness issue. These are studies focusing on trade costs and which aim at quantifying the extent of the negative impact on trade of various factors entering trade costs. As reducing trade costs for developing countries is one major AfT objective[32], such studies may provide insights into the various channels through which AfT may help recipient countries to improve trade performance and how AfT should be channelled in priority to maximize its effectiveness.

[31] OECD (2006), Gamberoni and Newfarmer (2009), Huchet-Bourdon *et al.* (2009), Hoekman and Wilson (2010) for instance.
[32] Paul and Vandeninden (2012) develop a theoretical background to the concept of aid transaction costs.

3.1. Quantitative assessments of the trade impact of Aid for Trade

There are only a handful of studies aiming at quantifying the effects of aid for trade on trade flows. Cali and Te Velde (2009) and Helble *et al.* (2009) are the most complete studies in the sense that they consider the main categories of AfT and measure their respective impact on exports of recipient countries for the first two ones, on world trade for the second one. Lederman et al (2010), on the other hand, focus on one category of AfT only or even one item from this category and assess its effects on exports of recipient countries. There is an additional study (Gamberoni and Newfarmer, 2009) which is different from the previous ones since it is not concerned with the trade impacts of AfT but with the detection of the AfT needs of potential recipient countries. As this study also examines the link between trade and AfT we decided to list it under this sub-section. However one must keep in mind that this last study investigates trade performance of potential recipient countries in order to detect the extent of their AfT needs, while other reviewed studies quantify the impact of AfT on trade performance of actual recipient countries.

Cali and Te Velde (2009) assess the impact of different types of aid for trade flows on trade cost and on export performances of recipient countries. They use panel data from the OECD's Credit Reporting System (covering a large subset of developing countries over the period 1995-2007) and particularly examine the impact of "trade facilitation" which includes a "simplification and harmonisation of foreign trade procedures, a support to custom departments and tariffs reforms". They find that it significantly reduces trade cost (in USD per container). In addition, their results show that aid to infrastructure significantly fosters exports of recipient countries, while aid to productive capacity building has no effect on exports.

Helble *et al.* (2009) use a gravity equation over a 16 year time period (1990 to 2005) in order to estimate the impacts of various AfT categories on world trade (167 exporters and 172 importers). Their aim is to test to what extent aid directed toward trade facilitation is related to trade flows. They estimate various empirical specifications and several samples as to perform robustness checks. Their results suggest that a 1 per cent increase in aid for trade facilitation could enhance world trade by about USD 415 million (that is a nearly 5 USD gain in trade for each 1 USD aid distributed). In addition, they show that the trade impact of the "trade policy and regulation" category seems to be higher and fairly robust to changes in empirical specifications and working samples. Their results suggest that considering a narrower definition of aid for trade facilitation and based on aid and trade from 2007, a 1 per cent increase in "trade and policy regulation" aid could increase world trade by about USD 711 million (that is a "rate of return"

for each 1 USD aid invested of about 697 USD in trade). Finally, they find that their own-defined "broad AfT" category (covering the "economic infrastructure" and the "building productive capacity" categories) significantly affects imports but has no significant impact on exports.

Lederman *et al.* (2010) evaluate the effectiveness of Export Promotion Agencies (EPAs) on exports. It should be noticed that these agencies are mostly financed by foreign assistance in the poorest developing countries. They find that these institutions have, on average, a positive and significant impact on exports, but with heterogeneous effects across regions, with Africa particularly lagging behind. The authors note also that EPAs in hand of the private sector but with a large share of public sector funding are the best performers. Brenton and von Uexkull (2009) as well find that, as part of AfT, technical assistance for exports targeted to some specific products enhances, on average, export performance. Nevertheless, using a difference-by-difference approach, they show that this effect is robust only for export development programs targeted at initially large exports. They conclude thus that the positive effect that they pointed out may not be entirely due to the export development programs, and that the allocation of funds should be more directed to sectors that remain behind.

Finally, Gamberoni and Newfarmer (2009) study aims at detecting countries that are under performing in trade and that receive less aid for trade than their potential demand. Authors construct five trade performance indicators which are assimilated to the potential demand factor for each developing country. These indices include trade variables and internal capacity constraints related to institutions, infrastructure and trade policy. Finally, to identify countries that receive less aid for trade than expected, they introduce one of these indices of trade performance in a cross sectional estimation explaining aid for trade per recipient GDP, controlling for the level of development and the potential effectiveness of assistance. This work based over the period 1996-2006 highlights the need to raise aid to countries that are under-receiving and can be used as a benchmark to monitoring trade performance of recipients. Nevertheless, it does not assess the key question related to the effectiveness of these flows on trade outputs.

The above described studies (except the last one) all provide empirical evidence that AfT or at least some categories of AfT do positively affect the export performance of recipient countries. However, they do not offer much information on the mechanisms and channels through which AfT assistance enhances recipient countries' exports. In the same vein, they do not provide many insights regarding the effectiveness of AfT and its various categories. Indeed, at least to our knowledge, there is no existing study covering the whole chain from AfT to the

determinants of trade (that is the various channels) and from these latter to trade flows. Such an approach has recently been investigated by Vijil and Wagner (2012) focusing on two determinants of trade, namely the quantity and quality of infrastructure and the quality of institutions. This contribution adopts a two-step approach where the main determinants (including infrastructure and institutions) of countries' export performances are investigated first, while in the second stage the impact of AfT on the two considered export determinants is quantified for recipient countries. Then, using the results of both stages, it is possible to assess the impact of AfT on recipient countries exports. Vijil and Wagner's results indicate that infrastructure are a strong determinant of export performance while institutions have limited impact. Furthermore, they show that on average for developing countries, a 10 per cent increase in infrastructure AfT per capita results in a 2.34 per cent rise in the export to GDP ratio.

Fortunately there are numerous empirical studies dealing with the first stage of the above described approach. Such studies are not dealing with AfT but aim at modelling trade flows between countries and for that purpose they investigate the main determinants of these flows. Hence their empirical results provide insights on which are the main channels through which AfT may affect trade of recipient countries on the one hand, and on which channels AfT should be primarily targeted for being the most effective. A crucial determinant of trade flows, which is also one main target of AfT, is what is commonly named as "trade costs" in the literature. As defined by Abe and Wilson (2009) for instance, trade costs include costs which increase the price of traded goods during the delivery process from the exporters (or producers) in exporting countries to the importers (or final consumers) in importing countries. Trade costs depend on many factors (such as transport and storage conditions, logistics, functioning of institutions, functioning and complexity of administration, etc.) and are different across countries. Existing literature thus provides empirical results on the extent of the negative impact of various elements of trade costs on trade flows.

3.2 Literature on trade costs and their impact on trade: an overview

Trade facilitation measures may be considered as a way to reduce trade costs. They aim at improving infrastructures and trade institutions, facilitating export goods to meet foreign standards and supporting market search. These two components, infrastructures and institutions, may thus be viewed as possible channels for helping developing countries by benefitting from trade. Due to their important shares devoted in the corresponding categories of AfT (section 2.2)

it is important to link the literature on trade cost related to trade facilitation and the potential impact on trade. Such measures can be summarised considering the different empirical approaches used for analyzing their effects.

The Computable General Equilibrium (CGE) approach quantifies effects on income and welfare. It usually translates the potential incidence of trade facilitation measures as an exogenous productivity improvement in the transport sector or as an exogenous reduction in trade costs. OECD (2003) finds that developing countries are likely to benefit the most from trade facilitation measures because of their less efficient border procedures, the relative importance of trade in agri-food products and the relative high share of small and medium-size business as traders observed in these countries. Nevertheless, as Helble *et al.* (2009) point out, there is little data on the generalised parameters used to simulate trade facilitation improvements. Furthermore, even if these studies conclude that potential gains arise from trade facilitation reforms, they don't identify the mechanisms or the channels through which trade facilitation measures effectively affect transport productivity or trade costs.

The gravity model approach focuses on bilateral trade effects. It estimates the impact of different trade facilitation reforms on bilateral trade flows. For instance, Wilson *et al.* (2003, 2005) translate trade facilitation reforms impacts into increased port efficiency, better customs environment, better regulatory environment and improved electronic business-usage for Asian Pacific Economic Cooperation members and for a broader sample of 75 countries. They find that improvements in these fields, even unilateral efforts, significantly increase both imports and exports. Also, Hoekman and Nicita (2008) estimate that a 10 per cent fall in the domestic cost of exporting would increase exports by about 4.7 per cent. Iwanow and Kirkpatrick (2007) quantify the impacts of the implementation of trade facilitation reform on trade performance. They use a gravity model augmented with trade facilitation, regulatory quality and infrastructure indicators to assess the impact of trade facilitation and other trade-related constraints on export performance. Their results suggest that a 10 per cent improvement in trade facilitation would yield an increase in exports of about 5 per cent. In the same vein, a 10 per cent improvement in the regulatory environment and in the quality of infrastructure provision would result in increases of 9-11 per cent and 8 per cent, respectively. Their results prove that trade facilitation can contribute to improve export performance but also that the quality of the regulatory environment and the transport and communication infrastructure are even more important in facilitating export growth.

Finally, country-case studies allow a broader analysis of trade facilitation programs. These analyses generally present the rationale under the reform, describe precisely how measures have been implemented on the field, the obstacles that such programmes have sought to overcome, approaches that countries have adopted to address them, and finally assess their results. For instance, Duval (2006) reports the results of an expert survey on the cost of implementation of twelve trade facilitation measures. This study highlights the expert's opinion that long-term benefits largely exceed perceived costs of implementation.

Besides, costs induced by internal constraints are considering relatively high. Using a gravity model, Anderson and van Wincoop (2004) find that transportation, information and security costs barriers are equivalent to a 30 per cent tariff measure on trade flows for industrialized countries (with an even higher magnitude for developing countries). Taking into account the relative preference margins benefitting to developing countries, Hoekman and Nicita (2008, 2010) suggest that an improvement in logistic performances and trade facilitation, which includes port efficiency, customs environment, regulatory environment and service sector infrastructure, is likely to have a better payoff for developing countries than further market opening. Using the same domestic trade costs, Portugal-Perez and Wilson (2008) find the similar 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 WTO market opening for developing countries (Ikenson, 2008; Hoekman and Nicita, 2010).

4. Conclusion

The aim of this chapter was to contribute to clarify the AfT issue by providing a picture of what is currently known about aid for trade.

The statistical overview on AfT highlights the following points. First, the allocated amount of AfT has risen, particularly since 2005, but the share of AfT in total allocable ODA has decreased since 1995, from 49 per cent to 37 per cent. Second, within AfT, the most important share is devoted to the infrastructure category, followed by the building productive capacity category and, with an increasing weight since 2001, the trade policy and regulation category. Third, four donors gave 65 per cent of total allocated AfT in 2008 whereas twelve recipients shared around 47 per cent of this amount. It is worth noting that Asian and Sub-Saharan African countries are the first regions receiving AfT, when ranking according to total AfT received.

However the Least Developed Countries group is the top recipient when considering both AfT per capita and AfT per value of exports. Finally, considering the strong interlinkages between economic and social sectors, it is very often difficult to disentangle the share of the aid which effectively enhances foreign trade from the share which benefits other social or economic sectors.

The literature review allows drawing the following insights. First there are very few empirical studies assessing the impact of aid for trade on recipient countries' trade. Existing studies show that there would be a positive link between the amount of aid for trade allocated and world trade. Obtained results also suggest a positive impact of aid for trade received on export performances of recipient countries. These findings may suggest that additional aid could be effective in promoting development. Obviously further work is needed in order to confirm and complement these preliminary findings. Second, there is a very abundant theoretical and empirical literature dealing with the main determinants of trade flows. This literature is not directly concerned with aid for trade but can provide useful insights about the main trade determinants that aid for trade should "reach" in order to better contribute to improve trade performances of recipient countries. Results of existing studies do not allow drawing a clear and complete picture of the determinants of trade flows. Further research should quantify the extent of the negative impact on trade of various factors entering trade costs. The objective will be to determine whether trade costs components like infrastructure or institutions for instance may play a determinant role on aid for trade effectiveness.

Appendix

Glossary

Commitment: following the CRS database definition, a commitment is "a firm written obligation by a government or official agency, backed by the appropriation or availability of the necessary funds, to provide resources of a specified amount under specified financial terms and conditions and for specified purposes for the benefit of the recipient country.

Disbursement: CRS give the following definition, "a disbursement is the placement of resources at the disposal of a recipient country or agency, or in the case of internal development-related expenditures, the outlay of funds by the official sector".

Official Development Assistance (ODA) are flows to development countries in the DAC list of Aid Recipients and to multilateral development institutions. These flows must satisfy 2 conditions to be considered as ODA, which are:

- need to be supplied by official agencies (including state and local government) or by their executing agencies, and;

- each transaction must have:

i) a main objective of promotion of the economic development and welfare of developing countries and,

ii) a concessional nature: if it is a loan, it need to have a grant element of at least 25 per cent (calculated at a discount rate of 10 per cent).

In addition to financial flows, technical co-operation is also included in aid.

Countries in this list have a per-capita GDP below USD 10 065 in 2004 constants prices (except those that are members of the G8 or the European Union).

Sector allocable aid: some contributions are not susceptible to be allocated by sector and are reported as non-sector allocable aid. Examples are aid for general development purposes like, aid allocated to debt relief, humanitarian aid and internal transactions in the donor country. Considering this definition, in our ODA analysis we eliminate all the flows allocated to categories upper the 41009 CRS sector code.

ODA Grant: following the DAC definition, grants are transfers in cash or in kind for wich no legal debt is incurred by the recipient.

ODA Grant-like: these flows contain 1) loans for which the service payments are to be made into an account in the borrowing country and used by this country for its own benefit, and 2) provision of commodities for sale in the recipient's currency the proceeds of which are used in this country for its own benefit.

ODA Loan: these are transfers for which the recipient incurs a legal debt and repayment is required in convertible currencies or in kind.

Equity Investment: includes direct financing of enterprises in a developing country which does not (as opposed to direct investment) imply a lasting interest in the enterprise. This is not an ODA flow.

OOF: these are official sector transactions which do not meet the ODA criteria.

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Chapter 4: Does Aid for Trade Enhance Export Performance? Investigating the Infrastructure Channel[33]

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 marginalized by the recent wave of globalization. Also, the share of the poorest developing countries in global trade has not increased despite the preferential trade schemes offered by their industrialized partners (Huchet-Bourdon *et al.*, 2009).

[33] This chapter has been co-authored with Laurent Wagner and has been published in The World Economy.
Vijil, M., and Wagner, L., (2012). 'Does Aid for Trade Enhance Export Performance? Investigating the Infrastructure Channel', The World Economy, Vol 35, Issue 7, pp 838-868.

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. 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 liberalized 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 (Rajan and Subramanian, 2008; Roodman, 2007), 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 one per cent increase in assistance to trade facilitation could generate an increase in global trade of about 415 million United States Dollars (USD). Furthermore, the effect of aid directed to the "Trade Policy and Regulation" category seems stronger both in significance and magnitude, with a particularly high impact on aid

recipient's exports. Also, this aid category exhibits the highest rate of return with USD 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 program 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 Generalized 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 chapter 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 if 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 which 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 which quantify effects on income and welfare; gravity models which 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 is 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 analyze 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 ten 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 programs. 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 industrialized 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 payoff 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.

2.1. Trade costs related to a lack of infrastructure

The theoretical and empirical evidence suggests that investment in infrastructure quantity and quality effectively affect 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. [34]

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 non-competitive 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 organizational structure of the industry providing the service (Hummels *et al.*, 2009; Sequeria and Djankov, 2009). These findings suggest that barriers to 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 (Hoekman and Nicita, 2011; Portugal-Perez and Wilson, 2008; Anderson and Marcouiller, 2002).

2.2. Trade costs related to weak institutions

Findings on the effect of trade barriers due 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.

[34] There is also empirical evidence of the impact of a specific kind of infrastructure on exports. Freund and Weinhold (2004) find that a ten 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.

This ambiguity may be explained by the difficulty of measuring institutional costs exclusively related to trade activities. Consequently, a few papers have tried to focus on more specific data. For example, Sequeria and Djankov (2009) 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 (Cadot *et al.*, 2008; Carrère and de Melo, 2006). Likewise, increasing the participation of developing countries in international standards organisations seems relevant to improving their institutional capacity on these non-tariff barriers (Disdier *et al.*, 2008).

3. Aid for trade data and descriptive statistics

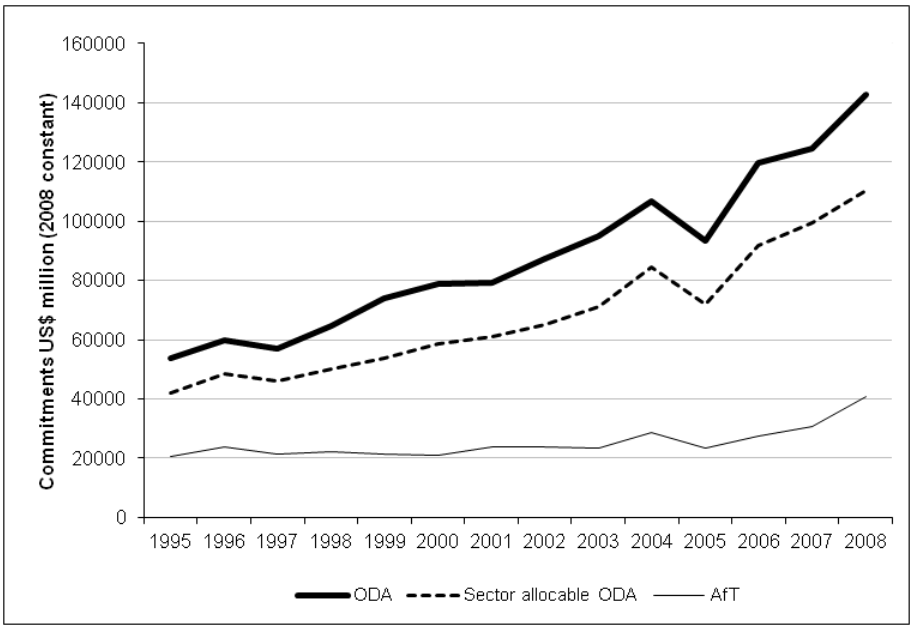
The previously mentioned supply-side constraints could be addressed through aid for trade, as part of the overall Official Development Assistance (ODA). The Development Assistance Committee (DAC) of the OECD is the main organ by which donors seek to coordinate their bilateral cooperation activities for 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 organizations. Data are collected through two reporting systems: the aggregated DAC which includes a breakdown by type of aid, donor countries and sectors; and data from the Creditor Reporting System (CRS) which contain detailed information on individual projects and aid programs. The CRS data thus allow the distribution of aid by sector, donor and recipient countries to be analyzed. However, it should be noted that disbursements are only reported routinely by DAC members and the European Commission, and not by multilateral 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.[35] 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.

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, i.e. 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 chapter 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.

Figure 1: Medium term trends in ODA and Aide for Trade



Source: Authors' calculations

[35] 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 harmonization, alignment and managing aid for results with a set of monitorable actions and indicators.

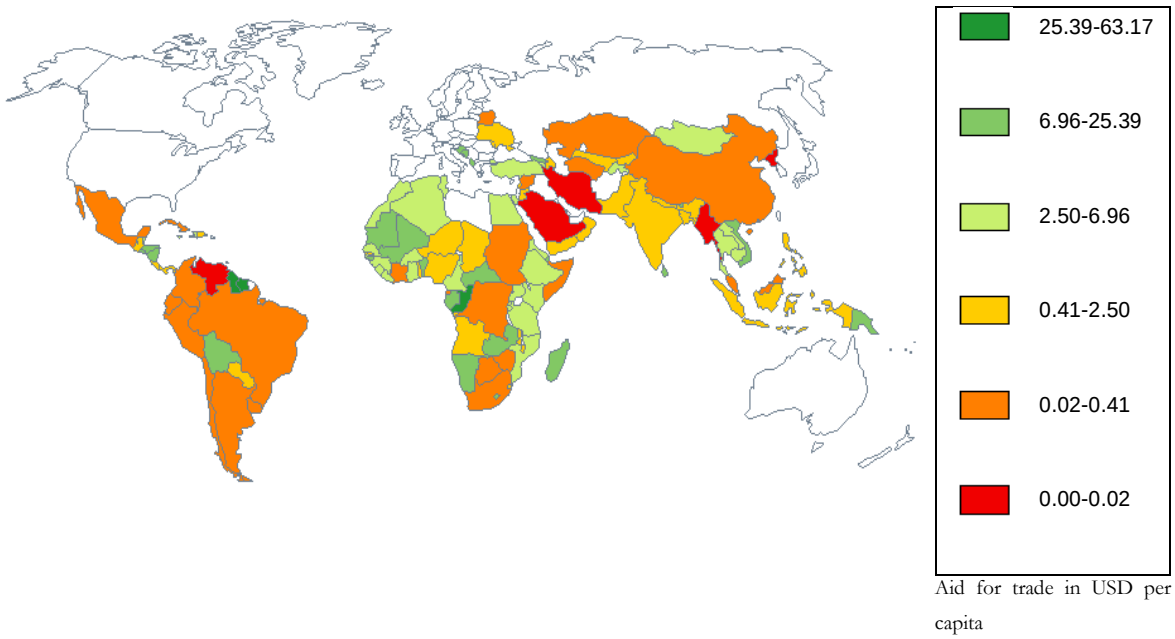
Thus, the two categories covered in our study are:

1) Trade policy and regulations, which 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 USD 1,155 million (commitments, constant 2008). It includes five sub-categories: projects and programs 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 USD 17,758 million (commitments, constant 2008). This category includes three sub-categories: aid for communications; energy; and transport and storage. Projects or programs 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 in Appendix) that aid for trade is not always allocated towards 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, Appendix). 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 USD per capita (2002-2007, 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).

4.1. Theoretical background

Let us assume that the world is composed of i = 1, ..., 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:

σ = 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 noticed 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 $s_i \equiv n_i (p_i t_i)^{1-\sigma}$. (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:

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

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 Ω:

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

where Ω 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 ^), and eliminating the price term allows us to describe how the total value of exports $V_i = n_i p_i x_i = s_i M_i$ varies according to:

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

where ω 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:

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

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

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

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 .

4.2. 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:

$$\ln(V_i) = \beta_0 + \beta_1 \ln(GDP_i) + \beta_2 \ln(Pop_i) + \beta_3 \ln(M_i) + B_4 \ln(t_i) + \beta_5 \ln(c_i) + \varepsilon_i \qquad (I)$$

where β 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 2002-2008. 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 (2005-2008) 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 toward 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 USD, V_i. Nevertheless, since we focus on a set of highly heterogeneous developing countries, we choose to normalize the export volumes by considering alternatively exports over GDP, $\frac{Exports_i}{GDP_i}$, following Guillaumont and Guillaumont Jeanneney (1988) and de Melo and Grether (2000).[36] 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 due to 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 which includes kilometres (km) of road and paved road (in total area, in km²), and the number of subscribers to mobile and telephone fixed lines (per 100 people) from the World Development Indicators (WDI) database. As in Brun *et al.* (2005), the first two variables are normalised by the countries' surface. The infrastructure index used in the rest of the chapter $Infrastructure_i$ is the first principal component obtained from our infrastructure variables by Principal Component Analysis (PCA) (Francois and Manchin, 2007; Calderon and Servén, 2004).[37] 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 due to 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

[36] 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.
[37] 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.

and Newfarmer (2009) and use the number of days needed to export $Time_i$ 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 most easily accessible port. Indeed, three-quarters of the delays seem to be due to 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 USD, GDP_i, from the WDI database. When moving to $\frac{Exports_i}{GDP_i}$ as the dependent variable, we then consider GDP per capita in 2000 constant USD, $\frac{GDP_i}{Pop_i}$. 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 due to tariff and non-tariff barriers $MA\text{-}OTRI_i$ 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*.[38] We expect it to be negatively related to the dependent variable.

In order to address endogeneity problems due to 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.

[38] The non-tariffs barriers included in this measure are: price control measures; quantity restrictions; monopolistic measures; technical regulations; and agricultural domestic support (Kee *et al.*, 2009).

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.[39] Concerning institutions, we 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 due to 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:

$$\ln(V_i) = \beta_0 + \beta_1 \ln\left(Infrastructure_i\right) + \beta_2 \ln(Time_i) + \beta_3 \ln(GDP_i) + \beta_4 \ln\left(Pop_i\right) + \beta_5 \ln(MA\text{-}OTRI_i) + \varepsilon_i \quad \text{(IIa)}$$

$$\ln\left(\frac{Exports_i}{GDP_i}\right) = \beta_0 + \beta_1 \ln\left(Infrastructure_i\right) + \beta_2 \ln(Time_i) + \beta_3 \ln\left(\frac{GDP_i}{Pop_i}\right) + \beta_4 \ln\left(Pop_i\right) + \beta_5 \ln(MA\text{-}OTRI_i) + \varepsilon_i \quad \text{(IIb)}$$

As a robustness check, following Lederman *et al.* (2010), we choose to introduce sequentially two additional control variables outside of the model. Firstly, we introduce the volatility of the exchange rate in country *i*, $Volat_i$, 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. Secondly, we control for the trade restrictiveness imposed by country *i* on its

[39] The correlation between exports over GDP ratio and the infrastructure instrument is very low (18 per cent) and not significant.

imports from the rest of the world $OTRI_i$ from Kee *et al.* (2009).[40] 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.

4.3. Results

The estimation results for equation (IIa) 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).

In the first column, using the OLS estimator, all of our variables turn out to be significant with the expected sign (except for population which has a positive sign). Nevertheless, from the theoretical model, we have to check if 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).[41] As displayed in column (2), in this case, only $Infrastructure_i$ 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 in Appendix 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 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.

[40] This variable captures the relative price distortion created by the trade policy imposed by *i* on its own imports.
[41] For further details, see Redding and Venables (2003; 2004).

Table 1: Trade costs and exports in constant USD

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

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All variables are in logarithmic form.

The results for equation (IIb) using OLS and 2SLS are shown in Table 2.[42] 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.[43] As a robustness check, we then introduce sequentially additional control variables in column (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.[44] Our preferred specification is that shown in column (5) where we dropped two outliers identified using the method of Hadi (1994).[45] These results indicate that infrastructure might be a potential channel of transmission by which aid for trade affects export performance. Indeed, an increase of ten 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

[42] Alternatively using the Limited Information Maximum Likelihood (LIML) estimator leads to the same results in term of significance levels.
[43] 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 (IIb). Using alternative instruments, such as surface area in square kilometers, 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).
[44] 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.
[45] Guinea and Zimbabwe appear as outliers.

infrastructure and trade (Limao 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 of 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.

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, $\frac{GDP_i}{Pop_i}$ 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 in Appendix). 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 $Customs\_Lpi_i$, 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; Hoeckman and Nicita, 2010). We do not find any significant impact on exports. Following Anderson and Marcouiller (2002) and Sequeira and Djankov (2009) we also use two variables of control for corruption; the first from the Polity IV

database $Pol4\_corrupt_i$ and the second $Icrg\_corrupt_i$ from the International Country Risk Guide (ICRG) – but without finding any significant impact. Nevertheless, it should be noticed that across all estimations the infrastructure proxy is positive and highly significant.

Table 2: Trade costs and exports over GDP ratio

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

Robust standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

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.

5. Aid for trade and infrastructure

5.1. 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_i in equation (IIb) 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 toward the tradable sector.

Table 3: Aid for Trade, infrastructure and institutions

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

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

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.

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:

$$\ln\left(Infrastructure_i\right) = \gamma_0 + \gamma_1 \ln(Infrastructure\_aid\_pc_i) + \gamma_2 \ln(ODA\_pc_i) + \gamma_3 \ln(Pop_i) + \gamma_4 \ln\left(\frac{GDP_i}{Pop_i}\right) +$$

$$\gamma_5 \ln(area_i) + \gamma_6 (pop100km_i) + \gamma_7 (land100km_i) + \gamma_8 \ln(pop\_density_i) + \gamma_9 \ln(urbanization_i) + \gamma_{10} \ln(rule\_of\_law_i) + \eta_i \quad \text{(III)}$$

where γ are the parameters to be estimated.

We use data averaged over the period 2002-2007. The dependant variable is the same infrastructure index $Infrastructure_i$ used in the previous analysis. $Infrastructure\_aid\_pc_i$ is aid commitments for trade-related infrastructure per capita in constant USD of 2000, averaged over the period 2002-2007. 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 USD of 2000, ODA_pc_i. The data come from the CRS database collected by the OECD.

Following Canning (1998), Randolph *et al.* (1996), Fay and Yepes (2003) and Esfahani and Ramirez (2003), we introduce the population Pop_i and GDP per capita $\frac{GDP_i}{Pop_i}$ 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). Firstly, 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 $area_i$. Secondly, 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 urbanization (the share of population in urban areas) $urbanization_i$; indeed, the costs of providing infrastructure in cities are lower. Also, Canning (1998) notes that the degree of urbanization 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 nationalizations 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 due to 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 privatization 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 in Appendix). The data were retrieved from the World Bank's Privatization Database. [46] This database contains data on the number and sale price of privatization transactions of over 1 million USD, carried out in developing countries between 2000 and 2007. It only includes transactions which 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 dataset 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 of many of the users, the donor community is expected

[46] http://rru.worldbank.org/Privatization/

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, privatization transactions are often followed hand by hand by assistance directed toward sectors that were reformed.

Thus, we expect that the number of privatization transactions explains the aid for infrastructure received without directly affecting our infrastructure indicator at the macro level. Indeed, today, most of the privatizations 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 peri-urban 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 privatization 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 Andrés *et al.* (2008) for Latin America,[47] we do not expect to witness any impact of the number of privatizations 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 privatizations 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 privatization 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 does 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 now, 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

[47] Andrés et al. (2008) review the performance of 181 privatized firms in three sectors (telecommunications, electricity distribution, water and sewerage) across 15 Latin American countries. Controlling for existing pre-privatization 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 multi-dimensional issue, with complex effects on the range of outcomes they analyze.

period, we might witness numerous structural changes in this relationship which could, in turn, blur our results.

5.2. Results

The results from the estimation of equation (III) are shown in Table 4 using OLS and 2SLS. Across all specifications, once instrumented, the aid for infrastructure per capita variable $Infrastructure\_aid\_pc_i$ appears to have a positive and statistically significant effect on infrastructure. As before, we choose to introduce additional controls sequentially. For column (2) to (5), our coefficient of interest remains remarkably stable both in magnitude and in significance. Indeed, column (5) suggests that an increase of ten per cent in aid for infrastructure per capita leads to an increase of the quantity of infrastructure of one per cent. Results are highly significant at the one per cent level and robust to outliers (column 5).[48] Furthermore, our instrument seems to perform relatively well. As can be seen in Table A3 in Appendix, the number of privatization 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 ten. 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 $\frac{GDP_i}{Pop_i}$ 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 urbanization $urbanization_i$, 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).

[48] Outliers are Jamaica, Burundi, Philippines, Sri Lanka, Rwanda, India, Mauritius and Bangladesh.

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 (III) 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.

Table 4: Aid for infrastructure and infrastructure

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

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
In column (5) eight outliers were dropped using the HADI procedure (Jamaica, Burundi, Philippines, Sri Lanka, Rwanda, India, Mauritius, Bangladesh)
Aid for infrastructure per capita is instrumented by the number of privatizations in the infrastructure sector between 2000 and 2007.
All variables, except Lnd100km and Pop100km, are in logarithmic form.

6. Concluding remarks

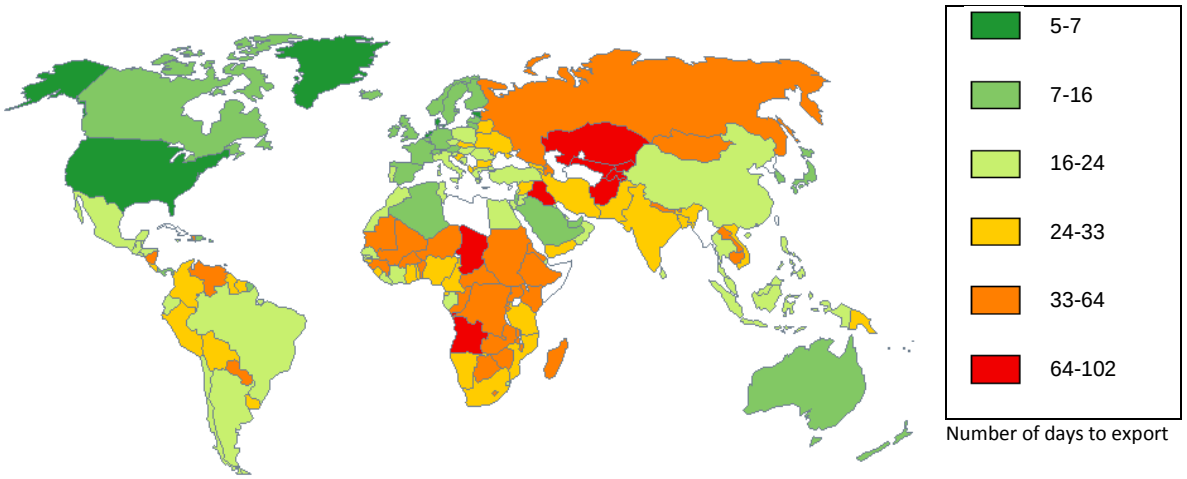
The actual slow down of multilateral talks has highlighted the relevance of trade facilitation measures as a complementary economic policy for developing countries. Indeed, recent empirical studies confirm that benefits from a reduction in internal trade costs can be as large as a tariff reduction within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

Nevertheless, despite the attractiveness of the aid for trade initiative for policy makers, 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 ten per cent increase in aid for infrastructure commitments leads to an average increase of the exports over GDP ratio of an aid recipient of 2.34 per cent.[49] 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 cent reduction of the tariff and non-tariff 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.

[49] We saw in Table 2, column (5) that an increase of ten per cent of the infrastructure index leads to an average increase of 10.7 per cent in export performance. Furthermore, an increase of ten per cent in aid for infrastructure commitments leads to an average increase of the infrastructure index of 1.14 per cent (Table 4, column 5).

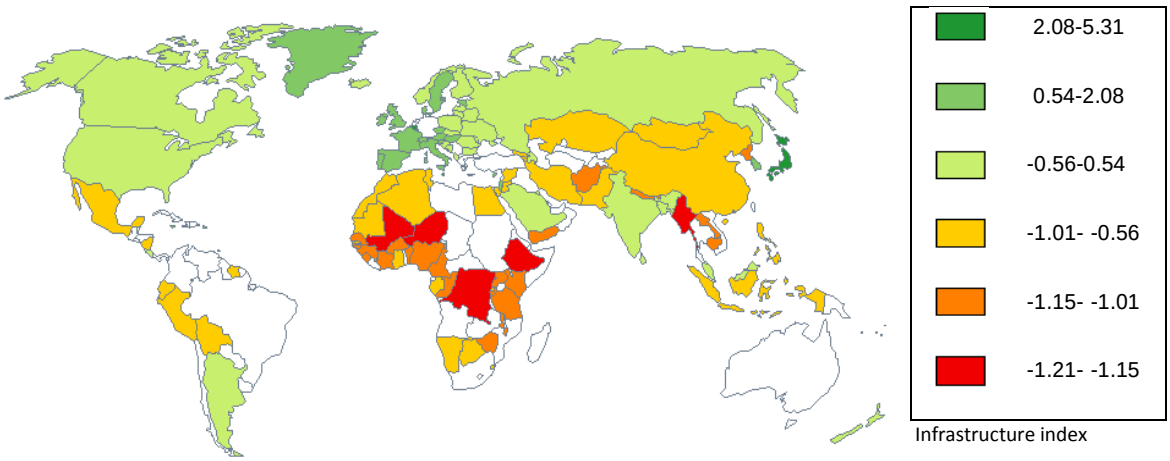
Appendix

Figure A.1.: Number of days to export (2005-2007)



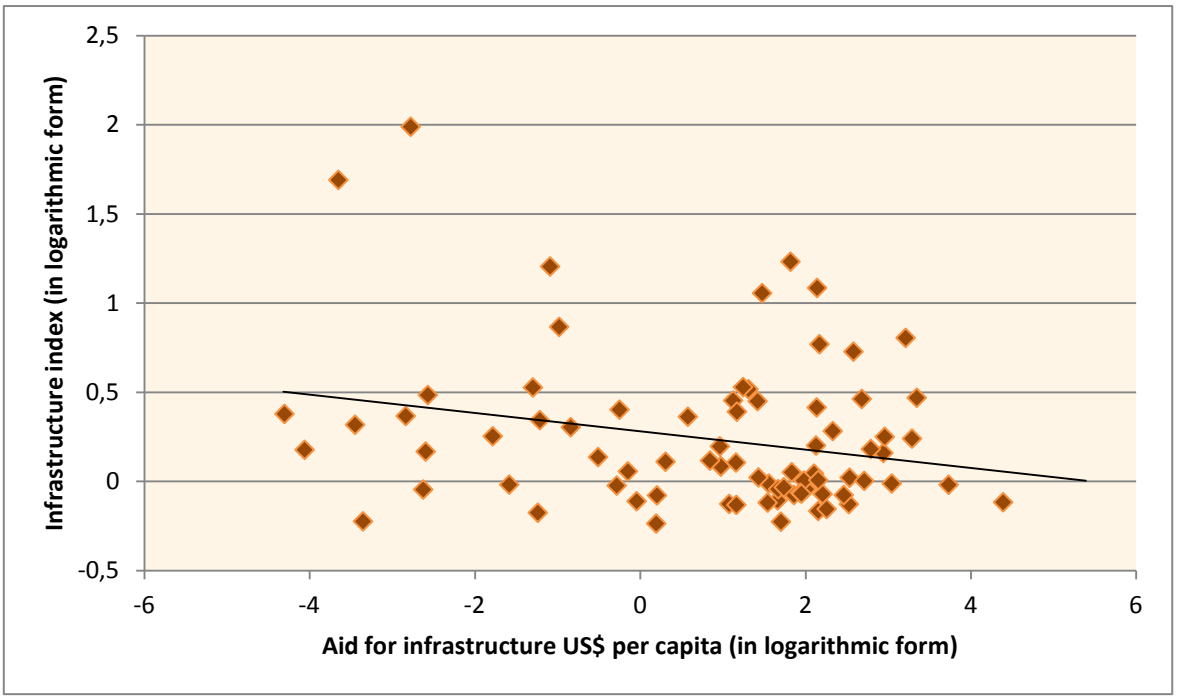
Source: Authors' calculations

Figure A.2.: Infrastructure index (2002-2007)



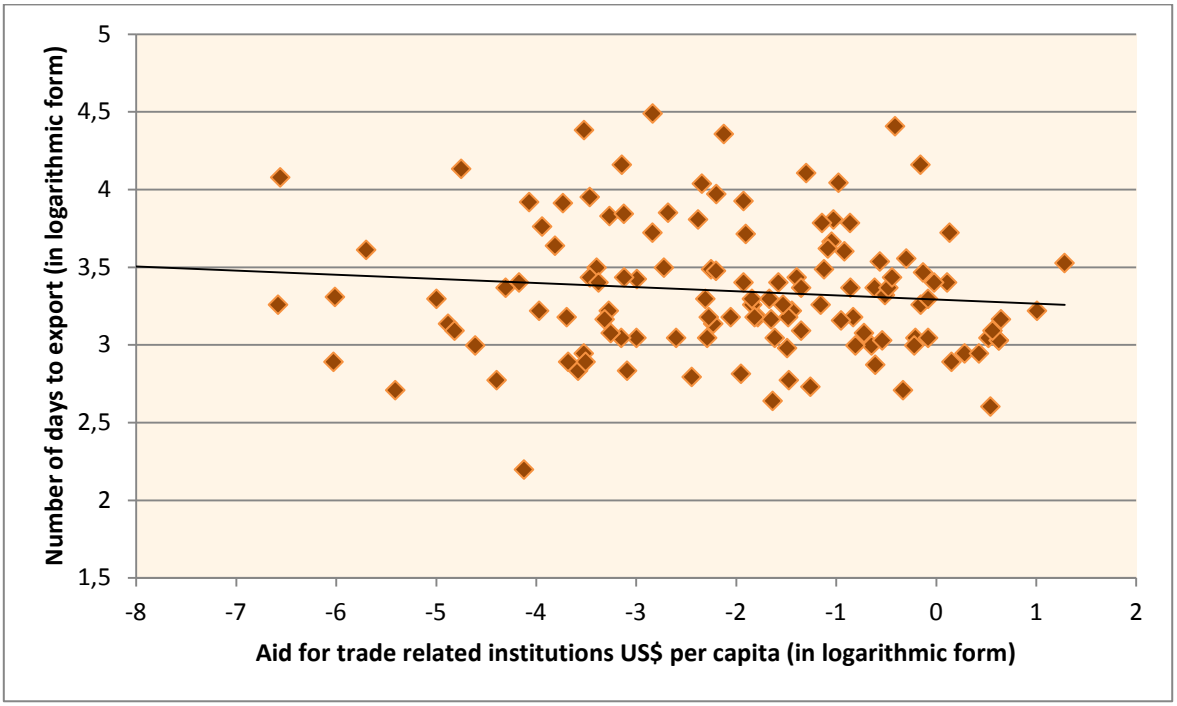
Source: Authors' calculations

Figure A.3: Correlation between infrastructure and aid for infrastructure (2002-2007)



Source: Authors' calculations

Figure A.4.: Correlation between number of days to export and aid for trade-related institutions (2002-2007)



Source: Authors' calculations

Table A.1.: Instrumentation of equation (IIb)

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

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All variables except Lnd100km are in logarithmic form.

Table A.2.: Robustness on exports over GDP ratio

Exports (without oil and minerals)/GDP	(1)	(2)	(3)
	2SLS	2SLS	2SLS
Infrastructure	1.884	1.332	1.627
	(0.372)***	(0.279)***	(0.336)***
Customs_Lpi	-0.640		
	(1.003)		
Icrg_corrupt		-0.183	
		(0.345)	
Pol4_corrupt			-0.748
			(0.734)
GDP/Pop	-0.363	-0.269	-0.224
	(0.145)**	(0.113)**	(0.183)
Pop	-0.132	-0.168	-0.173
	(0.061)**	(0.041)***	(0.045)***
Ma-otri	-0.845	-0.642	-0.765
	(0.291)***	(0.296)**	(0.301)**
Volat	-0.166	0.050	0.247
	(1.454)	(0.574)	(0.151)
Constant	5.972	6.144	5.903
	(1.194)***	(0.842)***	(0.871)***
Observations	71	69	76
R-squared	0.10	0.28	0.13
First stage *F*-stat for Infra	36.31	45.75	43.72
First stage *F*-stat for Institutions	9.73	4.52	4.94
Outliers (HADI)	Guinea Zimbabwe	Guinea Zimbabwe	Guinea Zimbabwe

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Instruments for institutions variables in columns (1) (2) and (3) are 4 dummy variables for French, English, German and Scandinavian legal origins as in La Porta *et al.* (1999).

Table A.3.: Instrumentation of equation (III)

	Infrastructure_aid_pc
ODA_pc	1.436
	(0.261)***
Pop	-0.862
	(2.671)
GDP/Pop	-0.308
	(0.247)
Lnd100km	1.214
	(1.508)
Area	1.072
	(2.752)
Pop100km	0.773
	(1.464)
Pop_density	0.787
	(2.672)
Urbanpop	-0.841
	(0.580)
Rule_of_law	1.070
	(0.689)
Privatizations_00_07	0.019
	(0.006)***
Constant	-3.301
	(4.290)
Observations	68
R-squared	0.71

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All variables except instruments are in logarithmic form except *Privatizations_00_07*.

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Chapter 5: Aid for Trade Effectiveness: Complementarities with Economic Integration

1. Introduction

The empirical evidence has demonstrated that trade can be a powerful engine for enhancing economic development and poverty reduction (Winters *et al.*, 2004). Thus, developing countries have pursued a trade-led growth strategy and regional integration has become one of the main tools. Moreover, the temporary impasse in multilateral negotiations at the Doha Round has further motivated countries -whether developed and developing- to use regionalism as an instrument to pursue trade liberalization.

This has led to a proliferation of reciprocal Preferential Trade Agreements (PTAs); as of middle-2012, almost 300 PTAs have been notified to the WTO and countries tend to belong to several different agreements. Part of this success is explained by the attractiveness of such agreements compared to multilateral ones; a smaller number of players, a possibility to deepen market access in the sectors with the highest pay-offs and a short-term advantage in terms of preferential margins.

Nevertheless, seeking to increase market access does not seem to be the only motivation for further regionalization. Negotiations in modern PTAs, whether they are North-South or South-South, tend to go wider and deeper over time, covering behind the border issues not sufficiently addressed by the multilateral system, such as cooperation in trade facilitation, investment and competition policy (Chauffour and Maur, 2011; WTO, 2011). Indeed, for many developing countries, an increase in trade does not depend on tariff reduction anymore (WTO, 2011) and some of the poorest developing countries such as the Least Developed Countries (LDCs) benefit from free access to major markets. International traders may face other - at the border - and – beyond the border - trade costs, such as burdensome procedures, transit bottlenecks and absence of certification agencies; and these trade facilitation constraints are recognized to have significant impacts on trade volumes (Limao and Venables, 2001; Wilson *et al.*, 2003, 2005; Portugal-Perez and Wilson, 2012). Estimates indicate that addressing those issues are likely to have higher pay-offs in terms of trade than a reduction in trade-policy barriers (Anderson and van Wincoop 2004; Hoeckman and Nicita, 2011).

In recognition of this, trade facilitation issues started to be negotiated at the WTO in 2004 on the basis of the "July package" and modern PTAs are increasingly including these features in their negotiation agendas (Chauffour and Maur, 2011). While North-South agreements tend to concentrate on a narrow definition of trade facilitation, very close to what is currently discussed at the WTO (–at the border- costs such as custom procedures); South-South agreements instead tend to go further in their trade facilitation vision, with negotiations on –behind the border- issues such as transit corridors and business environment. Indeed, because of the externalities arising from trade facilitation provisions, there is an increasing acceptance that important gains arise from regional coordination and cooperation on these issues (Maur, 2011).

Thus, developing countries are increasingly pointing out the need for assistance in covering the costs of implementing trade facilitation measures, whether this is done by Official Development Assistance (ODA) trough aid for trade or by PTA members' cooperation. Therefore, the development community has given rise to an increase in ODA directed toward sectors where domestic constraints to trade persist. This renew of interest in non-social aid can be illustrated by the launch of the Aid for Trade (AfT) initiative at the Honk-Kong WTO Ministerial conference in 2005. Aid flows covered by this initiative aim to assist developing countries in their attempt to enhance export performance and integration into the global economy, by targeting their own domestic constraints; such as a lack of knowledge, excessive red tape, insufficient financing and poor infrastructure. 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 liberalized 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", there is little evidence on the success of previous attempts to support trade performance. Considering the reduction of donors' budget allocated toward ODA because of the financial crisis, there is an urge to provide a precise measure of its efficacy. Furthermore, assessing its effectiveness through regionalization is all the more important that PTAs (particularly North-South) are increasingly relating trade-related aid packages to trade negotiations. For example, looking at provisions on standards, Budetta and Piermantini (2009) find that over 58 PTAs, 22 have provisions relating to technical assistance.

In light of this, the main contribution of this article is to assess whether complementing national AfT strategies with bilateral or regional economic integration priorities is effective. I test this by looking for complementarities between AfT and reciprocal or non-reciprocal PTAs. I expect to find a positive relationship between these two instruments since, contrary to multilateral commitments in trade facilitation issues, regional or bilateral agreements generally generate binding arrangements and create special institutions to ensure enforcement. Thus, the purpose of this article is to test whether AfT effectiveness' in terms of trade performance increases when there is a certain degree of economic integration.

The methodology used is the gravity model with panel data for the period 1995 to 2005. Results suggest that AfT is indeed effective in increasing PTAs intra-members' trade. South-South exports have benefited from these complementarities; and the combination of AfT and preferential market access seems to have facilitated the expansion of exports from developing countries to the North. Finally, braking AfT into three categories, I find that aid to trade-related institutions seems to generate the strongest complementarities with economic integration, both in terms of imports and exports.

The chapter is organized as follow. In section 2, I start with a brief literature review of the empirical evidence on the AfT effectiveness and PTA impacts on trade. The gravity model and the empirical strategy are presented in section 3. Section 4 provides an analysis of the results obtained using first the whole sample, then the South-South and the North-South sub-samples.

AfT is also divided into three categories: trade-related institutions, trade-related infrastructure and building productive capacity. Finally, section 5 concludes with some policy implications.

2. Literature review

With regards to the nexus between aid and trade, the theoretical literature has principally studied the interactions between aid and trade flows/policies; and the optimal donor assistance strategy for enhancing welfare in developing countries, whether this is measured by income, growth or domestic heterogeneity concerns such as poverty reduction (see the survey in Suwa-Einsenman and Verdier, 2007). Nevertheless, considering the difficulty to measure aid policies and trade policies, the empirical research has been mainly focused on testing the link between bilateral aid and trade flows, usually with a gravity model (Wagner, 2003; Silva and Nelson, 2012).

Within this literature, potential complementarities between aid, trade capacity and market access have been poorly addressed. Indeed, trade-related assistance can have dynamic effects on trade flows through trade facilitation improvements; these reductions in trade costs should in turn allow developing countries to better respond to an increase in market access. Moreover, AfT can also be used as a mechanism to compensate the losers from domestic reforms implemented following trade liberalization, answering thus the political feasibility concerns. As mentioned by Hoeckman (2011) "if PTAs are to be development-friendly, they must focus on complementing liberalization in trade goods with behind-the-border regulatory reforms that are supported through development assistance instruments […]".

2.1. Literature review on Aid for Trade effectiveness

Among the papers seeking to quantify empirically the impact of AfT flows on bilateral trade flows, Helble *et al.* (2012) finds that this assistance enhances the trade performance of recipient countries, particularly in terms of exports. Using a panel data gravity model estimated by Ordinary Least Squares (OLS) with bilateral 5-year fixed effects for the period 1990-2005, authors show that a one per cent increase in assistance to trade facilitation (219 million United States Dollars -USD- in 2008) could generate an increase in exports of 291 million USD for aid-receiving countries. Furthermore, the effect of aid directed to trade-related institutions seems stronger both in significance and magnitude, with a particularly high impact on aid recipients'

exports. This assistance also exhibits the highest rate of return with USD 71 in additional trade for every dollar invested.

Another trend of the literature focus on AfT effectiveness from an aggregated trade flows point of view. Using a Fixed Effect model with panel data for 130 developing countries, Cali and te Velde (2011) find that assistance to "simplification and harmonization of international import and export procedures […]; support to custom departments; tariff reforms" reduced the time and the cost to import during the period 2005-2009. In addition, aid for infrastructure had a significant impact on total exports between 2002 and 2007, while aid for capacity building didn't; suggesting that the later may go to already well performing sectors.

Furthermore, Vijil and Wagner (2012) test the impact of AfT on overall export performance using a two step cross-section empirical strategy for 79 countries during the period 2002-2008. They disentangle, between institutional and infrastructure trade-related costs, channels by which the aid for trade impact may transit. Results indicate that infrastructure is one of the main determinants of export performance; a ten per cent increase in aid for infrastructure commitments leads to an average increase of the recipient's exports over GDP ratio by 2.34 per cent. From a trade policy perspective, this is equivalent to a 2.71 per cent reduction in tariff and non-tariff barriers from the rest of the world.

An original methodology using input-output tables to evaluate the impact of AfT in five service sectors (transportation, information and communication technologies, energy, banking/financial services, and business services) on manufacturing exports in developing countries was also proposed by Ferro *et al.* (2011). From their sample of 132 developing countries over the period 2002-2008, results suggest that assistance to banking and energy sectors is the most effective in increasing recipient countries' exports. Moreover, aid to the business sector appears to have a positive and significant impact, while less robust.

Finally, trade interventions, whether they are financed by foreign aid and/or national resources, have also been increasingly evaluated at the microeconomic level on a cross-country basis (Brenton and von Uexkuhll, 2009; Lederman *et al.*, 2010) and, while still scarcely, on a national basis (Jaud and Cadot, 2012). On that matter, applying impact evaluation methods to AfT projects and programs is now considered as a promising yet challenging new perspective for future research (see Cadot *et al.*, 2011; Cadot *et al.*, 2012).

2.2. Selective survey on developing countries' reciprocal and non-reciprocal PTAs

The evidence on the effects of reciprocal and non-reciprocal PTAs on trade is quite abundant (see Hoeckman and Ozden, 2005; and Cardamone, 2007; for selective surveys on these issues). Performing a meta-analysis over 75 studies using the gravity model to evaluate the impact of reciprocal PTAs on trade, Cipollina and Salvatici (2010) find robust evidence supporting the idea that these agreements do increase trade; but they argue that estimates vary a lot across studies depending on the retained empirical method. Indeed, results may be very heterogeneous among studies because of the multitude of samples, gravity specifications considered and econometrical techniques used. As claimed by Cardamone (2007), papers tend to disregard one or more issues related to the endogeneity of PTAs, the presence of zero trade flows and the persistence of trade; leading to potentially biased estimates.

The endogeneity of PTAs due to omitted multilateral resistance terms and bilateral trade costs is one of the most challenging issues when studying the impact of trade agreements on trade flows with a gravity model. Baldwin and Taglioni (2006) and Feenstra (2004) recommend using as many fixed-effects as possible to account for omitted variables bias, but this strategy is not always optimal in short panels with PTA variables that vary little over time. Performing fist-differencing, country/year and bilateral fixed-effects as well as allowing for a phase-ing effect of agreements on a sample of 96 countries over the period 1960-2000, Baier and Bergstrand (2007) find that on average after 10 years, free trade agreements double members' trade. Also, using a model with bilateral specific random effects on a sample of 130 countries between 1962 and 1996 and after correcting for the endogeneity of regional trade agreement variables, Carrère (2006) find that these agreements did increase intra-members trade, sometimes at the expense of trade with the rest of the world.

However, when preferential market access is disentangled using more precise indicators (Carrère *et al.* 2010) some inefficiencies in terms of revealed preference margins, coverage and utilization can be found in PTAs for developing countries. These inefficiencies may arise from tariffs peaks in key products for exporters, burdensome procedures, costly rules of origins and an increasing preferential market access accorded to competitors.

Notwithstanding, as far as I know, no work has searched for complementarities between AfT and PTAs. The work that relates the most to this study is the one from Gradeva and Martinez-Zarzoso (2010). These authors examine the complementarities between ODA and the

"Everything But Arms" preference scheme accorded by European countries to exports from Least Developed Countries (LDCs). Using a gravity model with different panel data estimators for 79 African, Caribbean and Pacific countries and 15 European countries for the period 1995-2005, they find no direct impact for this preferential trade scheme but an indirect effect through complementarities with the ODA received from European donors.

I propose a strategy that goes beyond this work in three ways. First, I search for complementarities in terms of trade facilitation, between preferential market access and trade-related assistance (and not overall ODA). Second, TPAs can be reciprocal and non-reciprocal; I account for different degrees of intensity that will be assimilated to a deeper economic integration. Third, I run the regressions on the entire world sample, thus covering North-South and South-South PTAs.

3. Methodology

3.1. Data

The empirical strategy is based on an unbalanced panel of 185 countries with annual data over the period 1995-2005. Aid flows were compiled from the OECD Creditor Reporting System (CRS) database, which allows studying the distribution of the ODA by sector, donor and recipient country. Following the definition from the Task Force that matches with the CRS, AfT is measured as the sum of three aid categories[50]: (*i*) technical assistance for trade policy and regulations, proxy for trade-related institutions and delivered almost exclusively through technical assistance; (*ii*) trade-related infrastructure; and (*iii*) productive capacity building, proxy for assistance to productive sectors (see Appendix A.1. for further details). Aid commitments were preferred considering that disbursements are not routinely reported by multilateral donors and that development banks are important contributors in AfT. Finally, aid flows received by a country are summed across all donors[51].

The share of AfT in total programmable aid amounted to 33 per cent in 2009. According to Appendix A.2.1, in average between 1995 and 2005 for a particular aid receiving country, the second category, aid to trade-related infrastructure, regroups more than 50 per cent of AfT flows (60 million USD), while aid to productive capacity building represents about a third of total AfT

[50] The trade-related adjustment (iv) category was not included as it didn't exist before 2007.
[51] I am looking for an aggregate impact of AfT and not for tied-aid bilateral effects.

(35 million USD). Finally, technical assistance for trade policy and regulations is equal to 10 per cent of total AfT (10 million USD).

The degree of economic integration of a pair of countries is approximated by an ordered discrete variable ranging from 0 -no existing Economic Integration Agreement (EIA)- to 6 -Economic Union-[52] and comes from the Baier and Bergstrand's EIAs data base, which regroups PTAs by their date of entry into force. This indicator allows approximating a deepening in economic integration, proxy for tighter commitments in trade facilitation issues. As illustrated by Appendix A.2., world trade has increasingly been covered by EIAs, going from 30 per cent to 40 per cent of total trade between 1995 and 2005. Even more interesting is the fact that agreements involving a deeper economic integration, such as Free Trade Agreements and Common Markets, are displaying a higher share of world trade through time.

The dependent variable is the total bilateral exports from country *i* to country *j* in year *t*, and data comes from BACI, a trade data base constructed at CEPII[53]. Usual gravity variables to approximate trade costs come from the same institution[54]. Finally, GDP and population data was retrieved from the World Bank's World Development Indicators.

3.2. Theoretical model and estimation strategy

The gravity model allows indentifying the deviation from "normal" bilateral trade of countries having signed a trade agreement and received aid for trade. Motivated by the potential complementarities between these two instruments, three questions arise: Does AfT increase trade? Do PTAs increase trade? Does AfT has an additional positive impact on trade, conditional on the existence of a PTA? As the first two questions are already covered by the previous literature, this section focus on the third one: the additional impact of AfT flows on developing countries' exports and imports when combined with regional integration.

The capacity of the gravity model in explaining trade between countries by economical and trade costs factors while been consistent with theoretical frameworks, such as the Ricardian

[52] 0 denotes no existing Economic Integration Agreement, 1 denotes a One-Way Preferential Trade Agreement, 2 denotes a Two-Way Preferential Trade Agreement, 3 denotes a Free Trade Agreement, 4 denotes a Customs Union, 5 denotes a Common Market and 6 denotes an Economic Union. Data available at Bergstrand's webpage: http://kellogg.nd.edu/faculty/fellows/bergstrand.shtml.

[53] An original procedure is applied to reconcile export and import values from the United Nations' COMTRADE database; trade values are FOB.

[54] CEPII database website http://www.cepii.fr/anglaisgraph/bdd/distances.htm.

model, the increasing returns to scale or the firm heterogeneity model, has contributed to its success. This tool has been widely used to measure the impact of a variety of trade costs on international trade, with important implications for economic policy, such as the need to modernize institutions or to upgrade infrastructure.

This chapter follows a log-linearized version of the Anderson and van Wincoop (2003)'s gravity model:

$$\ln(X_{ij}) = lnY_i + lnY_j - lnY_w + (1-\sigma)ln\tau_{ij} - (1-\sigma)ln\Pi_i - (1-\sigma)lnP_j + \varepsilon_{ij} \qquad (1);$$

where X_{ij} is the nominal value of exports from *i* to *j*; Y_i and Y_j are the nominal income for each country; the constant Y_w is the nominal aggregate (world) income; σ is the elasticity of substitution, τ_{ij} are the trade costs faced by exports from country *i* to *j*, Π_i and P_j are the multilateral resistance terms; and finally ε_{ij} is the random error term, satisfying the usual assumptions. Variables of interest, namely, AfT, the level of trade integration, and the combination of the two, influence trade costs τ_{ij}; which are also function of distance and other usual gravity variables.

To deal with the endogeneity problem arising from the omission of multilateral resistance terms Π_i and P_j, the empirical strategy to estimate equation (1) uses exporter/time and importer/time specific effects as recommended by Baldwin and Taglioni (2006) and Feenstra (2004). Even if this makes it impossible to measure the direct impact of AfT on bilateral trade flows as in Helble *et al.* (2012)[55], its additional impact through regional integration can still be tested. Reducing further the potential endogeneity bias due to omitted bilateral trade costs (that may affect the trade agreement variable) by using time invariant dyadic effects is not recommended here because of the short time span of the panel (Baldwin and Taglioni, 2006). Indeed, most of the trade agreement effect would be lost as this indicator varies little over time. Also, the pair of countries with a constant level of trade integration, which represent 87 per cent of the total sample, are essential for testing if AfT does increase bilateral trade when there is a trade agreement, whether a deepening in integration has occurred or not during the period.

[55] As a robustness check, dummies will be replaced by a 1rst order Taylor-series expansion of trade costs to control for multilateral resistance terms (Baier and Bergstrand, 2009). This will allow me to keep AfT variables and measure their direct impact on bilateral trade.

Therefore, the empirical specification takes the following form:

$$Ln\left(X_{ij,t}\right) = \beta_0 + \beta_1 Integration_{ij,t} + \beta_2 ln\left(AfT_{i,t}\right) * Integration_{ij,t} + \beta_3 ln\left(AfT_{j,t}\right) * Integration_{ij,t} + \beta_4 ln\left(Distance_{ij}\right) + \beta_5 Landlocked_{ij} + \beta_6 Border_{ij} + \beta_7 Language_{ij} + \beta_8 Colonial\_Rel_{ij} + \beta_9 Common\_Colonizer_{ij} + \gamma_{it} + \gamma_{jt} + \eta_t + \varepsilon_{ij,t} \quad (2)$$

Where $X_{ij,t}$ is country *i* exports to *j* in current thousand USD at year *t*. Aid for Trade variables are expressed in current thousand USD and ln (1+ AfT) is used because some countries (e.g. industrialized economies) do not receive such assistance. The two variables of interest are the interaction of $AfT_{i,t}$ and $AfT_{j,t}$ with $Integration_{ij,t}$. This allows to test if AfT received by the exporter and the importer increase intra-members' trade when there is a PTA; and vice versa, if a deepening in regionalization increases intra-members trade when AfT is received by the members. Indeed, complementarities may appear if further integration traduces into a higher absorption capacity of foreign assistance, because of better coordination, cooperation and implementation of trade facilitation reforms between members of a PTA. However, a non-significance of interactive variables may also be interpreted as reforms equally benefiting all partners, regardless of their membership to a common preferential agreement. Finally, considering the extensive evidence on PTAs' effectiveness using gravity models (Cipollina and Salvatici, 2010), $Integration_{ij,t}$ should have a positive impact on the dependent variable.

Regarding other trade costs variables commonly used in gravity models, $Distance_{ij}$ is the distance between the most populous cities in country *i* and *j,* using the great circle formula; $Border_{ij}$, $Language_{ij}$, $Colonial\_Rel_{ij}$, and $Common\_Colonizer_{ij}$ are proxies for, respectively, sharing a common border, a common language, having had a common colonizer after 1945 and having had a colonial relationship after 1945. $Landlocked_{ij}$ is equal to 1 if country *i* or country *j* do not have access to the sea. Finally, $\gamma_{i,t}$ and $\gamma_{j,t}$ are country-year specific effects, τ_t is a vector of year specific effects and ε_{ijt} is a random error term.

Considering that interactive variables marginal effects (*e.g.* AfT combined with PTAs) are difficult to interpret in non-linear models, I use Ordinary Least Squares (OLS) with errors clustered at the country-pair level for positive values of trade. Santos-Silva and Tenreyro (2006) claim that a log-linearization of the gravity equation leads to a heteroskedasticity bias and that a Poisson Pseudo Maximum Likelihood estimator should be preferred; this gives the additional advantage of dealing with zero trade flows. However, this claim is still under discussion (Helpman *et al.* 2008; Anderson and Yotov, 2010; Martinez-Zarzoso, 2013). As advocated by

Anderson and van Wincoop (2003, 2004), economic size-adjusted trade will be used as an alternative dependent variable in order to attenuate a potential heteroskedasticity bias.

4. Results

Results will be analyzed in two steps: first I will comment average effects of AfT combined with regionalization in the entire sample and in North-South and South-South samples (Table 1). Then, the three main categories of AfT will be assessed sequentially: assistance to trade-related institutions, assistance to trade-related infrastructure and aid to building productive capacity.

4.1. Aid for Trade: complementarities with economic integration

Estimates for equation (2) using pooled OLS with country/year and year dummies on the entire sample are reported in Table 1 (column 1 to 4). The two variables of interest, namely, the interaction between the AfT received by the exporter *i* (importer *j*) with the level of economic integration of the pair appear both with a positive and highly significant coefficient (column 1). This suggests that AfT and economic integration do complement each other in enhancing intra-members trade. Indeed, an increase in the AfT received by the exporter (importer) will favor exports to (imports from) intra-members of the same EIA more than the ones directed to (from) the rest of the world. Moreover, for a country receiving AfT, the deeper the level of integration with his partner the higher the impact of AfT will be. Complementarities seem stronger from the exporter side, suggesting that AfT flows enhance more exports to members of an EIA (compared to exports to the rest of the world) than imports from members (compared to imports from the rest of the world).

Nevertheless, the level of integration appears insignificant in almost all specifications. This is surprising considering the extensive evidence that supports a positive impact of PTAs on trade using gravity models (Cardamone, 2007; Cipollina and Salvatici, 2010) but may be driven by unobserved bilateral trade costs bias. As explained earlier, a Fixed Effect model to control for constant dyadic effects is not suitable because of the short time span of the panel (Baldwin and Taglioni, 2006); all observations with a constant level of integration would be dropped, thus making impossible to test for the impact of AfT on bilateral trade when economic integration has been stable during the period (87 per cent of the sample). However, a Within estimator was performed on a gravity model including only the level of integration to see how the omitted

variable bias affect this variable (Appendix A.3.); it turns out positive and highly significant, suggesting that OLS estimations in Table 1 may underestimate the effect of PTAs.

Concerning traditional gravity variables, coefficients have the expected sign and are significant at a 1 per cent level: exports decrease with distance and with the handicap of been landlocked; and exports increase if the pair shares a common border, a common language, if they had a colonial relationship after 1945 and if they were colonized by the same country.

However, after the launch of the Aid for Trade Initiative in 2005, some developing countries feared that this raise in aid would come as a substitute to further market access from developed countries in multilateral negotiations. Running equation (2) over a North-South sample[56] shows that exports from developing countries to northern partners are higher when AfT is combined with preferential market access, suggesting that complementarities arise between these two development instruments (Table 1, column 2). Indeed, AfT may help southern exporters to cope with new technical regulations and product standards imposed by harmonization clauses contained in some North-South PTAs. One example is the Pesticide Initiative Program financed by the European Commission, which has the objective to help African-Caribbean-Pacific exporters of fresh fruits and vegetables to comply with European traceability and food-safety requirements (Jaud and Cadot, 2012).

[56] A country is considered to be from the South or from the North according to its GDP per capita in current USD for each year of the sample (following the World Bank's classification of countries by revenue).

Table 1 : Complementarities between Aid for Trade and economic integration during the period 1995-2005

Ln ($X_{ij,t}$)	(1) Total sample	(2) North-South	(3) South-South	(4) Disbursement	(5) AfT lagged 5 years	(6) $\frac{X_{ij,t}}{GDP_{i,t} * GDP_{j,t}}$
	OLS with country/year specific effects					
Ln (Distance_ij)	-1.324***	-1.473***	-1.258***	-1.324***	-1.332***	-1.324***
	(0.0248)	(0.0399)	(0.0339)	(0.0248)	(0.0275)	(0.0268)
Landlocked_ij	-0.605***	-0.643***	-0.471***	-0.610***	-0.579***	-0.617***
	(0.0972)	(0.143)	(0.119)	(0.0971)	(0.109)	(0.0989)
Common Frontier_ij	0.549***	0.271	0.749***	0.549***	0.433***	0.506***
	(0.116)	(0.292)	(0.134)	(0.117)	(0.123)	(0.118)
Common Language_off_ij	0.528***	0.549***	0.695***	0.528***	0.551***	0.561***
	(0.0507)	(0.0717)	(0.0763)	(0.0507)	(0.0546)	(0.0538)
Colony before 1945_ij	1.604***	1.351***	1.895***	1.611***	1.550***	1.617***
	(0.147)	(0.172)	(0.263)	(0.147)	(0.153)	(0.151)
Common Colonizer_ij	0.795***	0.290***	0.819***	0.799***	0.711***	0.806***
	(0.0663)	(0.101)	(0.0882)	(0.0663)	(0.0703)	(0.0709)
Integration_ij	-0.0122	0.0194	0.314***	-0.00407	0.00789	-0.0156
	(0.0203)	(0.0394)	(0.0498)	(0.0204)	(0.0304)	(0.0206)
Ln(AfT_i)*Integration_ij	0.0298***	0.0115**	0.0118**	0.0312***	0.0120***	0.0276***
	(0.00292)	(0.00568)	(0.00499)	(0.00310)	(0.00372)	(0.00301)
Ln(AfT_j)*Integration_ij	0.00737***	0.0123***	-0.00841*	0.00625**	0.00663**	0.00932***
	(0.00280)	(0.00447)	(0.00502)	(0.00301)	(0.00333)	(0.00286)
L5_ Integration_ij					-0.00876	
					(0.0317)	
L5_Ln(AfT_i)*Integration_ij					0.0190***	
					(0.00438)	
L5_ Ln(AfT_j)*Integration_ij					0.00273	
					(0.00387)	
Constant	10.71***	2.719	10.29***	10.68***	15.69***	-37.81***
	(1.410)	(21,632)	(0.393)	(1.416)	(0.435)	(0.351)
Observations	105,617	48,021	47,566	105,617	58,625	95,280
R-squared	0.762	0.798	0.678	0.761	0.768	0.475

All specifications include country/year and year specific dummies. Robust standard errors in brackets (clustered by country pairs).
* p<0.1; ** p<0.05; *** p<0.01 . Source: Author's

In the sub-sample of South-South trade (Table 1, column 3), results indicate some complementarities between AfT and economic integration from the exporter side, suggesting that exports to EIAs' partners are enhanced by trade-related assistance. This may occur, for example, if technical assistance is delivered to members to accompany their negotiations on mutual-recognition of procedures and product standards. Trade assistance might also favor exports by creating incentives to develop regional standards infrastructure (Maur, 2011). Indeed, they are usually lacking in developing countries, mainly because their economy is too small; and a regional approach has been pointed out as a promising solution. Finally, results from the importer side indicate that the marginal effect of trade-related assistance is higher for imports from non-PTA members (even if the coefficient appears much less significant).

Coming back to the total sample, a sensitive analysis was performed to the baseline estimation in column 1. Even if commitments are preferable in terms of data coverage, they may not reflect the actual amount of aid received by a country. Colum 4 shows equation (2) run over disbursements and results appear similar both in magnitude and significance. Also, AfT might not have a contemporaneous impact on trade values, even more considering that regional trade-related programs may require a coordination between members which could take time. Using 5-year lags, results indicate that both past and actual values influence exports to members relative to non-members (column 5). Nevertheless, the impact for imports seems to be more immediate. This may be due to the fact that AfT programs oriented toward import facilitation (such as custom modernization, simplification of procedures to have access to import licenses) have a faster impact on trade. Finally, in column 6 exports over the product of GDPs is used as the dependent variable in order to reduce heteroskedasticity concerns (Anderson and van Wincoop, 2003; 2004) and results stay very close to the baseline.

A final robustness is done by using a 1rst order Taylor-series expansion of trade costs instead of country/time dummies to control for multilateral resistance, as suggested by Baier and Bergstrand (2009). Similar to the baseline, both multiplicative variables $ln(AfT_{i,t}) * Integration_{ij,t}$ and $ln(AfT_{j,t}) * Integration_{ij,t}$ appear positive and significant for the total sample (Appendix A.4., column 1). Furthermore, as this methodology allows keeping the estimates of the direct impact of AfT on bilateral trade, results indicate that trade-related assistance received by both the exporter and the importer increased bilateral trade (consistent with Helble *et al.*, 2012).

4.2. Aid for Trade effectiveness by category: trade related institutions, trade-related infrastructure and productive capacity building

Each component of the AfT agenda address different obstacles to trade, whether they are linked to trade-related institutions, trade-related infrastructure or a lack of productive capacity. Table 2 looks at complementarities between these three categories and EIAs on the entire sample. Similar results can be found on North-South and South-South sub-samples (results upon request).

Table 2: Aid for Trade to institutions, infrastructure and productive capacity building

Ln ($X_{ij,t}$)	AfT by category		
	Institutions	Infrastructure	Production
	OLS with country/year specific effects		
Ln (Distance_ij)	-1.323***	-1.327***	-1.329***
	(0.0249)	(0.0249)	(0.0250)
Landlocked_ij	-0.620***	-0.609***	-0.621***
	(0.0967)	(0.0972)	(0.0973)
Common Frontier_ij	0.609***	0.551***	0.579***
	(0.117)	(0.117)	(0.118)
Common Language_off_ij	0.537***	0.535***	0.538***
	(0.0508)	(0.0508)	(0.0508)
Colony before 1945_ij	1.608***	1.609***	1.622***
	(0.148)	(0.147)	(0.147)
Common Colonizer_ij	0.815***	0.803***	0.812***
	(0.0662)	(0.0664)	(0.0664)
Integration_ij	0.0368*	0.0142	0.0620***
	(0.0193)	(0.0203)	(0.0200)
Ln(AfT_i)*Integration_ij	0.0319***	0.0300***	0.0255***
	(0.00330)	(0.00306)	(0.00279)
Ln(AfT_j)*Integration_ij	0.0176***	0.00745***	0.00558**
	(0.00292)	(0.00285)	(0.00275)
Constant	10.68***	10.71***	10.69***
	(1.405)	(1.411)	(1.435)
Observations	105,617	105,617	105,617
R-squared	0.761	0.761	0.761

All specifications include country/year and year specific dummies. Robust standard errors in brackets (clustered by country pairs).
* $p<0.1$; ** $p<0.05$; *** $p<0.01$

4.2.1. Aid to trade-related institutions

It can be seen from column (1) that aid to trade-related institutions, which takes usually the form of technical assistance, is a complement to economic integration and seems to enhance

both exports and imports from members. This can occur if programs such as trainings courses on bilateral trade negotiations for government staff or on compliance with rules of origins and standards for exporters are financed. Having received support from various donors, the Southern African Development Community program of vaccination, surveillance, and control of animal movements across borders to combat highly contagious bovine diseases is a good example of aid to trade-related institutions with a regional approach (Maur, 2011). We can also think about a one-stop border post at customs serving only EIA members trade, as it is the case in the East African Community or in the Central American Custom Union (SICA). Considering the strategic role played by customs in the import duty collection, AfT directed toward these features is of crucial importance for regionalization. Also, as in Helble *et al.* (2012), aid to trade-related institutions has the biggest elasticity compared to aid to infrastructure and aid to building productive capacity, suggesting that projects and programs within this category are the most cost-effective.

4.2.2. Aid to trade-related infrastructure

Aid to trade-related infrastructure aims to reduce bottleneck obstacles that increase trade costs related to infrastructure and many of them have a regional dimension, often considered as regional public goods. In fact, when prioritizing projects to be financed, connecting a country to regional markets appears as a major concern for developing countries. Thus, I am looking for strong complementarities between this AfT category and economic integration. As expected, complementarities appear for both directions of trade (column 2); but assistance to infrastructure seems to enhance further imports from members of a PTA, than exports to them.

One of the main examples when illustrating potential complementarities arising between AfT and regional trade agreements are transit corridors, which are of crucial relevance for landlocked countries. As Maur (2011) highlights, the management of transit corridors requires three key ingredients which are, legal arrangements, the provision of physical infrastructure and the operationalization of the transit itself. As part of PTA's negotiations, binding arrangements in infrastructure-related trade facilitation provisions could facilitate acceptance of reforms at home and skirt political-economy concerns, often frequent in those often non-competitive markets; while AfT could cover the capital investment needed.

4.2.3. Aid to building productive capacity

Finally, Column (3) report results for aid to building productive capacity. This kind of aid can enhance trade by increasing the exportable production; for example, by supporting the birth

of a new agricultural supply chain where the country has a comparative advantage. It can also favor imports if assistance is directed towards sectors intensive in foreign intermediate goods consumption. Results indicate that this kind of assistance is a complement to economic integration for both exports and imports, even if the effect seems higher for the former.

In the case of AfT received by the exporting country *i*, we my think that complementarities will arise when building productive capacity programs help exporters to adopt standards promoted by harmonization clauses in North-South EIAs (e.g. the European Pesticide Program; Jaud and Cadot, 2012). Also, complementarities may appear if AfT finance emerging export sectors where the country has a comparative advantage in EIAs members' markets.

If aid to productive capacity building is received by the importer, complementarities with economic integration may arise if assistance promotes sectors intensive in foreign intermediate goods consumption, where production is intended to be exported to PTAs members' markets. In this case, we might think indeed that rules of origins will promote imports from intra-members PTAs more than from the rest of the world. Other complementarities may also take place if AfT supports the development of regional integrated value chains.

5. Conclusion, policy implications and avenues for further research

This study analyzes the complementarities between AfT and economic integration using a gravity model for the period 1995 to 2005. Results indicate that AfT effectiveness is increased when countries share a certain degree of economic integration. While average marginal effects are rather small (depending on the level of integration of the pair, 1 USD in AfT translates into 0,12 to 0,72 USD in additional intra-members trade[57]), the relationship benefits from a strong statistical significance. Estimates also suggest that within AfT, assistance to trade-related institutions displays the highest impact; on average, 1 USD in institutional assistance will translate into 2 to 10 USD in additional intra-members' trade[58].

Thus, combining EIAs with trade-related assistance seems to be a promising development strategy to foster developing countries' trade. From a policy recommendation

[57] Average trade and AfT values during the entire period and estimates from the baseline (Table 1, column 1) are used to produce marginal effects.
[58] Average values for trade and trade-related institutional assistance and estimates from Table 2 (column 1) are used to produce marginal effects.

perspective, this cross-country evidence encourages the design of trade interventions projects and programs with a regional approach and gives support to economic integration agreements where trade negotiations and aid packages go hand-by-hand. Nevertheless, one question remains open: how best to direct AfT a the country level to maximize the benefits from economic integration? Adopting impact evaluation as a routine practice in trade interventions is a promising yet challenging new direction for research (Cadot *et al.*, 2011; Cadot *et al.*, 2012). Establishing a dialogue with governments during economic integration agreements' negotiations on the need to ensure the availability of firm level statistics could be part of the solution.

Appendix

1. Measuring Aid for Trade

Following the definition from the Task Force, AfT is measured as the sum of three aid categories[59]:

The trade policy and regulations category, proxy for trade-related institutions, includes assistance for trade policy and administrative management, trade facilitation, regional trade agreements, multilateral trade negotiations and trade education/training.

The economic infrastructure category, which is a proxy for trade-related infrastructure includes aid for three sub-categories: transport and storage, communications and energy generation and supply. Projects or programs under this category range from technical cooperation on policy planning for ministries, to heavy construction of roads, power plants or airports.

The building productive capacity category includes, for example, support devoted to various economic sectors in recipient countries in order to help them exploit their comparative advantage and diversify exports. Taking the agricultural sector as an example, programs can range from technical assistance for policy planning for agriculture ministries to microfinance for small farmers, for instance.

[59] The trade-related adjustment (iv) category was not included as it didn't existent before 2007.

2. Summary Statistics

Table A.2.1.: Exports and Aid for Trade variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Bilateral exports (thousand USD)	105 617	339 340.5	3 644 305	1	2.82e+08
AfT (thousand USD)	105 617	105 597.2	307 060.9	0	4 589 134
AfT by category:					
Institutions	105 617	10 461.92	68 722.51	0	1 657 733
Infrastructure	105 617	60 222.34	215 491.6	0	3 236 803
Production	105 617	34 912.57	105 327.4	0	1 351 560

Source: Author's calculations

Table A.2.2. : Economic Integration Agreement variable

	t=1995		t=2000		t=2005	
Increasing Level of integration	Nb pairs	Value share in world trade (%)	Nb pairs	Value share in world trade (%)	Nb pairs	Value share in world trade (%)
1	1471	21	1549	18	2282	22
2	307	4	338	4	271	3
3	236	4	448	7	625	8
4	88	1	104	1	139	2
5	104	2	59	1	257	4
6	0	0	75	1	78	1
Total pairs	8142	32	9781	32	10597	40

Level of integration: 1 denotes a One-Way Preferential Trade Agreement, 2 denotes a Two-Way Preferential Trade Agreement, 3 denotes a Free Trade Agreement, 4 denotes a Customs Union, 5 denotes a Common Market and 6 denotes an Economic Union.

Source: Author's calculations

3. The endogeneity of Economic Integration Agreements

Table A.3 : Fixed Effect Model: economic integration agreements' impact on trade

Ln ($X_{ij,t}$)	(1) Total sample
	Within
Integration_ij	0.131*** (0.0175)
Constant	6.113*** (1.319)
Observations	105,563
R-squared	0.649

Specification includes country/year and year specific dummies. Robust standard errors in brackets (clustered by country pairs). * p<0.1; ** p<0.05; *** p<0.01.

Source: Author's calculations

Table A.4. : Robustness following Baier and Bergstrand's (2009) methodology to control for multilateral resistance

	Total AfT			AfT by category		
	(1)	(2)	(3)	(4)	(5)	(6)
Ln ($X_{ij,t}$)	Total sample	North-South	South-South	Institutions	Infrastructure	Production
			Ordinary Least Squares			
Ln(AfT_i)	0.0278***	0.0352**	0.0360**	0.0106**	0.0317***	0.0598***
	(0.0105)	(0.0154)	(0.0155)	(0.00470)	(0.00756)	(0.0125)
Dummy_AfT_i	0.359***	0.174	0.557***	0.121***	0.262***	0.555***
	(0.0985)	(0.139)	(0.156)	(0.0463)	(0.0746)	(0.123)
Ln(AfT_j)	0.0527***	0.0565***	0.0954***	0.0339***	0.0443***	0.00894
	(0.0102)	(0.0149)	(0.0146)	(0.00433)	(0.00737)	(0.0102)
Dummy_AfT_j	0.461***	0.338**	0.650***	0.257***	0.453***	0.367***
	(0.0968)	(0.141)	(0.149)	(0.0420)	(0.0708)	(0.0942)
Integration_mrt_ij	0.415***	0.427***	0.417***	0.465***	0.445***	0.487***
	(0.0223)	(0.0313)	(0.0482)	(0.0209)	(0.0222)	(0.0215)
Ln(AfT_i)*Integration_ij	0.00457*	-0.00430	0.0159***	0.00754**	0.00453+	0.00127
	(0.00275)	(0.00400)	(0.00484)	(0.00303)	(0.00287)	(0.00252)
Ln(AfT_j)*Integration_ij	0.0231***	0.0256***	-0.00192	0.0244***	0.0213***	0.0174***
	(0.00351)	(0.00497)	(0.00518)	(0.00385)	(0.00362)	(0.00352)
Observations	95,280	42,635	40,183	95,280	95,280	95,280
R-squared	0.650	0.673	0.583	0.649	0.649	0.649

All specifications include an US dummy variable and year specific dummies.
Robust standard errors in brackets (clustered by country pairs). Coefficients for other gravity variables available upon request.
+ p<0.15 ; * p<0.1; ** p<0.05; *** p<0.01
Source: Author's calculations

3. List of countries

Afghanistan
Albania
Algeria
Angola
Antigua And Barbuda
Argentina
Armenia
Aruba
Australia
Austria
Azerbaijan
Bahamas
Bahrain
Bangladesh
Barbados
Belarus
Belize
Benin
Bermuda
Bhutan
Bolivia
Bosnia and Herzegovina
Brazil
Brunei Darussalam
Bulgaria
Burkina Faso
Burundi
Cambodia
Cameroon
Canada
Cape Verde
Cayman Islands
Central African Republic
Chad
Chile
China
Colombia
Comoros
Costa Rica
Croatia
Cuba
Cyprus
Czech Republic
Denmark
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Eritrea
Estonia
Ethiopia
Fiji
Finland
France
Gabon
Gambia
Georgia
Germany
Ghana
Greece
Greenland
Grenada
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
Hong Kong
Hungary
Iceland
India
Indonesia
Iran
Iraq
Ireland
Israel
Italy
Ivory Coast
Jamaica
Japan
Jordan
Kazakhstan
Kenya
Kiribati
Korea
Kuwait
Kyrgyzstan
Laos
Latvia
Lebanon
Liberia
Libya
Lithuania
Macao, China
Macedonia
Madagascar
Malawi
Malaysia
Maldives
Mali
Malta
Marshall Islands
Mauritania
Mauritius
Mexico
Micronesia
Moldova
Mongolia
Morocco
Mozambique
Myanmar (Burma)
Nepal
Netherlands
Netherlands Antilles
New Caledonia
New Zealand
Nicaragua
Niger
Nigeria
Norway
Oman
Pakistan
Palau
Panama
Papua New Guinea
Paraguay
Peru
Philippines

Poland
Portugal
Qatar
Romania
Russia
Rwanda
Saint Kitts and Nevis
Saint Lucia
Saint Vincent and the Grenadines
Samoa
San Marino
São Tomé and Principe
Saudi Arabia
Senegal
Seychelles
Sierra Leone
Singapore
Slovak Republic
Slovenia
Solomon Islands
Somalia
Spain
Sri Lanka
Sudan
Suriname
Sweden
Switzerland
Syria
Taiwan
Tajikistan
Tanzania
Thailand
Timor-Leste
Togo
Tonga
Trinidad And Tobago
Tunisia
Turkey
Turkmenistan
Uganda
UK
Ukraine
United Arab Emirates
Uruguay
USA
Uzbekistan
Vanuatu
Venezuela
Vietnam
Yemen
Zambia
Zimbabwe

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CONCLUSION

Le lancement de l'initiative aide pour le commerce en 2005 généra d'importantes attentes autour de l'efficacité de l'aide publique au développement dirigée vers les secteurs en lien avec les échanges internationaux. En ciblant directement les coûts internes au commerce, l'aide pour le commerce fut alors perçue comme le meilleur moyen d'améliorer l'insertion des pays en développement dans le commerce international. Ces attentes politiques appelèrent à davantage de travaux empiriques sur les bénéfices d'une stratégie de développement tournée vers l'extérieur et sur l'efficacité de l'aide pour le commerce. Bien que la première question ait déjà fait l'objet de nombreuses études appartenant au courant de la littérature sur le commerce comme déterminant profond de la croissance économique, les analyses restent fortement critiquées de part les problèmes liés à la mesure de l'ouverture aux échanges et au biais d'endogénéité. Concernant l'impact de l'aide pour le commerce sur des cibles de performance commerciale, les études demeurent encore peu nombreuses. Cette thèse vise à combler ce vide en proposant, au travers de cinq essais, de nouvelles perspectives sur l'insertion des pays aux échanges internationaux ainsi que sur l'efficacité de l'aide pour le commerce. Les cinq chapitres peuvent être rassemblés en deux parties s'intéressant, d'une part, aux problèmes liés à la mesure de l'insertion aux échanges et à sa relation avec la croissance économique et d'autre part, à l'efficacité de l'aide pour le commerce vis-à-vis de la performance commerciale des pays en développement.

Le premier chapitre propose un nouvel indicateur d'insertion aux échanges combinant différentes dimensions du commerce international, à savoir, l'ouverture aux échanges, la diversification, la variété, la qualité et la performance. L'analyse met en évidence l'importance de l'accès au marché et des infrastructures pour améliorer l'insertion des pays en développement dans les échanges internationaux. La mise en œuvre de politiques de développement ciblant ce type d'obstacles au commerce apparaît ainsi cruciale, d'autant plus que le quatrième chapitre démontre que l'efficacité de l'aide pour le commerce en matière de performance à l'exportation transite via le canal des infrastructures.

Etant donné que le premier chapitre propose des perspectives d'amélioration de la mesure de l'insertion aux échanges, le deuxième chapitre revisite la relation entre l'ouverture au commerce et la croissance économique en incluant deux dimensions supplémentaires à l'analyse : la qualité et la variété du panier de biens exportés. Les résultats révèlent d'intéressantes non-linéarités entre l'ouverture aux échanges et la croissance lorsque la qualité des exportations est considérée. Ainsi, les pays en développement et notamment les pays les moins avancés devraient promouvoir une montée en gamme de leurs exportations de manière à bénéficier d'une stratégie de croissance tournée vers l'extérieur. De même, certaines complémentarités entre l'ouverture aux échanges et la variété des biens exportés semblent exister aux étapes initiales du développement économique, indiquant que la diversification des exportations reste cruciale pour favoriser la croissance dans les pays à faible revenu.

Ainsi, la première partie de cette thèse met en avant l'importance d'élargir la définition et la mesure de l'insertion aux échanges, de manière à identifier l'hétérogénéité des besoins des pays en développement et de tenir compte des diverses conséquences d'une ouverture au commerce sur la croissance économique. Compte tenu du fait que les pays présentant un faible niveau d'insertion aux échanges partagent également des obstacles au commerce similaires (dont certains font l'objet d'un traitement via l'aide pour le commerce) cette première partie de l'analyse appelle à une étude plus approfondie de l'efficacité de l'aide pour le commerce.

De ce fait, le troisième chapitre vise à dessiner les contours de l'aide pour le commerce, aussi bien en termes de stratégies d'allocation déployées par les bailleurs de fonds qu'en termes de travaux académiques s'intéressant à son efficacité. Bien que l'aide pour le commerce ait été placée

au devant de la scène internationale, l'analyse statistique démontre que sa part dans l'aide publique au développement a baissé de 49 % en 1995 à 33 % en 2009, ce malgré une hausse continue de ses flux. Il est également intéressant de noter qu'au sein de l'aide pour le commerce, l'assistance dirigée aux institutions liées au commerce fait l'objet d'une attention particulière de la part des bailleurs de fonds. En outre, les pays les moins avancés semblent être les principaux receveurs de l'aide pour le commerce. Enfin, concernant les travaux empiriques, peu d'études semblent s'être intéressées à l'efficacité de cette aide sectorielle. Cependant, les résultats tendent à montrer que l'aide pour le commerce a favorisé l'augmentation des flux d'échanges internationaux dans les pays receveurs, notamment en termes d'exportations.

Le quatrième chapitre vise à alimenter la littérature sur l'efficacité de l'aide pour le commerce en proposant une approche en deux étapes, qui permet d'identifier les infrastructures comme le canal de transmission par lequel l'aide améliore la performance à l'exportation des pays receveurs. Les résultats indiquent qu'une augmentation de 10 % des engagements d'aide aux infrastructures par tête conduit à une augmentation moyenne du ratio des exportations sur le produit intérieur brut d'un pays receveur d'aide de 2,34 %, ce qui est équivalent à une réduction de 2,71 % des barrières tarifaires et non-tarifaires. Cette analyse renforce l'idée selon laquelle l'aide pour le commerce constitue un instrument puissant pour soutenir les pays en développement dans leur tentative d'amélioration de leur performance à l'exportation et d'insertion dans les échanges internationaux, d'autant plus que les discussions multilatérales du round de Doha traînent en longueur.

Enfin, le cinquième chapitre s'intéresse aux complémentarités susceptibles d'exister entre l'aide pour le commerce et les accords préférentiels de libre-échange. En effet, les pays en développement font de plus en plus appel à la libéralisation bilatérale ou régionale pour accroître leur intégration économique avec leurs partenaires commerciaux. Or, les résultats indiquent que l'efficacité de l'aide pour le commerce est d'autant plus forte que le pays receveur partage un certain degré d'intégration économique avec son partenaire. Bien que les effets marginaux moyens restent faibles (un dollar d'aide pour le commerce se traduit par une augmentation de 0,12 dollars à 0,72 dollars additionnels de commerce intra-membres), cette relation est largement significative en termes statistiques. Les estimations suggèrent également qu'au sein de l'aide pour le commerce, l'aide aux institutions liées aux échanges internationaux présente l'impact le plus

élevé. Ainsi, on observe en moyenne 2 à 10 dollars de commerce intra-membres supplémentaire pour chaque dollar d'aide aux institutions reçu. Combiner les accords de libre-échange avec de l'aide pour le commerce apparaît donc comme une stratégie de développement prometteuse pour augmenter les échanges internationaux des pays en développement. Ces résultats encouragent notamment la conception de projets et de programmes de développement à visée régionale et soutiennent les accords d'intégration économique où les négociations commerciales vont de pair avec l'octroi d'aide pour le commerce.

Ainsi, la seconde partie de cette thèse démontre que l'aide pour le commerce est efficace pour améliorer la performance commerciale, aussi bien en termes d'exportations que d'importations. Les résultats suggèrent également que cet effet transite via le canal des infrastructures et que l'aide pour le commerce est d'autant plus efficace que le pays receveur partage un certain degré d'intégration économique avec ses partenaires commerciaux.

Une des principales contributions de cette thèse consiste à ouvrir à nouveau le débat sur la définition et la mesure de l'insertion aux échanges, de manière à identifier de nouvelles perspectives de recherche en matière d'évaluation de l'efficacité de l'aide pour le commerce. En ce sens, ce travail de recherche propose des éléments solides indiquant que l'aide pour le commerce promeut l'augmentation des exportations et des importations. Or, cette analyse pourrait être étendue à d'autres dimensions de l'insertion aux échanges, telles que la diversification et la qualité. En effet, l'aide pour le commerce pourrait permettre de couvrir les coûts fixes surmontés par les nouvelles entreprises entrant sur les marchés à l'exportation et de ce fait, avoir un impact sur la marge extensive du commerce ou sur la variété des biens exportés. L'aide pour le commerce, notamment l'aide au renforcement des capacités productives, pourrait également soutenir les exportateurs dans l'adoption de nouvelles technologies et encourager ainsi la montée en gamme des exportations.

De plus, il semble prometteur de s'intéresser à l'efficacité de l'aide pour le commerce au regard de la réduction des coûts internes au commerce. En effet, ces derniers constituent les principales cibles visées par les projets et les programmes d'aide pour le commerce mis en œuvre sur le terrain. Or, mise à part la contribution proposée par le quatrième chapitre de cette thèse,

cette relation demeure peu couverte par les études empiriques. Compte tenu de l'amélioration de la profondeur temporelle des bases de données mesurant les coûts internes au commerce, cette voie d'analyse offre de nouvelles perspectives de recherche.

Enfin, une évaluation de l'efficacité de l'aide pour le commerce au niveau macroéconomique nécessite d'être soutenue par de solides évidences microéconomiques. Etant donné que l'évaluation d'impact devient un instrument populaire pour mesurer l'efficacité de l'aide dirigée vers les secteurs sociaux, il convient de s'interroger sur la manière d'adapter cette technique d'analyse aux caractéristiques des interventions d'aide pour le commerce. Par ailleurs, les analyses académiques devraient constamment s'inspirer des retours d'expérience de terrain en matière de suivi et d'évaluation des programmes d'aide pour le commerce, et vice versa. En effet, les travaux empiriques mettant en avant un lien de causalité entre l'aide pour le commerce et les coûts internes au commerce pourraient se révéler utiles pour identifier les indicateurs à retenir lors du suivi et de l'évaluation des projets et des programmes d'aide pour le commerce.

With the launch of the Aid for Trade initiative in 2005, expectations were high concerning foreign assistance directed towards trade-related sectors as a way to enhance developing countries' trade integration, by targeting their internal costs to trade. This political debate called for further evidence on the benefits of trade integration as a development strategy and on the effectiveness of AfT. While the first concern has been already extensively treated by the literature on the determinants of growth, analysis remain undermined by empirical concerns related to the way trade integration is measured and also to the treatment of endogeneity. As for the impact of AfT on trade-related targets, evidence is still scarce. This dissertation is an attempt to fill this gap by providing new perspectives on trade integration and AfT efficacy through five essays. The five chapters can be clustered in two distinct parts, addressing respectively issues related to the measurement of trade integration and its relationship with growth, and to the efficacy of trade-related assistance as regards to trade performance for developing countries.

Chapter 1 (Developing Countries Integration in International Trade: Measurements and Determinants) proposes a new indicator of trade integration that combines different dimensions of trade, including concepts such as openness, diversification, variety, quality and performance. A limited market access and a lack of infrastructure are identified as important obstacles for increasing such integration, suggesting that development policies addressing those concerns are crucial. This is particularly interesting considering that Chapter 4 indicates that AfT effectiveness' in terms of export performance transits via the infrastructure channel.

As Chapter 1 argued that the measurement of trade integration can be improved, Chapter 2 (The relationship between Trade Openness and Economic Growth: Some New Insights on the Openness Measurement Issue) revisits the relationship between trade openness and growth adding two additional trade dimensions to the analysis: export quality and export variety. Results reveal an interesting non-linear pattern between trade openness and growth when the export quality is taken into account, suggesting that developing economies, particularly the least developed ones, should move up on the value chain in order to benefit from openness to trade. Also, there seems to be some complementarities between trade openness and export variety at the first stage of development, indicating that export diversification is crucial for fostering growth.

The first part of the dissertation calls thus for a more complete definition and measurement of trade integration in order to highlight developing countries' heterogeneous needs, and their implications for growth. As countries with a low level of trade integration also share common obstacles to trade -some of them actually addressed by trade-related assistance-

this first part of the analysis shows the necessity to perform an extensive assessment on AfT effectiveness.

Thus, Chapter 3 (Aid for Trade: A Selected Survey) starts by drawing a picture of AfT, both in terms of how it has been used by donors and the state of the art on its effectiveness. Despite the fact that trade-related assistance seems to be a central topic in international forums, the statistical analysis highlights that while the allocated amount of AfT has been rising since 1995, AfT in total allocable ODA has decreased from 49 per cent to 33 per cent in 2009. Another interesting feature is that within AfT, assistance to trade-related institutions is receiving an increasing attention. Furthermore, once adjusted for the size of countries, the least developed countries appear as the main recipients of AfT. In terms of empirical evidence, few studies have tested the efficacy of trade assistance but results suggest that it has been effective in increasing recipient countries' trade flows, particularly in terms of exports.

Chapter 4 (Does Aid for Trade Enhance Export Performance? Investigating the Infrastructure Channel) respond to this scarcity of evidence by proposing a two-step analysis that highlights infrastructure as the channel by which AfT enhances export performance. Results indicate that a ten per cent increase in aid for infrastructure commitments leads to an average increase of the exports over GDP ratio of an aid recipient by 2.34 per cent, which is also equivalent to a 2.71 per cent reduction of the tariff and non-tariff barriers. This analysis supports the view that AfT 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.

Finally, Chapter 5 (Aid for Trade Effectiveness: Complementarities with Economic Integration) addresses the complementarities that may arise between AfT and preferential trade agreements, as the later are increasingly used by developing countries to enhance economic integration with their partners. Results indicate that AfT effectiveness' is increased when the recipient country shares a certain degree of economic integration with his partner. While average marginal effects are rather small (1 USD in AfT translates into 0,12 to 0,72 USD in additional intra-members' trade), the relationship has a strong statistical significance. Estimates also suggest that within AfT, assistance to trade-related institutions displays the highest impact, with on average 2 to 10 USD in additional intra-members' trade for every 1 USD in institutional assistance received. Combining Economic Integration Agreements (EIAs) with trade-related assistance seems thus to be a promising development strategy for fostering developing countries' trade. This evidence encourage the design of trade interventions projects and programs with a

regional approach and gives support to EIAs where trade negotiations go hand-by-hand with trade-related aid packages.

Thus, the second part of this dissertation shows that AfT is effective in increasing trade performance, both in terms of exports and imports. Results also suggest that this effect transits via the infrastructure channel and that trade assistance is even more effective when the recipient shares a certain degree of economic integration with its trading partners.

One of the contributions of this dissertation is to re-open the debate on how to define and measure trade integration, in order to propose new perspectives for research when evaluating the effectiveness of AfT. As such, it provided sound evidence that trade assistance promotes the expansion of exports and imports. However, this analysis could also be extended to other dimensions of trade integration, such as diversification and quality. For instance, AfT may cover fixed costs of new firms entering into the export market and thus have an impact on the extensive margin or the variety of exports. Trade assistance and more precisely, aid for building productive capacity, may also help exporters to adopt new technologies and thus move upward the export quality.

Moreover, it seems also promising to measure the AfT efficacy in terms of a reduction in trade costs, which are the immediate targets trade-related projects and programs focus on the ground. Except for a few exceptions such as the contribution in Chapter 4, this link has been barely empirically tested. Considering that the time span of specific trade costs databases has been improving over the years (e.g. the Doing Business database from the World Bank), this pathway offers new perspectives for research.

Finally, an evaluation of AfT efficacy at a macroeconomic level needs to be complemented by sound evidence at the microeconomic level. As impact evaluation is becoming a popular instrument in social sectors for measuring the effectiveness of aid, adapting this technique to the characteristics of trade interventions appears as an appealing perspective for future research. Also, empirical analysis performed by academicals should constantly feed back into one another with monitoring and evaluation activities performed by governments and donor agencies on the ground. Indeed, further empirical evidence on the causal link between AfT flows and internal trade costs may be helpful to determine which indicators should be selected to monitor and evaluate AfT on a day to day basis.