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**Thèse de Doctorat en Sciences Economiques**

# The effects of Financial & Institutional Systems on International Trade, Specialization and Foreign Direct Investment

présentée par

**Rafael CEZAR VASCONCELLOS BARROS**

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| | |
|---|---|
| Directeur de thèse : | M. Jean-Marc SIROËN<br>*Professeur, Université Paris-Dauphine* |
| Rapporteurs : | M. Matthieu CROZET<br>*Professeur, Université Paris-Sud 11* |
| | Mme Flora BELLONE<br>*Professeur, Université de Nice-Sophia-Antipolis* |
| Suffragants : | M. Hervé BOULHOL<br>*Economiste senior, OCDE* |
| | M. El Mouhoub MOUHOUD<br>*Professeur, Université Paris-Dauphine* |

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**Rafael CEZAR VASCONCELLOS BARROS**

dirigée par

**Jean-Marc SIROËN**

**Laboratoire d'Economie de Dauphine, LEDa – DIAL.**

Place du Maréchal de Lattre de Tassigny

75 775 Paris

**IRD UMR 225 DIAL.**

4, rue d'Enghien

75 010 Paris

**École Doctorale de Dauphine.**

Place du Maréchal de Lattre de Tassigny

75 775 Paris

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can be explained to the most slow-witted man
if he has not formed any idea of them already;
but the simplest thing
cannot be made clear to the most intelligent man
if he is firmly persuaded that he knows already,
without a shadow of doubt,
what is laid before him.”

– Leo Tolstoy, 1897

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# Résumé de la thèse

Cette thèse étudie l'impact des institutions, notamment les institutions financières, sur le commerce et les investissements internationaux. Les quatre premiers chapitres étudient les institutions financières et leur impact sur le commerce et la spécialisation internationale. Précisément, le premier chapitre étudie ces institutions et les déterminants de leur niveau de développement. Le deuxième chapitre analyse la façon dont la finance intervient sur le commerce bilatéral. Le troisième chapitre construit un modèle théorique qui vise à expliquer l'impact de la finance sur le commerce sectoriel en fonction du degré d'intensité financière de chaque secteur. Le quatrième chapitre analyse l'impact hétérogène de la finance sur les différents secteurs manufacturiers. Le dernier chapitre de la thèse utilise le terme "institution" dans un sens plus large et étudie théoriquement et empiriquement si les similitudes et différences dans les environnements institutionnels à travers les pays explique la distribution internationale des investissements directs étrangers (IDE).

**Mots-clés :** Systèmes financiers ; Commerce international ; Spécialisation internationale ; Investissement direct étranger ; Firmes hétérogènes, Modèle de gravité.

**Classification JEL:** C43, F12, F13, F14, F21, F23, F40, G20, H80, K20, 016.

# Abstract

This thesis examines the impact of institutions, especially the financial institutions, on international trade and foreign direct investments. The first four chapters study the financial institutions and their impact on trade and international specialization. Specifically, the first chapter examines these financial institutions and the determinants of their level of development. The second chapter examines how finance impacts bilateral trade. The third chapter builds a theoretical model and aims to explain the impact of finance on the sectoral trade as a function of the degree of financial intensity of each sector. The fourth chapter analyzes the heterogeneous impact of finance on the different manufacturing sectors. The last chapter of the thesis uses the term "institution" in a broader sense and studies theoretically and empirically whether the similarities and differences in institutional environments across countries explain the international patterns of foreign direct investment (FDI).

**Keywords:** Financial development; International trade; International specialization; Foreign direct investment; Heterogeneous firms; Gravity model.

**Classification JEL*:*** C43, F12, F13, F14, F21, F23, F40, G20, H80, K20, 016.

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# Introduction Générale

# Introduction

Cette thèse étudie l'impact des institutions, notamment les institutions financières, sur le commerce et les investissements internationaux.

Le terme "institution" désigne les structures qui affectent les relations économiques. North (1993) définit les institutions comme les contraintes, formelles ou informelles, construites par les hommes et conçues pour organiser les relations sociales. Les contraintes formelles comprennent les règlementations, les droits de propriété, les systèmes financiers ou l'application des contrats (Levchenko, 2007), tandis que les contraintes informelles comprennent les niveaux de confiance sociale (Algan et Cahuc, 2010) ou de corruption (Habib et Zurawicki, 2002).

Les quatre premiers chapitres de la thèse sont dédiés à l'étude de la façon dont l'économie internationale est affectée par une de ces "contraintes" : les institutions financières. Plus précisément, le premier chapitre étudie ces systèmes et les déterminants de leur développement. Les trois chapitres qui suivent essayent de comprendre la façon dont la finance intervient sur les échanges et la spécialisation internationale. Le terme "institution" dans le cinquième chapitre est employé dans un sens plus large. Ce chapitre analyse comment les similitudes et différences à travers des systèmes institutionnelles interviennent sur la distribution internationale des investissements directs étrangers (IDE).

# I. Motivations

Depuis longtemps, la littérature économique discute des déterminants du développement des systèmes financiers et ses effets sur l'activité économique

(Schumpeter, 1912). Le focus était initialement porté sur l'analyse de l'impact de l'amélioration des systèmes financiers sur la croissance économique (Goldsmith, 1969 ; McKinnon, 1973). Cette littérature a connu un essor important à partir des années 1990 (King & Lavine, 1993a ; King & Lavine, 1993b ; Gregorio & Guidotti, 1995 ; Odedokun, 1996) et, selon ces travaux, le développement financier affecte positivement la croissance économique par des nombreux canaux. Précisément, les systèmes financiers (i) contribuent à mobiliser et à allouer les capitaux vers les projets les plus efficaces. Ils améliorent (ii) la qualité et la quantité d'information disponible et (iii) la gouvernance et la surveillance des entreprises. Le développement financier facilite (iv) les échanges de biens et services, et (v) le commerce, la diversification et la gestion des risques (Levine, 2005).

Parmi ces travaux, Rajan & Zingales (1998) analysent la relation avec une méthodologie innovatrice. Ils construisent un indice sectoriel de dépendance financière à partir de données de firmes sur la part des dépenses en capital financée par leurs flux de trésorerie, de sorte que les secteurs les plus dépendants sont ceux dont les investissements sont les plus importants par rapport aux flux, et vice-versa. A partir de cet indice, les auteurs démontrent que les pays les plus développés financièrement connaissent également un niveau de croissance plus soutenu dans les secteurs les plus dépendants. Or, ces résultats démontrent que les systèmes financiers affectent la structure productive des pays. Il n'était donc qu'une question de temps pour que d'autres études établissent une relation entre les systèmes financiers et la structure de l'insertion internationale des pays.

La littérature qui analyse la relation entre le développement financier et le commerce international apparaît bien plus tard que celle sur la croissance économique. Au début, les modèles théoriques se sont basés sur une logique Heckscher-Ohlin des échanges internationaux (Dornbusch et al, 1979) et ils soutenaient que les pays dotés de systèmes financiers relativement développés se spécialisaient dans les secteurs demandeurs de capital, c'est à dire les secteurs manufacturiers, tandis que les pays faiblement dotés de ces systèmes se spécialisaient dans les secteurs primaires, où

l'utilisation du facteur capital est relativement faible (Kletzer & Bardhan, 1987 ; Baldwin, 1989). Des études empiriques ont soutenu ces propositions et démontré que la part des exportations et du solde des échanges de produits manufacturiers est plus élevée dans les pays financièrement développés (Beck, 2002).

Dans un deuxième temps, un ensemble d'études empiriques s'est approprié la méthodologie et l'indice de Rajan & Zingales pour analyser la manière dont les dotations financières des pays attribuaient un avantage commercial aux secteurs manufacturiers et si celui-ci était plus important dans les secteurs intensifs en finance (Beck, 2003). Leurs résultats confirment ceux présentés auparavant et indiquent que le développement financier concède effectivement un avantage dans les exportations des secteurs manufacturiers et, ainsi comme dans les résultats pour la croissance économique, que cet avantage est plus prononcé dans les secteurs intensifs dans l'utilisation des systèmes financiers (Wynne, 2005 ; Hur, et al., 2006 ; Becker, et al., 2013). Selon Svaleryd & Vlachos (2005), les différences financières entre les pays provoquent un effet encore plus fort sur la structure des échanges internationaux que les écarts entre le capital humain. Manova (2008) conclut que les systèmes financiers sont un déterminant majeur du commerce international et que les pays financièrement développés exportent un volume plus élevé à partir d'un plus grand nombre de firmes dans les secteurs manufacturiers, et ce phénomène est encore plus fort que le niveau sectoriel de dépendance financière est élevé.

Selon cette littérature, le commerce manufacturier est soumis aux systèmes financiers. Ces résultats laissent néanmoins des questions ouvertes sur le rapport entre les systèmes financiers et le commerce international. D'abord, la base de données utilisée par ces études ne couvre pas la totalité des secteurs économiques, ni même tous les secteurs manufacturiers, de sorte que les conclusions portent sur des analyses empiriques dont la couverture ne dépasse 60% du commerce global. Ensuite, dans une logique Heckscher-Ohlin, la spécialisation dans des secteurs à forte intensité financière, induite par le développement financier, devrait conduire à un désengagement dans des secteurs (manufacturiers inclus) moins intensifs

financièrement (Trefler, 1993). Et c'est ce que montre Matsuyama (2005). Selon l'auteur, la manière dont la finance affecte le commerce varie en fonction des caractéristiques de chaque secteur économique, et cela même parmi les industries manufacturières. Plus précisément, ses propositions théoriques vont dans le sens que le développement financier procure un avantage aux secteurs dépendants de la finance, tandis que les pays à faible dotation financière se spécialisent dans les secteurs ayant de faibles problèmes d'agence (les secteurs manufacturiers compris), soit dans les secteurs peu dépendants des financements externes.

En d'autres termes, les effets des systèmes financiers sur le commerce global, c'est à dire les exportations de la totalité des secteurs économiques, ne sont pas connus. D'autre part, tel que présentée par la littérature, la relation entre la finance et le commerce manufacturier est homogène et positive dans la totalité des secteurs manufacturiers (tous les secteurs analysés, en tout cas). Il se peut que, néanmoins, à l'intérieur de cet effet positif, cette relation soit également négative ou non-significative pour certains secteurs et que l'effet sur la spécialisation internationale signalé par la littérature soit aussi valable au sein des secteurs manufacturiers et non seulement entre les secteurs primaires et ceux de la manufacture. Les quatre premiers chapitres de cette thèse sont dédiés à l'étude de ces questions laissées sans réponse sur la relation entre les systèmes financiers et le commerce international.

Le dernier chapitre de la thèse élargit l'étude de l'impact des institutions financières sur l'économie internationale pour étudier une tendance nouvelle vérifiée sur les investissements directs étrangers : la croissance importante lors de la dernière décennie du montant des investissements directs étrangers sortant des économies en développement et en transition, et le fait que ceux-ci se dirigent principalement vers d'autres pays en développement ou en transition (CNUCED, 2012). Ainsi, depuis 2003, la part des IDE en provenance de ces pays n'a cessé d'augmenter pour atteindre 25% des IDE totaux en 2011 ; et plus de 70% de ces IDE sont destinés à d'autres économies en développement ou en transition.

La littérature souligne que cette préférence pour des économies similaires est expliquée par la proximité géographique et culturelle (Head et Ries, 2008 ; Helpman et al, 2004). La similitude des préférences est aussi expliquée par la proximité du niveau de développement économique (Krugman, 1980). Selon Johanson & Vahlne (2009), les entreprises obtiennent de meilleurs résultats économiques sur des marchés étrangers similaires à leurs marchés intérieurs. En outre, les différences entre les pays hôte et d'origine des IDE en termes de corruption (Habib et Zurawicki, 2002), de règles juridiques (Guiso et al., 2009), de la réglementation du marché du crédit, des contraintes juridiques et des règles sur le marché du travail (Bénassy-Quéré et al., 2007) réduisent les flux d'IDE bilatéraux. Le dernier chapitre de cette thèse rentre dans cette discussion et analyse cette nouvelle tendance dans le mode d'insertion international des firmes multinationales.

# II. Les chapitres

Le premier chapitre de la thèse commence par définir le développement des systèmes financiers et les caractéristiques qui définissent le niveau de développement de cette industrie. Précisément, le développement financier traduit l'efficacité dans l'exécution de six fonctions principales, soit: (i) la mobilisation et allocation du capital ; (ii) la production et diffusion d'informations sur les agents économiques ; (iii) la maîtrise et le partage des risques ; (iv) le suivi des investissements et la gouvernance des entreprises ; (v) la réduction des coût des transaction ; et (vi) la liquidité des marchés financiers. Ensuite, un indice financier composite est proposé pour synthétiser l'efficacité des systèmes financiers dans l'exécution de ces fonctions dans quatre-vingt pays pendant les cinq années comprises entre 2005 et 2009. L'indice est construit à partir de l'analyse en composante principale de six indicateurs financiers et institutionnels et possède trois avantages par rapport aux indicateurs

financiers déjà utilisés : (1) l'indice présente une mesure plus complète du développement financier, (2) l'indice est moins dépendant des changements dans un seul aspect des systèmes financiers, et (3) il est moins sensible aux effets conjoncturels.

Le deuxième chapitre étudie empiriquement le lien entre le développement financier et le commerce international, plus précisément l'impact de l'amélioration de l'efficacité dans l'intermédiation financière sur la variation marginale de la proportion de firmes exportatrices (marge extensive) et le volume total exporté par les pays (marge intensive). Les données commerciales portent sur les exportations totales, tous les secteurs économiques combinés, de façon à ce que la contribution principale du chapitre soit une analyse de l'effet du développement financier sur le commerce global. Comme la littérature analyse principalement l'effet de la finance sur la spécialisation internationale ou sur les exportations des secteurs manufacturiers, cette étude fournit une contribution importante sur le rôle de la finance sur le commerce international.

L'étude s'appuie sur une base de données sur les exportations bilatérales de 104 pays entre 1998 et 2007. La section empirique estime un modèle de gravité en deux étapes. La première étape estime un modèle probit pour analyser l'impact du niveau de développement financier sur la variation marginale de la productivité seuil à partir de laquelle les firmes sont capables d'accéder aux marchés étrangers. La deuxième étape de la méthodologie estime l'impact de la finance sur les flux commerciaux à partir d'une équation de gravité traditionnelle avec contrôle de la marge extensive, qui est construit à partir de la première étape. Les résultats montrent une relation positive entre le niveau de développement financier et la marge extensive de façon à ce que le développement financier réduit le niveau de productivité au-dessus duquel les firmes exportent et augmente le nombre de firmes exportatrices. Toutefois, l'estimation de la relation entre la finance et la marge intensive indique des résultats inattendus. Ceux-ci sont incohérents et démontrent une relation négative, positive ou statistiquement nulle, qui dépend de l'indicateur financier employé dans les estimations.

Le chapitre montre ainsi qu'il existe un lien étroit entre la finance et l'accès des firmes aux marchés étrangers. Lorsque la contrainte financière est détendue, une plus grande proportion de firmes est en mesure d'accéder à ces marchés. En revanche, le lien entre la finance et les flux commerciaux suit deux voies distinctes. En utilisant des données sur les secteurs manufacturiers (qui ne sont pas extensifs), la littérature (voir section I) constate que le développement financier se traduit par un avantage comparatif dans ces secteurs. D'un autre côté, ce chapitre de la thèse estime la relation à partir de données bilatérales, qui couvrent tous les secteurs économiques, et démontre que l'impact macroéconomique du développement financier sur le commerce n'est pas concluant. La spécialisation induite par le développement financier sur certains secteurs manufacturiers (comme indiqué par Beck, 2002), provoque également une baisse des exportations dans certains autres secteurs (comme le montre Cezar, 2013). Les résultats rencontrés dans cette analyse peuvent donc être expliqués par ces deux phénomènes opposés qui s'annulent les uns les autres. La baisse des exportations dans certains secteurs compense la croissance dans d'autres, de sorte que l'effet global de la finance sur les flux commerciaux soit non concluant.

Le chapitre 3 qui suit propose un modèle théorique qui explique les résultats empiriques présentés dans le chapitre précédent. Le modèle est construit à partir d'un cadre théorique simple, basé sur le modèle des firmes hétérogènes, comme dans Melitz (2003) ou Ghironi et Melitz (2007), des avantages comparatifs, comme proposé par Dornbusch et al. (1977), et également sur le travail de Matsuyama (2005).

L'approche méthodologique s'appuie sur l'analyse de la productivité de coupure à partir de laquelle les firmes exportent. Celles-ci font face à deux contraintes pour accéder aux marchés étrangers et elles exportent seulement si le revenu de cette activité est supérieur à ces deux contraintes. La première contrainte est celle d'endettement, qui est le montant de financement extérieur nécessaire pour payer les coûts fixes de commerce. Cette contrainte dépend du niveau de productivité des entreprises, de la dépendance sectorielle des financements externes et du niveau de

restriction sur le marché du crédit dans chaque pays. La deuxième contrainte est la contrainte de rentabilité et indique que les firmes exportent seulement si le revenu de cette activité est au moins égal à zéro. Cette contrainte est fonction du niveau des coûts.

Le modèle montre que, pour exporter, les secteurs dépendants de financement externe nécessitent un système financier développé pour surmonter leur contrainte d'endettement. Ainsi, les pays développés financièrement ont un avantage commercial, caractérisé par une plus forte proportion de firmes exportatrices et des flux commerciaux plus importants, dans ces secteurs intensifs en finance. D'un autre côté, la réduction de l'intensité financière sectorielle réduit la contrainte d'endettement jusqu'à ce que la contrainte de rentabilité l'emporte sur la première. Cette contrainte dépend des coûts de production, de sorte que les pays qui présentent des coûts relativement faibles possèdent une contrainte commerciale plus faible dans les secteurs à faible dépendance financière. De ce fait, ces pays ont un avantage commercial dans ces secteurs peu intensifs en finance externe.

Le chapitre 4 de la thèse teste empiriquement si l'impact du développement financier sur le commerce international est hétérogène à travers des secteurs manufacturiers et si celui-ci dépend du niveau sectoriel de dépendance du financement externe. Plus précisément, il teste l'hypothèse selon laquelle le développement financier favorise les exportations des secteurs manufacturiers les plus dépendants des systèmes financiers, tandis qu'il réduit les exportations des secteurs peu dépendants. Ce schéma s'explique par l'avantage des pays développés financièrement dans les secteurs intensifs en finance et par l'avantage des pays dont le système financier est relativement peu développé dans les secteurs peu intensifs en finance.

L'analyse empirique s'appuie sur une base de données en panel sur le commerce de vingt-cinq secteurs manufacturiers dans quatre-vingt pays entre 2000 et 2009. L'analyse est divisée en trois étapes. Tout d'abord, l'effet global de la finance sur le commerce de l'ensemble des vingt-cinq secteurs est calculé. Ensuite, les secteurs sont

partagés en groupes par ordre croissant de leur niveau d'intensité financière, et un coefficient pour chacun d'entre eux est calculé pour évaluer l'impact du développement financier sur chaque groupe. La dernière étape calcule l'impact de la finance sur les exportations de chacun des vingt-cinq secteurs. Ces deux dernières étapes permettent d'identifier également le rôle de l'intensité financière sectorielle dans la relation puisque chaque groupe et secteur est identifié par leur niveau de dépendance financière.

Les résultats empiriques confirment les hypothèses testées. La première étape est conforme aux résultats présentés par la littérature antérieure (voir section I) et montre que l'impact de la finance sur le commerce manufacturier total est positif. Ensuite, les estimations de l'effet du développement financier sur chaque groupe et sur chaque secteur indiquent que l'impact du premier sur le deuxième est hétérogène. Précisément, en analysant les estimations par secteur, les résultats montrent que l'effet de la finance sur les exportations est positif dans douze secteurs, négatif dans onze et statistiquement nul dans deux autres. En outre, parmi les douze secteurs présentant un niveau d'intensité financière en dessous de la valeur médiane, neuf ont un coefficient négatif, et, parmi ceux qui ont un niveau d'intensité financière au-dessus de la valeur médiane, huit ont un coefficient positif. Ceci suggère que le développement financier favorise les exportations dans les secteurs manufacturiers intensifs en finance externe tandis qu'il réduit les exportations dans les secteurs faiblement intensifs.

Le dernier chapitre de la thèse étudie l'impact des écarts institutionnels sur les investissements directs étrangers (IDE). Ceci aborde la problématique par deux stratégies. D'abord un modèle théorique est développé et ensuite une analyse empirique est effectuée pour valider les propositions théoriques.

Le modèle théorique est basé sur Melitz (2003), Helpman et al. (2004) et sur Yeaple (2009) et se focalise sur l'arbitrage des entreprises entre exporter et effectuer un IDE. Les firmes qui souhaitent produire à l'étranger doivent s'adapter au système

juridique, les lois fiscales, le cadre politique et gouvernemental, les conditions d'accès au crédit et les règlementations du pays d'accueil des investissements. Cette adaptation a un coût et le modèle suppose que ce coût est moindre lorsque l'environnement institutionnel du pays d'accueil est semblable à celui du pays d'origine des IDE. Par conséquent, l'augmentation de la distance institutionnelle augmente les coûts d'implémentation et réduit à la fois le nombre de firmes multinationales et le montant investi par ces firmes. La première relation est expliquée par la hausse des coûts et la deuxième par la baisse de la profitabilité des investissements.

L'analyse empirique utilise le modèle de gravité en deux étapes proposé par Helpman et al. (2008). La base de données en panel porte sur les relations bilatérales entre 31 pays de l'OCDE et 125 pays à différents stades de développement économique pendant la période entre 2004 et 2009. L'indicateur de distance institutionnelle est construit à partir de l'analyse en composante principale de plusieurs mesures institutionnelles.

Les résultats des estimations confirment la proposition théorique sur le rôle de la proximité institutionnelle sur les IDE et indiquent que la réduction de cette distance augmente à la fois le nombre de firmes qui effectuent les IDE (la marge extensive) et le montant engagé dans ces investissements (marge intensive). En outre, les résultats montrent que les entreprises des économies développées s'adaptent plus facilement à la distance institutionnelle que les entreprises des pays en développement.

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# Chapitre 1:

# A new financial development index

**Abstract:** The article proposes a new financial composite index that is sensitive to the countries' level of financial development. The principal component analysis methodology is used to condensate the information contained in six different measures of the effectiveness in which financial systems perform resource allocation. In addition to traditional financial indicators, such as private credit and market capitalization, the article also uses indicators of the quality of available information and legal system, so that the index proposed allows a better comprehension and measurement of financial systems. Furthermore, the index is less dependent of changes in one single aspect of financial systems and thus less sensitive to cyclical economic effects.

**Keywords**: PCA; Financial and institutional development index

**Résumé:** L'article propose un nouvel indice financier composite, sensible au niveau de développement financier des pays. La technique de l'analyse en composante principale est employée pour condenser l'information de six indicateurs distincts sur l'efficience des systèmes financiers dans l'allocation des ressources. En plus des indicateurs financiers traditionnels, tels que le crédit privé ou la capitalisation boursière, l'article utilise également des indicateurs de la qualité de l'information disponible et du système juridique de sorte que l'indice proposé permette une meilleure compréhension et mesure des systèmes financiers. De plus, l'indice est moins dépendant des variations d'un seul aspect des systèmes financiers et donc moins sensible aux effets conjoncturels.

**Mots clés:** ACP ; Indice de développement financier & institutionnel

**Classification JEL:** C43, O16, G20.

# Introduction

There is a growing body of literature that analyzes the effect of financial development on several macroeconomic variables, such as economic growth, income inequality, international specialization and trade (e.g., Rajan & Zingales, 2008; Beck et al., 2007; Kletzer & Bardhan, 1987; and Svaleryd & Vlachos, 2005; respectively). However, accessible financial indicators are often inadequate for the assessment of the development of financial systems (Levine, 2005). Ideally, a financial indicator should be sensitive to the efficiency of financial systems in capital allocation and to the performance of the main financial functions, such as savings mobilization, production and dissemination of information, corporate governance, or risk management. Such indicator does not exist or is unavailable either for numerous countries or for sufficient years to allow an international comparison (Beck et al., 2008). Another particularity is the possible endogeneity of these indicators, as they are often sensitive to the economic conditions (Do & Levchenko, 2007).

This study addresses these peculiarities and proposes a new composite financial index constructed from the principal component analysis of six distinct indicators. This method performs a linear transformation of the six variables and builds a single composite indicator that condensates the information contained in the original data. The composite index summarizes information with respect to several aspects of financial systems and provides a more complete measure of financial development. Furthermore, the index is less dependent on changes in one single aspect of financial systems and is also less susceptible to cyclical economic effects. This latter characteristic is reinforced by the presence of structural variables in the construction of the index, such as indicators of the level of information and of the rule of law.

The data cover eighty countries between 2005 and 2009. The choice of each of the six indicators employed in the construction of the index was subject to the identification of the efficiency with which financial systems allocate available ressources in each country of the sample. The first of the six indicators employed measures the credit allocated to the private sector; the second reflects the size of financial market; the third indicator reflects the importance of private financial institutions in the financial system; the fourth reflects the functioning of the credit markets; the fifth indicator reflects the quality and the availability of information; and the final indicator captures the perception of whether and the extent to which economic agents trust and respect the rules of law.

The results are presented in the appendix A of the paper. The benchmark financial system, that is the country that possesses the average level of financial development in the sample, is the Slovak Republic. Thirty-eight countries have a level of financial development higher than this standard financial system and forty-two countries have a lower level of financial development. The most developed country over the study period is the Switzerland, whose financial system is 3.697 standard deviations above the average (because the indicator is center reduced, it indicates the distance from the mean). The United Kingdom (3.436), the United States (3.117), Denmark (2.825) and Ireland (2.707) follow the classification. This latter country demonstrates a low level of financial constraint despite its low market capitalization, but the strength of its financial system relies on a stable economic and institutional environment.

Inversely, Malawi (-2.838), Côte d'Ivoire (-2.869) and Uganda (-3.261) have the three most inefficient financial systems in the sample, which are classified with more than two and half standard deviations below the average system. There are several financial constraints in these countries, and the main financial functions are performed ineffectively. Their financial systems provide an unfavorable framework for capital intermediation. Firms and households are unable to obtain financing for their projects, information is scarce and governments do not provide an effective environment for law enforcement and property rights.

The reminder of the paper is organized as follows. The following section defines financial development and discusses the main functions of financial systems. The second and third sections present the methodology and data from the six financial and institutional indicators employed in the construction of the composite index. Section IV presents the index and discusses the main results. The final section concludes the analysis.

# I. Financial development

The history and evolution of economic and institutional systems over time explain the differences between financial systems across countries. La Porta, et al. (1998) indicate that the combination of legal systems, regulatory policies and tax environments are the reason for variations in the cost of economic transactions, access to information, contract enforcement and property rights (private or intellectual). The combination of these costs with various institutional and economic systems has motivated financial innovation and the development of different financial systems.

The main function of financial systems is the intermediation of capital between surplus and deficit agents. However, this intermediation faces barriers that complicate the mobilization of capital and its allocation to efficient investment projects. These frictions between agents affect resource allocation across space and time to the extent that financial development is characterized by the reduction of these barriers and therefore by the improvement of capital intermediation. There are six main functions of financial systems that impact capital intermediation, and the effectiveness in which financial systems perform these functions defines their level of development. The six functions are as follows: (i) savings mobilization; (ii) production and dissemination of

information; (iii) monitoring of investments and corporate governance; (iv) risk diversification and management; (v) reduction of transaction costs and; (vi) liquidity of markets.

By improving the effectiveness in the execution of these functions, financial systems reduce frictions and improve credit allocation in the economy. For example, the development of a banking system facilitates the identification of capital holders and reduces the costs of collecting and mobilizing savings. The emergence of institutions that produce and disseminate information with respect to firms and households also reduces financial friction by reducing costs. The enforcement of contracts increases the confidence between agents and encourages capital allocation. Adequate corporate governance decreases the credit constraints faced by firms because shareholder interest is favored rather than manager interest.

Financial development occurs when financial institutions reduce these frictions and facilitate the allocation of resources among economic agents. Specifically, financial development reflects improvements in the effectiveness of systems in the execution of these principal financial functions and, therefore, the improvement of resource allocation. Financially developed countries are characterized by a financial system that performs the six functions efficiently and effectively. The following of this section elaborates on each of these six functions.

# (i) Capital mobilization

Capital mobilization is the costly process of collecting savings from surplus agents to respond to the financial requirements of deficit agents. This process must overcome high transaction costs and information asymmetries, such as the costs of searching and identifying agents, formulating and signing contracts and also the marketing costs. Thereby, financial development is achieved through the reduction of these costs, which decreases financial friction and optimizes the amount of available

savings in the economy (Fisman & Love, 2007). Financial systems can reduce these costs, for example, by developing a network of proximity banks or by developing joint stock companies that allow multiple individuals to invest their savings directly into the listed companies.

## (ii) Production and dissemination of information

The absence of information on investment projects is a major barrier to resource allocation in an economy. Investors are reluctant to invest their savings in an environment for which they have no (or inadequate) information. Saving allocation is therefore subject to informational constraints that are divided into two sub-constraints. The first sub-constraint is related to the costs associated with the production of information. Collecting data on firms or on households and the assessment and analysis of these data are usually expensive. And even when relevant information is available, investors do not always have the skills to properly understand or to evaluate the risks inherent to their investment decision. The second sub-constraint concerns the availability of information that defines the risk level of the investment project such that, when information is scarce, the risk is high. If financial systems do not produce or diffuse enough information concerning firms and households, savings are reduced and its allocation is penalized.

The development of financial institutions depends on the effective production and dissemination of information. Without these institutions, each investor would incur high costs and meet significant risks (Allen, 1990).

## (iii) Monitoring of investments and exerting corporate governance

The degree of shareholder control influences the way firms manage their capital and make their investment decisions. However, corporate governance is not always favorable to shareholders and, in many cases, supports manager interest. Thus, by monitoring investments and exerting corporate governance, financial systems ensure efficiency in capital allocation (Stiglitz & Weiss, 1983).

## (iv) Risk diversification and management

Financial systems facilitate the identification and the classification of risk by providing information on households, firms and governments. Financial intermediation also offers products and services that cover and share these risks. Theory distinguishes two types of risk sharing: cross-sectional and intertemporal. The former refers to the allocation of risk among individuals, firms, industries and governments at a set moment in time. The latter refers to the allocation of risk over time, and the financing in the long term.

Riskier projects pay higher risk premiums and offer higher yields, which encourages the allocation of resources to these projects. King and Levine (1993b) demonstrate, for example, that the identification and measurement of risk by financial systems promote innovation. As investment in innovation is often risky, sharing mechanisms allow the composition of portfolios with high-risk assets and encourage the allocation of resources to innovative projects, and thus the development of these activities. The role of financial systems in the identification, measurement and management of risk facilitates resource allocation, mainly toward riskier sectors (often composed of small and medium firms and innovative companies). The development of these mechanisms reduces friction and improves financial intermediation.

## (v) The reduction of transaction costs

The reduction of transaction costs increases the amount of capital allocated in the economy by preventing that the financial intermediation retains a large proportion of available savings. High transaction costs reflect the inefficiency of financial systems in performing the functions described above and can be the result of a lack of competition in the sector, which increases the market power of a small number of firms. Adam Smith (1776) emphasized that a monetary system also has a role in these costs. For example, economies that experience high inflation face high transaction costs that reduce resource allocation and affect the formation of savings and the financing of long-term projects.

## (vi) The liquidity of available markets

Liquidity indicates the degree to which assets or securities can be exchanged without affecting their price. Investors avoid illiquid markets to prevent losses, mainly in the financing of long-term projects. These illiquid markets require a substantial risk premium and prevent an optimal allocation of resources in the economy. However, liquid markets ease the financing of long-term projects. For example, they provide funding for the acquisition of durable goods, such as primary residence for households. They also ease the financing of large investment projects that are usually spread over the long term. According to Bencivenga et al. (1995), the British industrial revolution in the sixteenth century was possible only after a financial revolution that has provided funding for the required heavy and illiquid investments.

# II. Methodology

The technique of principal component analysis (PCA) is used in this study to construct a composite index to measure the level of financial development. This technique is widely used and is one of the oldest techniques in multivariate analysis, being introduced initially by Pearson (1901) and Hotelling (1933). The method enables the description of a set of multivariate data using a smaller number of uncorrelated variables, each of them is a linear combination of the original data. The choice of the components is such that the variance explained by the new variables is maximized, minimizing the loss of information after the linear transformation. Specifically, in a standard PCA, the original variables $x_1$, (...), $x_n$ are transformed into new variables $y_1$, (...), $y_{p,}$ as following:

$$y_1 = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_i$$
$$y_2 = a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_i$$
$$(\dots)$$
$$y_p = a_{p1}x_1 + a_{p2}x_2 + \cdots + a_{pn}x_i$$

Where the share of the variance of the first component ($y_1$) in the total variance is maximal and is superior to the share of the second component ($y_2$), and so on. The weighting coefficients of the first component ($a_{11}$, $a_{12}$, ..., $a_{1n}$) maximize the variance of $y_1$ and minimize the loss of information in the original sample. As the growth of these coefficients increases the variance indefinitely, the sum of their squares is constrained to equal one. Additionally, to standardize the different scales and units across variables, the initial sample is center reduced so that the mean of each variable equals zero, and the standard deviation equals one.

The weighting coefficients of the second component maximize the variance of $y_2$, under the constraint that the correlation between $y_1$ and $y_2$ is zero, so that the two axes formed by these vectors are orthogonal. The construction of the other components follows the same procedure. In practice, the weights of the new vectors are given by

the eigenvalues of the correlation matrix of $x_1$, $x_2$, ... , $x_n$ and their variances are calculated from the corresponding eigenvalues. In addition, components are often derived from the correlation matrix of the sample instead of the variance-covariance matrix, particularly if differences in scales are important.

# III. The financial indicators

Ideally, a financial indicator should evaluate the efficiency that financial systems mobilize and allocate savings to the most efficient investment projects. The ideal indicator should be sensitive to the financial activity and to the variety of intermediaries and markets available in the economy, as well as to the efficiency of financial systems in the production and dissemination of information and the monitoring of investment projects. An ideal financial index should also be sensitive to the legal and regulatory framework provided by institutions, to the level of trust between agents, contract enforcement and property rights. Specifically, this ideal index should measure the effectiveness with which financial systems perform each of the six functions presented in section I.

Six financial and institutional indicators have been selected to construct the composite index proposed in this study. The main aim is for this index to be representative of the main features that characterize financial development. Each of the selected indicators in the original data is sensitive to a specific function of financial systems. The selection of the six indicators was also constrained by the availability of data for a large number of countries.

The data cover eighty countries for the five-year period between 2005 and 2009. The six indicators used are: Private credit, Market capitalization, Private assets, Credit rights, Information index and Rule of law. Data on these six indicators are presented

in appendix B. The first indicator is available from the World Bank database "Global Development Finance". Market capitalization and Private assets are available from the World Bank's September 2012 database on "Financial Development and Structure"[1]. Credit rights and Information index are available from the World Bank's report "Doing Business". The rule-of-law indicator is available from the World Bank's database "World Governance Indicators". Table 1 below presents the main descriptive statistics about these indicators.

**Table 1: Descriptive statistics**

| Variable | Obs. | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Private credit | 400 | 71.398 | 53.286 | 7.913 | 231.630 |
| Market capitalization | 398 | 57.168 | 51.542 | 0.386 | 309.919 |
| Private assets | 400 | 0.941 | 0.093 | 0.543 | 1.351 |
| Credit rights | 400 | 6.048 | 2.199 | 1.000 | 10.000 |
| Information index | 400 | 3.953 | 1.848 | 0.000 | 6.000 |
| Rule of law | 400 | 0.281 | 0.965 | -1.641 | 1.964 |

The first indicator equalizes credits from private institutions to the private sector divided by GDP. It indicates the financial resources available to the private sector through loans, the purchase of non-equity securities, and trade credits. This index indicates the size of financial intermediation and also the financial constraints faced by firms in the private sector. On average, Private credit equals 71% of counties GDP and varies between 7.9% in Malawi to 231% in Denmark.

Market capitalization is the share price multiplied by the number of shares outstanding. Listed domestic companies are the domestically incorporated companies listed on the country's stock exchanges at the end of the year. This index measures the size of financial markets and highlights the importance of this financing mode in the

[1] See Berk, Demirguc-Kent & Levine (2000).

economy. It is an important complement to the private credit indicator because in some countries this source of financing is widespread. The highest observation of Market capitalization is in the Swiss economy (310%), whereas the lowest is in the Uruguay (0,4%).

Private assets highlight the importance of private financial institution assets related to the total financial assets in the economy. It is assumed that private institutions are more efficient than public institutions in capital allocation, risk diversification and management, and in the production and dissemination of information (King & Levine, 1993a). Therefore, values close to unity indicate that private financial institutions are significantly important relative to public institutions and reflect an efficient financial system.

The indicator Credit rights measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and therefore the functioning of credit markets. The index ranges from 0 to 10, with higher scores indicating that laws are well designed to expand access to credit. The average value in the sample is 6, with a standard deviation of 2,2. Six countries in the sample have the maximum value for this variable and include the United Kingdom, Singapore, Malaysia and New Zealand.

The information index measures the rules that affect the scope, accessibility, and quality of information that is available through either public or private credit registries. This variable varies between 0 and 6. High values indicate greater availability of information and, therefore, a more credible environment with low information costs.

The final indicator employed measures the rule of law and captures the perception and the extent to which economic agents trust and respect these rules. The indicator is particularly sensitive to the quality and extent of contract enforcement, the enforcement of property rights, and the effectiveness of police and the judiciary

system. The estimates for the construction of this variable provide an aggregate indicator for each country in units of a normal distribution, with values ranging from -2 to +2. The maximum indicator value is observed in Denmark, and the minimum value is recorded in Cote d'Ivoire.

# IV. The composite index of financial development

This section presents the index of financial development proposed by the study, constructed from the first component of the principal component analysis of the six indicators presented in the previous section. This composite index summarizes information concerning several aspects of financial systems and provides a more complete measure of financial development. Additionally, as the index includes several features of financial development, it is less dependent on changes in one single aspect of financial systems. Another characteristic is that the index is less susceptible to cyclical economic effects, as it is composed of some structural variables such as the Information index and Rule of law. The index for each of the eighty countries and for the five years is presented in the appendix A of this paper. The last column in this table presents the average index for the five-years period.

An increase (decrease) in the value of the index reflects an improvement (deterioration) in the level of financial development. The index is center reduced, so that values close to zero indicate proximity to the average financial system, i.e., the system with features that are close to the average of the sample. Indexes with positive values indicate levels of financial development higher than the average, whereas negative index values indicate financial sectors that are below the average. Moreover, the index indicates distance from the mean and, for example, a country with an index

equal to one has a financial system with features that are one standard deviation above the average of the sample. This also implies that variations in original variables change the index value relative to the mean and the standard deviation (for more details on these statistics, see Table 1).

The composite index is calculated from the first component of the linear transformation of the original data. The weighted coefficients in this transformation are such that the part of the variance explained by this component in the total variance is maximal. The coefficients for Private credit, Market capitalization, Private assets, Credit rights, Information index and Rule of law are, respectively, 0.515, 0.355, 0.344, 0.341, 0.312 and 0.525. This first component explains 47% of the total variance. Despite this value, the number and the heterogeneity of the variables in the original sample justify the use of this single component to construct the financial index without significant loss of information.

One hundred and eighty three indexes have positive values, and two hundred and seventeen are negative[2]. The index ranges between -3,42 in Uganda (2005) and 4,09 in Switzerland (2006). The country with the level of financial development that most approximates the average system, i.e., the reference in the analysis, is the Slovak Republic. In 2006, the index of this country was -0.004, whereas Private credit represented 38% of Slovak GDP and Market capitalization 8%. Credit rights and the Information index were equal to 9 and 3, respectively, and 99% of financial assets in this country were in private institutions. Rule of law was higher than the international mean and was equal to 0.544. The Italian financial system also approximates the sample mean. In 2006 and 2008, the financial system of this country was noted by the composite index 0.021 and 0.026, respectively. The country exhibited higher indicators than the Slovak Republic for Private credit (105%), Market capitalization

[2] Because low values for the original variables are bounded, outliers pull the mean upward.

(22%) and Information (5), whereas the indicators for Private assets (97%), Credit rights (3) and Rule of law (0.38) were lower.

Estimates of the average index for the period are presented in the last column of the appendix A and indicate that the financial systems of Switzerland, United Kingdom and United States were the three most highly developed in the five-year period, all of these three countries demonstrating a financial index more than three standard deviations higher than the average financial system. Switzerland is classified as having the most highly developed financial system, with an average index of 3.697. This country presents high values for all variables. For example, Market capitalization represented 310% of the Swiss GDP in 2006, Private credit 174% in 2009 and Rule of law was 1.823 in 2005. The United Kingdom (UK) also presents high values for the six variables that compose the composite financial index. Credit rights and the Information index in this country reach their highest values during the entire period and equal, respectively, 10 and 6. The financial constraints are low, as demonstrated by the level of private credit (213% in 2009) and market capitalization (155% in 2006). The United States' (US) financial system has similar components but demonstrates lower values for Private assets and for Rule of law.

Among these three countries, only the UK experienced an improvement in its financial level during the period, which increased by 20% from 3.137 to 3.760. Three indicators explain this result – Private credit (increased from 159% to 213%), Private assets (increased from 0.988 to 0.999) and Rule of law (increased from 1.516 in 2005 to 1.705 in 2009). The other two countries demonstrated approximately the same levels in 2009 and in 2005. However, between 2007 and 2008, the composite index dropped in these three economies, changing by -22% in Switzerland, -7% in the UK and by -17% in the US. This phenomenon is repeated in almost all of the economies in the sample and is explained by the financial crisis (Chor & Manova, 2012). This decline in the financial indexes is mostly explained by an increase in credit constraints, measured by Private credit and by Market capitalization. For example, in

the US, the first indicator decreased from 212% to 190%, whereas the second indicator decreased from 143% to 81% between the two years.

The ten countries that follow have average indexes that range from 2.119 to 2.825; i.e., their indexes are higher than two standard deviations from the average financial system. These countries are: Denmark (2.825), Ireland (2.707), Canada (2.583), Singapore (2.542), the Netherlands (2.481), Australia (2.450), New Zealand (2.253), Japan (2.165), Malaysia (2.144) and Spain (2.099). In general, these countries are highly financially developed and their resources allocation is efficient. More precisely, their financial systems accomplish effectively the six main financial functions presented in section I.

The strength of the Danish financial system is reflected in a high level of Rule of law (1.964 in 2007), Private assets (1 in 2009) and Private credit (232% in 2009). Similarly, Ireland presents high values for Rule of law (1.74 in 2007), Private assets (0.999 for the whole period) and Credit rights (9 for the whole period), despite a low level of market capitalization (18% in 2008). The Canadian financial system suffered during the crisis, and the index decreased by -35% from 3.109 in 2006 to 2.037 in 2008. The financial levels of Singapore, the Netherlands and Australia remained relatively stable during the period. The index for Singapore decreased by -16%, in Netherlands it increased by 15%, whereas the Australian index increased by 9%. New Zealand's financial system improved by 20% during the period and did not suffer from the crisis. During the period 2007 to 2008, New Zealand's index increased by 1% and followed the opposite trend to that of other countries. Japan's financial development decreased during the period, mainly because of a decrease in market capitalization.

Malaysia and Spain are also grouped as highly financially developed countries. The former country benefits from an efficient level of available information and Credit rights, which equal, respectively, 6 and 10. Credit constraints are low in this country, whereas Private credit represented 117% of Malaysian GDP in 2009, and Market

capitalization represented 132%. Spain has acceptable levels for Credit rights (6), Information (5) and Rule of law (1.133 in 2009), whereas Private credit was high in 2009, reaching 210% of the Spanish GDP[3].

It is important to note the difference between the composite index and the other main financial indicators in measuring the level of financial development. If Private credit was the only indicator used in measuring financial development, Denmark would be the most financially developed country in 2009, and Spain and Portugal would be classified as the fifth and the seventh, respectively. And if Market capitalization was the only indicator used, Papua New Guinea, Chile and Jordan would be, respectively, the third, sixth and the eighth most financially developed countries. Furthermore, the composite financial index smooths the conjunctural effects and is less sensitive to economic cycles. Using Ireland as an example, the indicator for private credit demonstrates an improvement in the level of financial development in this country of 44%, from 160% (2005) to 230% (2009), whereas Market capitalization indicates that the financial level decreased by 82% from 2006 (73%) to 2009 (13%). Canada is another example where private credit decreased by 36% from 2005 (179%) to 2009 (114%) and the composite index decreased by 18%. Moreover, the Singaporean market capitalization decreased by 61% in the same period, whereas the composite index declined by significantly less.

The estimates identify another group of financially developed countries that demonstrate indexes between one and two standard deviations from the average financial system. This group consists of ten countries and is bounded by Finland (1.918) and Chile (1.074). Sweden (1.884), Germany (1.829), South Korea (1.535) and France (1.320) are also members of this group. During the five year study period, the Swedish financial system improved by 37%, largely as a result of an improvement in Private assets, which increased from 0.929 to 0.982 and an improvement in the rule

[3] This can be explained by the effects of a real estate bubble in this country (Müller, 2011)

of law, which indicator increased from 1.725 to 1.927. German market capitalization corresponded to 39% of the country's GDP in 2009 and Private credit to 112%. The levels of Rule of law and Private assets were high, as well as the Information index. The French information index was relatively low (4) and Credit rights increased during the period from 4 (2005) to 7 (2009). Credit constraints were low and, in 2006, the levels of Private credit (98%) and Market capitalization (107%) were high.

The subsequent set of countries regroups financial systems with features close to the sample average. This group encompasses countries that gravitate around the average financial system, i.e. countries whose indexes are close to zero. The financial indexes of the members of this group are between one and minus-one standard deviations from the sample mean. This group is bounded by Estonia (0.784) and El Salvador (-0.955) and consists of thirty-two countries. Fifteen of these countries have a positive average index, and seventeen have a negative average index.

The sub-group of countries with positive indexes includes the Czech Republic (0.382), Thailand (0.347), Poland (0.226), India (0.102), Italy (0.084) and China (0.080). The Czech Republic demonstrates medium levels of financial constraints (Private credit equaled 53% in 2008 and Market capitalization equaled 29% in 2009) and a stable institutional environment (Rule of law ranged from 0.868 in 2005 to 0.963 in 2009, and the Information index remained equal to 5 over the period). Poland exhibits a similar financial environment, with a lower level of Rule of law (0.682 in 2009) and a higher level of Credit rights (9 for the same year). Thailand faced deterioration in its financial condition during the five years, largely because of a decrease in Private assets and Market capitalization. The Indian financial system improved by 156% during the five years. All of the indicators for India increased (the Information index increased by 100% from 2 to 4, Credit rights increased by 50% from 4 to 6 and Market capitalization from 66% to 85%), with only one exception (Rule of law, which decreased from 0.193 to 0.049). The Chinese financial system exhibited a similar trend between 2005 and 2009 and improved by 149% from -0.568 to 0.282. This financial development is explained by Market capitalization (which

grew from 34% to 100%), Credit rights (increased from 4 to 6) and the Information index (increased from 2 to 4). The Chinese Rule of law and Private credit also improved during the five-years period.

The other sub-group of countries that approximate the average financial system but demonstrate a negative average index includes Vietnam (-0.173), Turkey (-0.650), Colombia (-0.741), Mexico (-0.787) and Morocco (-0.815). The Vietnamese financial system developed by almost 150% over the period, largely because of improvements in Market capitalization and in Private credit. The other four countries also developed their financial systems during the period. The Turkish financial system improved by 38% (explained by improvements in Private assets and Private credit), the Colombian improved by 50%, the Mexican by 27% and the Moroccan financial system improved by 80%. However, these countries face credit constraints, and typical levels for Credit rights, information availability and Rule of law are low.

The twenty-five remaining countries are classified by the composite index as demonstrating underdeveloped financial systems. They can be divided into two separate groups; one group of countries with financial indexes that range from minus-one to minus-two, and another group with indexes that are lower than minus-two standard deviations from the mean. These countries face significant financial constraints, and their financial and institutional systems do not perform the six main financial functions effectively. These financial systems often fail to provide an optimal framework for capital intermediation between economic agents. Firms and households are unable to obtain funds and face credit constraints. Agents lack credible information, and governments do not provide an effective environment for law enforcement or property rights.

The first of these two groups is bounded by Sri Lanka (-1.020) and the Kyrgyz Republic (-1.950) and includes eighteen countries, such as Brazil (-1.125), Russia (-1.402), the Philippines (-1.556), Egypt (-1.597), Argentina (1.810) and Iran (1.943). The Brazilian financial system is characterized by an adequate Information index and

Market capitalization (which equaled 100% in 2007 but declined to 75% in 2009). Credit rights and Rule of law are low (3 and -0.343 in 2008, respectively), and Private assets are lower than the sample mean. The country improved its financial condition by 93% during the five-years period, following improvements in Rule of law and on Private credit. Russia has a similar financial system, with a lower level of Private credit (27% in 2005) but relatively high of Market capitalization (70% in 2009). Rule of law and Credit rights are not well developed, but the Information index increased from 0 to 5 over the five-year period. Filipino and Egyptian financial systems have approximately the same average index for the five-year period. These two countries face similar financial constraints. The Philippines demonstrate a higher level of Private assets and a higher level of Credit rights whereas Egypt has a higher level of Rule of law and available information. The underdeveloped financial system in Argentina is largely a product of substantial financial constraints (Private credit and Market capitalization reach approximately 15% of the GDP) and Rule of law (-0.663 in 2009). Private credit is not low in Iran (37% in 2009); however, this country faces a lower value for Rule of law, as well as for Information index and Credit rights (3 and 4, respectively, over the study period).

The last group contains the least financially developed countries in the sample. This group has seven countries and is bounded by Ecuador (-2.012) and Uganda (-3.261). The other five countries are Indonesia (-2.082), Bolivia (-2.119), Guyana (-2.658), Malawi (-2.838) and Cote d'Ivoire (-2.869). Levels for Rule of law are low in these countries (-1.332 for Cote d'Ivoire, -1.282 for Ecuador and -1.223 for Bolivia in 2009), as well as the levels for Credit rights (1 for Bolivia and 3 for Cote d'Ivoire, Ecuador and Indonesia in 2009) and for Information index (0 for Uganda, Guyana and Malawi in 2009). Finally, Credit constraints are high among these countries (in 2009, Private credit were 13% in Uganda, 14% in Malawi, 17% in Cote d'Ivoire and 25% in Ecuador whereas Market capitalization was 1% in Uganda and 8% in Ecuador).

# Conclusions

This paper proposes a composite index that measures the level of financial development of eighty countries for the period between 2005 and 2009. The index is constructed from the linear transformation of six financial and institutional indicators using the principal component analysis. This technique minimizes the loss of information and ensures that the variance explained by the index, compared to the original matrix, is maximized. The original indicators used are Private credit, Market capitalization, Private assets, Credit rights, Information index, and Rule of law (see section III).

The financial index summarizes the information of these variables and covers several aspects of financial systems. The main advantages of the composite index are that (i) the index presents a more complete measure of financial development; (ii) the index is less dependent on changes in one single aspect of financial systems, and (iii) it is less sensitive to cyclical economic effects.

The results confirm these characteristics (see section IV). For example, if only Market capitalization is used to measure the level of financial development, Jordan would be classified as the third most financially developed country in 2006 and the second in 2007. These classifications do not correspond to the level of financial development in this country since the quality and the availability of information is poor, the functioning of the credit markets approximates the sample mean and the measure of the rule of law is barely above the average. Hence, the composite index proposed by the study indicates that the Jordan financial system is near to the average; more precisely it indicates that the financial system of this country is at a distance of 0,5 standard deviations from the average financial system. Another example is the indicator for private credit in Nigeria. This measure indicates that the Nigerian financial system improved by 92% between 2006 and 2007; however, other indicators do not reflect this improvement. Credit rights, the level of information and Rule of

law remained unchanged to the extent that the composite index increased by approximately 30% over the two years. This same financial indicator increased by 30% between 2005 and 2006 in Brazil, but largely because of an increase in public loans (Ottaviano & Sousa, 2011); therefore, the composite index reflected a much lower increase.

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# Appendix A: The Composite index of financial development

| Country | Code | 2005 | 2006 | 2007 | 2008 | 2009 | Average | |
|---|---|---|---|---|---|---|---|---|
| Switzerland | CHE | 3.676 | 4.095 | 4.050 | 3.137 | 3.529 | 3.697 | (1) |
| United Kingdom | GBR | 3.137 | 3.483 | 3.517 | 3.281 | 3.760 | 3.436 | (2) |
| United States | USA | 3.048 | 3.272 | 3.359 | 2.814 | 3.090 | 3.117 | (3) |
| Denmark | DNK | 2.407 | 2.770 | 3.037 | 2.824 | 3.086 | 2.825 | (4) |
| Ireland | IRL | 2.361 | 2.764 | 2.828 | 2.749 | 2.834 | 2.707 | (5) |
| Canada | CAN | 2.868 | 3.109 | 2.608 | 2.037 | 2.295 | 2.583 | (6) |
| Singapore | SGP | 2.987 | 2.542 | 2.645 | 2.034 | 2.503 | 2.542 | (7) |
| Netherlands | NLD | 2.291 | 2.480 | 2.739 | 2.242 | 2.650 | 2.481 | (8) |
| Australia | AUS | 2.240 | 2.496 | 2.574 | 1.998 | 2.450 | 2.352 | (9) |
| New Zealand | NZL | 2.087 | 2.186 | 2.231 | 2.251 | 2.510 | 2.253 | (10) |
| Japan | JPN | 2.202 | 2.334 | 2.244 | 1.975 | 2.071 | 2.165 | (11) |
| Malaysia | MYS | 2.165 | 2.251 | 2.387 | 1.701 | 2.215 | 2.144 | (12) |
| Spain | ESP | 1.678 | 2.038 | 2.376 | 2.102 | 2.199 | 2.019 | (13) |
| Finland | FIN | 1.918 | 2.107 | 2.244 | 1.666 | 1.654 | 1.918 | (14) |
| Sweden | SWE | 1.582 | 1.956 | 2.079 | 1.629 | 2.172 | 1.884 | (15) |
| Austria | AUT | 1.835 | 1.985 | 2.019 | 1.748 | 1.723 | 1.862 | (16) |
| Germany | DEU | 1.868 | 1.965 | 1.979 | 1.627 | 1.707 | 1.829 | (17) |
| Israel | ISR | 1.477 | 1.697 | 1.858 | 1.378 | 1.469 | 1.576 | (18) |
| Korea. Rep. | KOR | 1.363 | 1.389 | 1.649 | 1.451 | 1.824 | 1.535 | (19) |
| France | FRA | 0.872 | 1.411 | 1.598 | 1.277 | 1.441 | 1.320 | (20) |
| Portugal | PRT | 0.946 | 1.085 | 1.228 | 1.139 | 1.382 | 1.156 | (21) |
| Belgium | BEL | 1.020 | 1.243 | 1.267 | 0.953 | 1.154 | 1.127 | (22) |
| Chile | CHL | 0.856 | 0.980 | 1.162 | 0.986 | 1.385 | 1.074 | (23) |
| Estonia | EST | 0.519 | 0.795 | 0.875 | 0.793 | 0.936 | 0.784 | (24) |
| Jordan | JOR | 1.149 | 0.553 | 0.903 | 0.352 | 0.038 | 0.599 | (25) |
| Hungary | HUN | 0.399 | 0.541 | 0.594 | 0.529 | 0.621 | 0.537 | (26) |
| Czech Republic | CZE | 0.283 | 0.387 | 0.524 | 0.307 | 0.407 | 0.382 | (27) |
| Thailand | THA | 0.332 | 0.365 | 0.551 | 0.214 | 0.271 | 0.347 | (28) |
| Mauritius | MUS | -0.214 | 0.063 | 0.347 | 0.531 | 0.714 | 0.288 | (29) |
| Lithuania | LTU | 0.144 | 0.238 | 0.298 | 0.211 | 0.357 | 0.250 | (30) |
| Bulgaria | BGR | -0.423 | -0.028 | 0.549 | 0.448 | 0.620 | 0.233 | (31) |
| Poland | POL | 0.040 | 0.127 | 0.232 | 0.192 | 0.536 | 0.226 | (32) |
| Greece | GRC | 0.041 | 0.286 | 0.435 | 0.089 | 0.120 | 0.194 | (33) |
| Slovak Republic | SVK | -0.036 | -0.004 | 0.175 | 0.237 | 0.293 | 0.133 | (34) |
| India | IND | -0.527 | -0.053 | 0.682 | 0.109 | 0.299 | 0.102 | (35) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Italy | ITA | 0.162 | 0.028 | 0.139 | 0.021 | 0.068 | 0.084 | (36) |
| China | CHN | -0.568 | 0.068 | 0.674 | -0.056 | 0.282 | 0.080 | (37) |
| St. Kitts and Nevis | KNA | -0.113 | -0.083 | 0.065 | 0.156 | 0.304 | 0.066 | (38) |
| Botswana | BWA | -0.201 | -0.144 | -0.017 | -0.150 | -0.025 | -0.107 | (39) |
| Vietnam | VNM | -0.735 | -0.683 | -0.036 | 0.065 | 0.389 | -0.173 | (40) |
| Trinidad and Tobago | TTO | -0.100 | -0.323 | -0.117 | -0.270 | -0.072 | -0.176 | (41) |
| Panama | PAN | -0.386 | -0.314 | -0.281 | -0.267 | -0.174 | -0.280 | (42) |
| Croatia | HRV | -1.036 | -0.857 | 0.237 | -0.213 | 0.038 | -0.499 | (43) |
| Fiji | FJI | -0.582 | -0.561 | -0.826 | -0.736 | -0.536 | -0.559 | (44) |
| Costa Rica | CRI | -0.685 | -0.684 | -0.635 | -0.510 | -0.437 | -0.561 | (45) |
| Peru | PER | -1.003 | -0.292 | -0.053 | -0.365 | -0.244 | -0.623 | (46) |
| Oman | OMN | -0.713 | -0.749 | -0.605 | -0.710 | -0.546 | -0.630 | (47) |
| Turkey | TUR | -0.805 | -0.810 | -0.651 | -0.730 | -0.496 | -0.650 | (48) |
| Tunisia | TUN | -1.007 | -0.949 | -0.770 | -0.401 | -0.311 | -0.659 | (49) |
| Colombia | COL | -1.003 | -0.829 | -0.643 | -0.666 | -0.480 | -0.741 | (50) |
| Macedonia, FYR | MKD | -1.073 | -0.987 | -0.723 | -0.552 | -0.413 | -0.743 | (51) |
| Kenya | KEN | -1.099 | -0.928 | -0.524 | -0.530 | -0.474 | -0.787 | (52) |
| Mexico | MEX | -0.911 | -0.660 | -0.602 | -0.865 | -0.663 | -0.787 | (53) |
| Morocco | MAR | -1.368 | -1.185 | -0.871 | -0.829 | -0.263 | -0.815 | (54) |
| El Salvador | SLV | -0.995 | -0.823 | -0.804 | -0.911 | -0.915 | -0.955 | (55) |
| Sri Lanka | LKA | -1.195 | -1.118 | -1.282 | -0.911 | -0.846 | -1.020 | (56) |
| Nigeria | NGA | -2.150 | -2.124 | -1.303 | -0.768 | -0.089 | -1.119 | (57) |
| Brazil | BRA | -1.403 | -1.181 | -0.868 | -1.202 | -0.848 | -1.125 | (58) |
| Armenia | ARM | -1.527 | -1.399 | -0.951 | -0.815 | -0.791 | -1.159 | (59) |
| Kazakhstan | KAZ | -1.928 | -0.963 | -0.883 | -0.869 | -0.584 | -1.256 | (60) |
| Jamaica | JAM | -1.446 | -1.466 | -1.311 | -1.318 | -1.129 | -1.288 | (61) |
| Russian Federation | RUS | -1.963 | -1.671 | -0.862 | -1.440 | -0.842 | -1.402 | (62) |
| Nepal | NPL | -1.598 | -1.357 | -1.232 | -1.254 | -1.270 | -1.434 | (63) |
| Bangladesh | BGD | -1.623 | -1.649 | -1.536 | -1.385 | -1.283 | -1.453 | (64) |
| Uruguay | URY | -2.092 | -1.281 | -1.141 | -0.968 | -0.825 | -1.458 | (65) |
| Papua New Guinea | PNG | -1.960 | -1.501 | -0.964 | -1.391 | -1.111 | -1.536 | (66) |
| Philippines | PHL | -1.250 | -1.347 | -1.416 | -1.827 | -1.861 | -1.556 | (67) |
| Pakistan | PAK | -1.710 | -1.505 | -1.374 | -1.568 | -1.459 | -1.584 | (68) |
| Egypt, Arab Rep. | EGY | -1.801 | -1.903 | -1.420 | -1.520 | -1.393 | -1.597 | (69) |
| Georgia | GEO | -3.231 | -2.167 | -1.481 | -0.590 | -0.032 | -1.632 | (70) |
| Argentina | ARG | -1.841 | -1.755 | -1.738 | -1.829 | -1.779 | -1.810 | (71) |
| Iran, Islamic Rep. | IRN | -2.165 | -2.091 | -1.974 | -1.863 | -1.721 | -1.943 | (72) |
| Kyrgyz Republic | KGZ | -3.349 | -2.920 | -2.404 | -1.701 | -0.551 | -1.950 | (73) |
| Ecuador | ECU | -2.101 | -1.931 | -1.905 | -1.935 | -1.923 | -2.012 | (74) |
| Indonesia | IDN | -2.618 | -2.446 | -2.015 | -1.863 | -1.547 | -2.082 | (75) |
| Bolivia | BOL | -2.160 | -1.929 | -1.958 | -2.051 | -2.078 | -2.119 | (76) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Guyana | GUY | -2.763 | -2.892 | -2.755 | -2.734 | -2.552 | -2.658 | (77) |
| Malawi | MWI | -3.074 | -2.452 | | -2.397 | -2.601 | -2.838 | (78) |
| Cote d'Ivoire | CIV | -3.230 | -2.987 | -2.773 | -2.713 | -2.507 | -2.869 | (79) |
| Uganda | UGA | -3.462 | -3.028 | | -2.992 | -3.059 | -3.261 | (80) |

# Appendix B: The financial and institutional indicators

| Year | Country | Code | Priv. C. | Mark. Cap. | Priv. Asset. | Credit R. | Info. | R. of L. |
|---|---|---|---|---|---|---|---|---|
| 2005 | Argentina | ARG | 11,67 | 33,56 | 0,74 | 4 | 6 | -0,57 |
| 2005 | Armenia | ARM | 8,05 | 0,87 | 0,97 | 5 | 3 | -0,34 |
| 2005 | Australia | AUS | 108,38 | 115,45 | 0,98 | 9 | 5 | 1,67 |
| 2005 | Austria | AUT | 116,42 | 40,79 | 0,99 | 7 | 6 | 1,81 |
| 2005 | Bangladesh | BGD | 33,81 | 5,04 | 0,91 | 7 | 2 | -0,90 |
| 2005 | Belgium | BEL | 73,90 | 76,48 | 1,00 | 7 | 4 | 1,22 |
| 2005 | Bolivia | BOL | 45,03 | 23,04 | 0,80 | 1 | 5 | -0,90 |
| 2005 | Botswana | BWA | 19,14 | 23,76 | 0,99 | 7 | 4 | 0,64 |
| 2005 | Brazil | BRA | 31,37 | 53,80 | 0,84 | 3 | 5 | -0,45 |
| 2005 | Bulgaria | BGR | 41,03 | 17,60 | 0,95 | 8 | 4 | -0,10 |
| 2005 | Canada | CAN | 178,18 | 130,62 | 0,98 | 7 | 6 | 1,63 |
| 2005 | Chile | CHL | 80,30 | 115,39 | 0,93 | 4 | 5 | 1,25 |
| 2005 | China | CHN | 113,28 | 34,59 | 0,99 | 4 | 2 | -0,42 |
| 2005 | Colombia | COL | 22,60 | 31,40 | 0,98 | 5 | 5 | -0,73 |
| 2005 | Costa Rica | CRI | 35,61 | 7,40 | 0,97 | 3 | 5 | 0,52 |
| 2005 | Cote d'Ivoire | CIV | 13,79 | 14,22 | 0,82 | 3 | 1 | -1,64 |
| 2005 | Croatia | HRV | 52,57 | 28,82 | 1,00 | 5 | 0 | 0,15 |
| 2005 | Czech Republic | CZE | 36,96 | 30,79 | 0,98 | 7 | 5 | 0,87 |
| 2005 | Denmark | DNK | 171,78 | 69,09 | 1,00 | 8 | 4 | 1,89 |
| 2005 | Ecuador | ECU | 23,19 | 8,70 | 0,87 | 3 | 4 | -0,90 |
| 2005 | Egypt, Arab Rep. | EGY | 51,17 | 88,83 | 0,70 | 3 | 2 | -0,01 |
| 2005 | El Salvador | SLV | 42,87 | 21,19 | 0,91 | 5 | 5 | -0,46 |
| 2005 | Estonia | EST | 69,71 | 25,14 | 1,00 | 6 | 5 | 0,93 |
| 2005 | Fiji | FJI | 38,34 | 19,51 | 0,94 | 7 | 4 | -0,06 |
| 2005 | Finland | FIN | 75,11 | 107,01 | 1,00 | 8 | 5 | 1,89 |
| 2005 | France | FRA | 92,24 | 82,32 | 1,00 | 4 | 4 | 1,37 |
| 2005 | Georgia | GEO | 14,77 | 5,53 | 0,66 | 5 | 0 | -0,63 |
| 2005 | Germany | DEU | 111,70 | 44,15 | 1,00 | 8 | 6 | 1,61 |
| 2005 | Greece | GRC | 78,64 | 60,40 | 0,93 | 4 | 4 | 0,77 |
| 2005 | Guyana | GUY | 57,12 | 22,71 | 0,71 | 4 | 0 | -0,79 |
| 2005 | Hungary | HUN | 51,31 | 29,53 | 0,98 | 7 | 5 | 0,84 |
| 2005 | India | IND | 39,41 | 66,31 | 0,97 | 6 | 2 | 0,19 |
| 2005 | Indonesia | IDN | 26,43 | 28,48 | 0,76 | 3 | 2 | -0,81 |
| 2005 | Iran, Islamic Rep. | IRN | 29,96 | 20,17 | 0,80 | 4 | 3 | -0,78 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2005 | Ireland | IRL | 160,84 | 56,15 | 1,00 | 9 | 5 | 1,54 |
| 2005 | Israel | ISR | 89,66 | 89,47 | 0,99 | 9 | 5 | 0,82 |
| 2005 | Italy | ITA | 89,42 | 44,68 | 0,95 | 3 | 6 | 0,49 |
| 2005 | Jamaica | JAM | 21,15 | 116,83 | 0,79 | 8 | 0 | -0,50 |
| 2005 | Japan | JPN | 182,87 | 104,05 | 0,89 | 7 | 6 | 1,24 |
| 2005 | Jordan | JOR | 88,09 | 298,99 | 0,92 | 4 | 2 | 0,44 |
| 2005 | Kazakhstan | KAZ | 35,69 | 18,42 | 0,99 | 4 | 0 | -0,76 |
| 2005 | Kenya | KEN | 25,93 | 34,07 | 0,91 | 10 | 2 | -0,94 |
| 2005 | Korea, Rep. | KOR | 87,15 | 85,01 | 0,99 | 8 | 5 | 0,96 |
| 2005 | Kyrgyz Republic | KGZ | 7,98 | 1,71 | 0,58 | 6 | 2 | -1,08 |
| 2005 | Lithuania | LTU | 40,92 | 31,52 | 1,00 | 5 | 6 | 0,62 |
| 2005 | Macedonia, FYR | MKD | 25,11 | 10,79 | 0,94 | 7 | 3 | -0,33 |
| 2005 | Malawi | MWI | 7,91 | 8,36 | 0,57 | 7 | 0 | -0,18 |
| 2005 | Malaysia | MYS | 110,83 | 131,38 | 0,99 | 10 | 6 | 0,60 |
| 2005 | Mauritius | MUS | 75,28 | 41,65 | 0,98 | 6 | 0 | 0,99 |
| 2005 | Mexico | MEX | 16,55 | 28,17 | 0,93 | 5 | 6 | -0,40 |
| 2005 | Morocco | MAR | 46,15 | 45,73 | 0,96 | 3 | 1 | -0,08 |
| 2005 | Nepal | NPL | 28,95 | 16,53 | 0,92 | 7 | 2 | -0,99 |
| 2005 | Netherlands | NLD | 165,04 | 92,86 | 1,00 | 6 | 5 | 1,70 |
| 2005 | New Zealand | NZL | 122,40 | 39,12 | 0,98 | 10 | 5 | 1,80 |
| 2005 | Nigeria | NGA | 13,24 | 17,24 | 0,88 | 9 | 0 | -1,39 |
| 2005 | Oman | OMN | 30,83 | 49,41 | 1,00 | 4 | 2 | 0,53 |
| 2005 | Pakistan | PAK | 28,65 | 41,91 | 0,83 | 6 | 3 | -0,89 |
| 2005 | Panama | PAN | 87,12 | 32,81 | 0,85 | 5 | 6 | -0,16 |
| 2005 | Papua New Guinea | PNG | 14,04 | 64,60 | 0,97 | 5 | 0 | -1,11 |
| 2005 | Peru | PER | 19,41 | 45,34 | 1,00 | 3 | 6 | -0,78 |
| 2005 | Philippines | PHL | 30,32 | 38,96 | 0,95 | 4 | 3 | -0,33 |
| 2005 | Poland | POL | 28,94 | 30,89 | 1,00 | 8 | 4 | 0,47 |
| 2005 | Portugal | PRT | 141,21 | 34,91 | 1,00 | 3 | 5 | 1,15 |
| 2005 | Russian Federation | RUS | 27,47 | 71,80 | 0,96 | 3 | 0 | -0,84 |
| 2005 | Singapore | SGP | 90,92 | 256,39 | 0,97 | 10 | 4 | 1,70 |
| 2005 | Slovak Republic | SVK | 35,14 | 7,16 | 1,00 | 9 | 3 | 0,56 |
| 2005 | Spain | ESP | 145,73 | 84,95 | 0,99 | 6 | 5 | 1,07 |
| 2005 | Sri Lanka | LKA | 32,90 | 23,44 | 0,92 | 3 | 4 | 0,12 |
| 2005 | St. Kitts and Nevis | KNA | 67,93 | 53,40 | 1,00 | 7 | 0 | 0,78 |
| 2005 | Sweden | SWE | 107,86 | 109,00 | 0,93 | 7 | 4 | 1,73 |
| 2005 | Switzerland | CHE | 164,37 | 252,00 | 0,99 | 8 | 5 | 1,82 |
| 2005 | Thailand | THA | 100,73 | 70,80 | 0,99 | 5 | 4 | 0,14 |
| 2005 | Trinidad and Tobago | TTO | 34,56 | 106,19 | 0,94 | 8 | 3 | -0,08 |
| 2005 | Tunisia | TUN | 64,96 | 8,91 | 1,00 | 3 | 2 | 0,16 |
| 2005 | Turkey | TUR | 22,25 | 33,45 | 0,94 | 4 | 5 | 0,16 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2005 | Uganda | UGA | 8,63 | 1,12 | 0,54 | 7 | 0 | -0,65 |
| 2005 | United Kingdom | GBR | 159,64 | 134,10 | 0,99 | 10 | 6 | 1,52 |
| 2005 | United States | USA | 195,52 | 134,91 | 0,91 | 9 | 6 | 1,49 |
| 2005 | Uruguay | URY | 22,48 | 0,55 | 0,61 | 4 | 5 | 0,45 |
| 2005 | Vietnam | VNM | 65,86 | 0,87 | 0,97 | 6 | 3 | -0,23 |
| 2006 | Argentina | ARG | 13,03 | 37,25 | 0,76 | 4 | 6 | -0,57 |
| 2006 | Armenia | ARM | 8,84 | 0,94 | 0,98 | 6 | 3 | -0,47 |
| 2006 | Australia | AUS | 113,47 | 146,15 | 0,97 | 9 | 5 | 1,73 |
| 2006 | Austria | AUT | 117,32 | 58,87 | 0,99 | 7 | 6 | 1,88 |
| 2006 | Bangladesh | BGD | 36,16 | 5,83 | 0,89 | 7 | 2 | -0,84 |
| 2006 | Belgium | BEL | 82,20 | 99,10 | 1,00 | 7 | 4 | 1,20 |
| 2006 | Bolivia | BOL | 37,80 | 19,41 | 0,85 | 1 | 6 | -0,92 |
| 2006 | Botswana | BWA | 18,43 | 35,07 | 0,99 | 7 | 4 | 0,61 |
| 2006 | Brazil | BRA | 40,34 | 65,30 | 0,86 | 3 | 5 | -0,41 |
| 2006 | Bulgaria | BGR | 44,91 | 31,09 | 0,98 | 8 | 5 | -0,13 |
| 2006 | Canada | CAN | 194,19 | 133,01 | 0,98 | 7 | 6 | 1,75 |
| 2006 | Chile | CHL | 81,87 | 118,93 | 0,96 | 4 | 5 | 1,24 |
| 2006 | China | CHN | 110,73 | 89,43 | 0,99 | 4 | 4 | -0,52 |
| 2006 | Colombia | COL | 27,11 | 34,52 | 0,98 | 5 | 5 | -0,56 |
| 2006 | Costa Rica | CRI | 37,85 | 8,63 | 0,98 | 3 | 5 | 0,43 |
| 2006 | Cote d'Ivoire | CIV | 14,21 | 23,93 | 0,86 | 3 | 1 | -1,56 |
| 2006 | Croatia | HRV | 59,18 | 58,18 | 1,00 | 5 | 0 | 0,00 |
| 2006 | Czech Republic | CZE | 41,01 | 34,08 | 1,00 | 7 | 5 | 0,85 |
| 2006 | Denmark | DNK | 185,68 | 84,20 | 1,00 | 9 | 4 | 1,85 |
| 2006 | Ecuador | ECU | 23,83 | 9,69 | 0,89 | 3 | 5 | -1,10 |
| 2006 | Egypt, Arab Rep. | EGY | 49,29 | 86,97 | 0,71 | 3 | 2 | -0,21 |
| 2006 | El Salvador | SLV | 43,00 | 29,46 | 0,91 | 5 | 6 | -0,60 |
| 2006 | Estonia | EST | 83,81 | 35,48 | 1,00 | 6 | 5 | 1,07 |
| 2006 | Fiji | FJI | 44,89 | 20,52 | 0,93 | 7 | 4 | -0,09 |
| 2006 | Finland | FIN | 78,86 | 127,66 | 1,00 | 8 | 5 | 1,93 |
| 2006 | France | FRA | 97,95 | 107,66 | 1,00 | 6 | 4 | 1,41 |
| 2006 | Georgia | GEO | 19,50 | 8,63 | 0,76 | 5 | 3 | -0,41 |
| 2006 | Germany | DEU | 109,01 | 56,42 | 1,00 | 8 | 6 | 1,69 |
| 2006 | Greece | GRC | 84,50 | 79,48 | 0,94 | 4 | 4 | 0,83 |
| 2006 | Guyana | GUY | 36,97 | 12,85 | 0,72 | 4 | 0 | -0,62 |
| 2006 | Hungary | HUN | 55,37 | 37,26 | 0,99 | 7 | 5 | 0,91 |
| 2006 | India | IND | 43,23 | 86,08 | 0,96 | 7 | 3 | 0,19 |
| 2006 | Indonesia | IDN | 24,61 | 38,10 | 0,78 | 3 | 2 | -0,71 |
| 2006 | Iran, Islamic Rep. | IRN | 33,59 | 17,02 | 0,83 | 4 | 3 | -0,87 |
| 2006 | Ireland | IRL | 182,04 | 73,03 | 1,00 | 9 | 5 | 1,70 |
| 2006 | Israel | ISR | 86,26 | 118,83 | 0,99 | 9 | 5 | 0,91 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2006 | Italy | ITA | 94,96 | 54,81 | 0,96 | 3 | 5 | 0,31 |
| 2006 | Jamaica | JAM | 23,32 | 102,40 | 0,80 | 8 | 0 | -0,46 |
| 2006 | Japan | JPN | 179,99 | 108,34 | 0,91 | 7 | 6 | 1,35 |
| 2006 | Jordan | JOR | 88,32 | 190,02 | 0,95 | 4 | 2 | 0,45 |
| 2006 | Kazakhstan | KAZ | 47,78 | 53,93 | 1,00 | 4 | 4 | -0,92 |
| 2006 | Kenya | KEN | 26,08 | 50,56 | 0,92 | 10 | 2 | -0,90 |
| 2006 | Korea, Rep. | KOR | 95,14 | 87,75 | 0,99 | 8 | 5 | 0,84 |
| 2006 | Kyrgyz Republic | KGZ | 10,47 | 3,27 | 0,68 | 7 | 2 | -1,28 |
| 2006 | Lithuania | LTU | 50,05 | 33,87 | 1,00 | 5 | 6 | 0,60 |
| 2006 | Macedonia, FYR | MKD | 30,17 | 16,74 | 0,97 | 7 | 3 | -0,49 |
| 2006 | Malawi | MWI | 8,83 | 18,84 | 0,74 | 7 | 0 | -0,36 |
| 2006 | Malaysia | MYS | 107,70 | 150,29 | 0,99 | 10 | 6 | 0,56 |
| 2006 | Mauritius | MUS | 74,19 | 55,30 | 0,97 | 6 | 2 | 0,81 |
| 2006 | Mexico | MEX | 19,66 | 36,58 | 0,98 | 5 | 6 | -0,43 |
| 2006 | Morocco | MAR | 48,65 | 75,20 | 0,96 | 3 | 1 | -0,17 |
| 2006 | Nepal | NPL | 32,23 | 19,89 | 0,94 | 7 | 2 | -0,77 |
| 2006 | Netherlands | NLD | 167,19 | 115,04 | 1,00 | 6 | 5 | 1,73 |
| 2006 | New Zealand | NZL | 131,92 | 40,65 | 0,98 | 10 | 5 | 1,78 |
| 2006 | Nigeria | NGA | 13,18 | 22,57 | 0,85 | 9 | 0 | -1,14 |
| 2006 | Oman | OMN | 31,07 | 43,90 | 1,00 | 4 | 2 | 0,52 |
| 2006 | Pakistan | PAK | 28,94 | 35,70 | 0,84 | 6 | 4 | -0,84 |
| 2006 | Panama | PAN | 88,36 | 33,35 | 0,86 | 5 | 6 | -0,13 |
| 2006 | Papua New Guinea | PNG | 17,21 | 118,45 | 0,96 | 5 | 0 | -0,96 |
| 2006 | Peru | PER | 17,85 | 64,63 | 1,00 | 7 | 6 | -0,76 |
| 2006 | Philippines | PHL | 29,84 | 55,95 | 0,90 | 4 | 3 | -0,37 |
| 2006 | Poland | POL | 33,29 | 43,63 | 1,00 | 8 | 4 | 0,39 |
| 2006 | Portugal | PRT | 152,46 | 51,64 | 1,00 | 3 | 5 | 1,00 |
| 2006 | Russian Federation | RUS | 32,43 | 106,79 | 0,97 | 3 | 0 | -0,93 |
| 2006 | Singapore | SGP | 86,35 | 199,19 | 0,97 | 10 | 4 | 1,65 |
| 2006 | Slovak Republic | SVK | 38,65 | 8,08 | 1,00 | 9 | 3 | 0,54 |
| 2006 | Spain | ESP | 167,20 | 107,15 | 0,99 | 6 | 5 | 1,06 |
| 2006 | Sri Lanka | LKA | 33,97 | 27,48 | 0,92 | 3 | 4 | 0,18 |
| 2006 | St. Kitts and Nevis | KNA | 68,39 | 51,66 | 1,00 | 7 | 0 | 0,85 |
| 2006 | Sweden | SWE | 112,81 | 143,64 | 0,94 | 7 | 4 | 1,82 |
| 2006 | Switzerland | CHE | 169,52 | 309,92 | 0,99 | 8 | 5 | 1,78 |
| 2006 | Thailand | THA | 95,14 | 68,13 | 0,98 | 5 | 5 | 0,04 |
| 2006 | Trinidad and Tobago | TTO | 36,00 | 84,76 | 0,94 | 8 | 3 | -0,27 |
| 2006 | Tunisia | TUN | 63,65 | 12,93 | 0,99 | 3 | 2 | 0,28 |
| 2006 | Turkey | TUR | 25,94 | 30,59 | 0,95 | 4 | 5 | 0,05 |
| 2006 | Uganda | UGA | 10,13 | 1,16 | 0,62 | 7 | 0 | -0,40 |
| 2006 | United Kingdom | GBR | 171,10 | 155,21 | 0,99 | 10 | 6 | 1,70 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2006 | United States | USA | 205,41 | 145,66 | 0,92 | 9 | 6 | 1,57 |
| 2006 | Uruguay | URY | 23,68 | 0,64 | 0,77 | 4 | 6 | 0,48 |
| 2006 | Vietnam | VNM | 71,22 | 14,93 | 0,97 | 6 | 3 | -0,40 |
| 2007 | Argentina | ARG | 14,46 | 33,24 | 0,77 | 4 | 6 | -0,61 |
| 2007 | Armenia | ARM | 13,58 | 1,14 | 0,98 | 6 | 5 | -0,41 |
| 2007 | Australia | AUS | 122,18 | 151,50 | 0,96 | 9 | 5 | 1,72 |
| 2007 | Austria | AUT | 116,29 | 60,98 | 0,99 | 7 | 6 | 1,93 |
| 2007 | Bangladesh | BGD | 37,29 | 9,93 | 0,91 | 7 | 2 | -0,83 |
| 2007 | Belgium | BEL | 91,09 | 84,11 | 0,99 | 7 | 4 | 1,30 |
| 2007 | Bolivia | BOL | 36,97 | 17,25 | 0,85 | 1 | 6 | -0,96 |
| 2007 | Botswana | BWA | 20,03 | 47,57 | 0,99 | 7 | 4 | 0,65 |
| 2007 | Brazil | BRA | 47,85 | 100,32 | 0,86 | 3 | 5 | -0,42 |
| 2007 | Bulgaria | BGR | 62,78 | 51,75 | 1,00 | 8 | 6 | -0,08 |
| 2007 | Canada | CAN | 127,42 | 153,54 | 0,98 | 7 | 6 | 1,77 |
| 2007 | Chile | CHL | 88,30 | 129,57 | 0,97 | 4 | 5 | 1,23 |
| 2007 | China | CHN | 107,49 | 178,20 | 0,95 | 5 | 4 | -0,45 |
| 2007 | Colombia | COL | 30,39 | 49,16 | 0,99 | 5 | 5 | -0,51 |
| 2007 | Costa Rica | CRI | 44,40 | 7,73 | 0,99 | 3 | 5 | 0,36 |
| 2007 | Cote d'Ivoire | CIV | 16,14 | 42,20 | 0,88 | 3 | 1 | -1,60 |
| 2007 | Croatia | HRV | 62,28 | 111,19 | 1,00 | 6 | 3 | 0,09 |
| 2007 | Czech Republic | CZE | 47,95 | 42,14 | 1,00 | 7 | 5 | 0,87 |
| 2007 | Denmark | DNK | 202,96 | 89,19 | 1,00 | 9 | 4 | 1,96 |
| 2007 | Ecuador | ECU | 24,82 | 9,38 | 0,90 | 3 | 5 | -1,13 |
| 2007 | Egypt, Arab Rep. | EGY | 45,52 | 106,75 | 0,72 | 3 | 4 | -0,19 |
| 2007 | El Salvador | SLV | 42,82 | 33,54 | 0,92 | 5 | 6 | -0,66 |
| 2007 | Estonia | EST | 93,92 | 27,87 | 1,00 | 6 | 5 | 1,13 |
| 2007 | Fiji | FJI | 45,21 | 15,45 | 0,94 | 7 | 4 | -0,59 |
| 2007 | Finland | FIN | 81,58 | 149,99 | 1,00 | 8 | 5 | 1,86 |
| 2007 | France | FRA | 105,08 | 107,31 | 0,99 | 7 | 4 | 1,38 |
| 2007 | Georgia | GEO | 28,34 | 13,65 | 0,85 | 5 | 4 | -0,29 |
| 2007 | Germany | DEU | 105,08 | 63,35 | 1,00 | 8 | 6 | 1,70 |
| 2007 | Greece | GRC | 92,55 | 86,89 | 0,95 | 4 | 4 | 0,80 |
| 2007 | Guyana | GUY | 35,08 | 15,08 | 0,74 | 4 | 0 | -0,53 |
| 2007 | Hungary | HUN | 61,37 | 35,01 | 0,99 | 7 | 5 | 0,88 |
| 2007 | India | IND | 44,82 | 146,42 | 0,97 | 8 | 4 | 0,14 |
| 2007 | Indonesia | IDN | 25,46 | 48,98 | 0,82 | 3 | 3 | -0,64 |
| 2007 | Iran, Islamic Rep. | IRN | 37,28 | 15,93 | 0,86 | 4 | 3 | -0,89 |
| 2007 | Ireland | IRL | 199,07 | 55,40 | 1,00 | 9 | 5 | 1,73 |
| 2007 | Israel | ISR | 88,47 | 141,54 | 0,99 | 9 | 5 | 0,89 |
| 2007 | Italy | ITA | 101,09 | 50,43 | 0,96 | 3 | 5 | 0,40 |
| 2007 | Jamaica | JAM | 27,20 | 95,66 | 0,85 | 8 | 0 | -0,52 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2007 | Japan | JPN | 172,56 | 101,73 | 0,92 | 7 | 6 | 1,34 |
| 2007 | Jordan | JOR | 88,25 | 232,00 | 0,96 | 4 | 2 | 0,52 |
| 2007 | Kazakhstan | KAZ | 58,94 | 39,46 | 1,00 | 4 | 4 | -0,80 |
| 2007 | Kenya | KEN | 27,00 | 49,15 | 0,94 | 10 | 4 | -0,95 |
| 2007 | Korea, Rep. | KOR | 99,65 | 107,09 | 0,99 | 8 | 5 | 1,02 |
| 2007 | Kyrgyz Republic | KGZ | 15,05 | 3,18 | 0,80 | 7 | 2 | -1,20 |
| 2007 | Lithuania | LTU | 59,99 | 25,92 | 1,00 | 5 | 6 | 0,64 |
| 2007 | Macedonia, FYR | MKD | 36,79 | 33,28 | 0,98 | 7 | 3 | -0,42 |
| 2007 | Malawi | MWI | 10,88 | | 0,71 | 7 | 0 | -0,29 |
| 2007 | Malaysia | MYS | 105,27 | 174,36 | 0,99 | 10 | 6 | 0,56 |
| 2007 | Mauritius | MUS | 77,75 | 72,71 | 0,99 | 6 | 2 | 0,87 |
| 2007 | Mexico | MEX | 21,97 | 38,39 | 1,00 | 5 | 6 | -0,51 |
| 2007 | Morocco | MAR | 58,39 | 100,36 | 0,97 | 3 | 1 | -0,14 |
| 2007 | Nepal | NPL | 36,38 | 47,77 | 0,92 | 7 | 2 | -0,83 |
| 2007 | Netherlands | NLD | 189,09 | 122,22 | 1,00 | 6 | 5 | 1,74 |
| 2007 | New Zealand | NZL | 138,00 | 34,31 | 0,98 | 10 | 5 | 1,82 |
| 2007 | Nigeria | NGA | 25,33 | 52,04 | 0,98 | 9 | 0 | -1,15 |
| 2007 | Oman | OMN | 35,70 | 55,04 | 1,00 | 4 | 2 | 0,58 |
| 2007 | Pakistan | PAK | 29,66 | 49,08 | 0,86 | 6 | 4 | -0,92 |
| 2007 | Panama | PAN | 90,54 | 31,42 | 0,87 | 5 | 6 | -0,18 |
| 2007 | Papua New Guinea | PNG | 21,07 | 188,95 | 0,96 | 5 | 0 | -0,92 |
| 2007 | Peru | PER | 20,99 | 98,81 | 1,00 | 7 | 6 | -0,79 |
| 2007 | Philippines | PHL | 29,92 | 69,11 | 0,87 | 4 | 3 | -0,47 |
| 2007 | Poland | POL | 39,44 | 48,74 | 1,00 | 8 | 4 | 0,41 |
| 2007 | Portugal | PRT | 163,06 | 57,07 | 1,00 | 3 | 5 | 1,01 |
| 2007 | Russian Federation | RUS | 38,74 | 115,64 | 0,97 | 3 | 4 | -0,93 |
| 2007 | Singapore | SGP | 87,37 | 210,16 | 0,98 | 10 | 4 | 1,66 |
| 2007 | Slovak Republic | SVK | 42,35 | 8,29 | 1,00 | 9 | 4 | 0,49 |
| 2007 | Spain | ESP | 187,96 | 124,84 | 0,99 | 6 | 5 | 1,08 |
| 2007 | Sri Lanka | LKA | 33,26 | 23,35 | 0,94 | 3 | 3 | 0,13 |
| 2007 | St. Kitts and Nevis | KNA | 73,52 | 67,91 | 1,00 | 7 | 0 | 0,83 |
| 2007 | Sweden | SWE | 121,47 | 132,43 | 0,97 | 7 | 4 | 1,86 |
| 2007 | Switzerland | CHE | 173,64 | 293,59 | 0,99 | 8 | 5 | 1,82 |
| 2007 | Thailand | THA | 113,18 | 79,38 | 0,97 | 5 | 5 | -0,02 |
| 2007 | Trinidad and Tobago | TTO | 35,65 | 71,79 | 0,96 | 8 | 4 | -0,18 |
| 2007 | Tunisia | TUN | 63,21 | 13,75 | 1,00 | 3 | 3 | 0,26 |
| 2007 | Turkey | TUR | 29,50 | 44,28 | 0,96 | 4 | 5 | 0,03 |
| 2007 | Uganda | UGA | 10,24 | | 0,60 | 7 | 0 | -0,49 |
| 2007 | United Kingdom | GBR | 188,11 | 137,17 | 0,99 | 10 | 6 | 1,66 |
| 2007 | United States | USA | 212,46 | 142,53 | 0,93 | 9 | 6 | 1,57 |
| 2007 | Uruguay | URY | 22,88 | 0,68 | 0,81 | 4 | 6 | 0,53 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2007 | Vietnam | VNM | 93,36 | 27,52 | 0,99 | 8 | 3 | -0,41 |
| 2008 | Argentina | ARG | 13,71 | 16,01 | 0,79 | 4 | 6 | -0,66 |
| 2008 | Armenia | ARM | 17,39 | 1,51 | 0,99 | 6 | 5 | -0,28 |
| 2008 | Australia | AUS | 126,73 | 63,64 | 0,95 | 9 | 5 | 1,73 |
| 2008 | Austria | AUT | 120,15 | 17,46 | 0,99 | 7 | 6 | 1,89 |
| 2008 | Bangladesh | BGD | 39,21 | 8,38 | 0,93 | 7 | 2 | -0,72 |
| 2008 | Belgium | BEL | 94,28 | 33,03 | 0,99 | 7 | 4 | 1,31 |
| 2008 | Bolivia | BOL | 34,69 | 16,03 | 0,86 | 1 | 6 | -1,10 |
| 2008 | Botswana | BWA | 21,02 | 26,39 | 0,99 | 7 | 4 | 0,64 |
| 2008 | Brazil | BRA | 53,10 | 35,66 | 0,86 | 3 | 5 | -0,34 |
| 2008 | Bulgaria | BGR | 71,73 | 17,09 | 1,02 | 8 | 6 | -0,16 |
| 2008 | Canada | CAN | 128,55 | 66,70 | 0,98 | 7 | 6 | 1,77 |
| 2008 | Chile | CHL | 96,93 | 77,56 | 0,99 | 4 | 5 | 1,28 |
| 2008 | China | CHN | 103,69 | 61,78 | 0,92 | 6 | 4 | -0,33 |
| 2008 | Colombia | COL | 31,32 | 35,57 | 1,00 | 5 | 5 | -0,47 |
| 2008 | Costa Rica | CRI | 50,76 | 6,33 | 0,99 | 3 | 5 | 0,44 |
| 2008 | Cote d'Ivoire | CIV | 16,25 | 30,20 | 0,91 | 3 | 1 | -1,53 |
| 2008 | Croatia | HRV | 64,94 | 38,32 | 1,00 | 6 | 3 | 0,12 |
| 2008 | Czech Republic | CZE | 52,77 | 22,61 | 1,00 | 6 | 5 | 0,89 |
| 2008 | Denmark | DNK | 218,27 | 38,25 | 1,00 | 9 | 4 | 1,91 |
| 2008 | Ecuador | ECU | 26,07 | 8,42 | 0,91 | 3 | 5 | -1,26 |
| 2008 | Egypt, Arab Rep. | EGY | 42,79 | 52,75 | 0,73 | 3 | 5 | -0,05 |
| 2008 | El Salvador | SLV | 41,32 | 21,73 | 0,92 | 5 | 6 | -0,73 |
| 2008 | Estonia | EST | 97,37 | 8,28 | 1,00 | 6 | 5 | 1,16 |
| 2008 | Fiji | FJI | 48,52 | 15,83 | 0,95 | 7 | 4 | -0,55 |
| 2008 | Finland | FIN | 86,46 | 56,76 | 1,00 | 8 | 5 | 1,86 |
| 2008 | France | FRA | 107,88 | 52,70 | 0,99 | 7 | 4 | 1,43 |
| 2008 | Georgia | GEO | 33,25 | 2,56 | 0,96 | 6 | 6 | -0,23 |
| 2008 | Germany | DEU | 108,29 | 30,58 | 1,00 | 7 | 6 | 1,67 |
| 2008 | Greece | GRC | 94,99 | 26,49 | 0,96 | 4 | 4 | 0,79 |
| 2008 | Guyana | GUY | 34,08 | 15,08 | 0,77 | 4 | 0 | -0,67 |
| 2008 | Hungary | HUN | 69,60 | 12,05 | 1,00 | 7 | 5 | 0,85 |
| 2008 | India | IND | 48,95 | 53,08 | 0,98 | 8 | 4 | 0,12 |
| 2008 | Indonesia | IDN | 26,54 | 19,36 | 0,87 | 3 | 4 | -0,62 |
| 2008 | Iran, Islamic Rep. | IRN | 33,86 | 14,50 | 0,89 | 4 | 3 | -0,82 |
| 2008 | Ireland | IRL | 218,06 | 18,74 | 1,00 | 9 | 5 | 1,71 |
| 2008 | Israel | ISR | 90,09 | 66,53 | 0,99 | 9 | 5 | 0,90 |
| 2008 | Italy | ITA | 105,24 | 22,57 | 0,97 | 3 | 5 | 0,38 |
| 2008 | Jamaica | JAM | 29,04 | 52,74 | 0,91 | 8 | 0 | -0,46 |
| 2008 | Japan | JPN | 165,48 | 66,00 | 0,93 | 7 | 6 | 1,34 |
| 2008 | Jordan | JOR | 78,30 | 157,94 | 0,97 | 4 | 2 | 0,53 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2008 | Kazakhstan | KAZ | 49,65 | 23,29 | 1,00 | 4 | 5 | -0,74 |
| 2008 | Kenya | KEN | 30,34 | 35,77 | 0,97 | 10 | 4 | -1,01 |
| 2008 | Korea, Rep. | KOR | 108,80 | 53,11 | 0,99 | 8 | 6 | 0,85 |
| 2008 | Kyrgyz Republic | KGZ | 14,74 | 1,82 | 0,96 | 7 | 3 | -1,29 |
| 2008 | Lithuania | LTU | 62,89 | 7,67 | 1,00 | 5 | 6 | 0,65 |
| 2008 | Macedonia, FYR | MKD | 43,83 | 8,37 | 1,00 | 7 | 4 | -0,33 |
| 2008 | Malawi | MWI | 11,90 | 43,47 | 0,68 | 7 | 0 | -0,18 |
| 2008 | Malaysia | MYS | 100,54 | 83,98 | 0,99 | 10 | 6 | 0,49 |
| 2008 | Mauritius | MUS | 87,78 | 35,71 | 1,02 | 6 | 3 | 0,97 |
| 2008 | Mexico | MEX | 21,05 | 21,25 | 0,98 | 5 | 6 | -0,68 |
| 2008 | Morocco | MAR | 63,24 | 73,97 | 0,99 | 3 | 2 | -0,21 |
| 2008 | Nepal | NPL | 50,17 | 38,93 | 0,90 | 7 | 2 | -0,87 |
| 2008 | Netherlands | NLD | 192,70 | 44,55 | 1,00 | 6 | 5 | 1,72 |
| 2008 | New Zealand | NZL | 147,56 | 20,51 | 0,99 | 10 | 5 | 1,84 |
| 2008 | Nigeria | NGA | 33,91 | 24,05 | 1,16 | 9 | 0 | -1,13 |
| 2008 | Oman | OMN | 35,48 | 24,62 | 1,00 | 4 | 2 | 0,77 |
| 2008 | Pakistan | PAK | 29,84 | 14,33 | 0,88 | 6 | 4 | -1,00 |
| 2008 | Panama | PAN | 89,38 | 28,33 | 0,88 | 5 | 6 | -0,18 |
| 2008 | Papua New Guinea | PNG | 23,68 | 127,47 | 0,97 | 5 | 0 | -1,00 |
| 2008 | Peru | PER | 24,76 | 43,86 | 1,00 | 7 | 6 | -0,76 |
| 2008 | Philippines | PHL | 30,29 | 30,01 | 0,84 | 4 | 3 | -0,53 |
| 2008 | Poland | POL | 49,74 | 17,04 | 1,00 | 8 | 4 | 0,55 |
| 2008 | Portugal | PRT | 173,75 | 27,28 | 1,00 | 3 | 5 | 1,02 |
| 2008 | Russian Federation | RUS | 41,75 | 23,91 | 0,98 | 3 | 4 | -0,92 |
| 2008 | Singapore | SGP | 98,01 | 101,25 | 0,98 | 10 | 4 | 1,65 |
| 2008 | Slovak Republic | SVK | 44,74 | 5,18 | 1,00 | 9 | 4 | 0,60 |
| 2008 | Spain | ESP | 202,71 | 59,36 | 0,99 | 6 | 5 | 1,12 |
| 2008 | Sri Lanka | LKA | 28,70 | 10,62 | 0,96 | 4 | 5 | 0,00 |
| 2008 | St. Kitts and Nevis | KNA | 75,13 | 84,78 | 1,00 | 7 | 0 | 0,76 |
| 2008 | Sweden | SWE | 127,27 | 51,95 | 0,97 | 7 | 4 | 1,88 |
| 2008 | Switzerland | CHE | 164,68 | 171,43 | 0,99 | 8 | 5 | 1,79 |
| 2008 | Thailand | THA | 113,11 | 37,64 | 0,96 | 5 | 5 | -0,06 |
| 2008 | Trinidad and Tobago | TTO | 31,52 | 44,81 | 0,98 | 8 | 4 | -0,23 |
| 2008 | Tunisia | TUN | 65,77 | 14,20 | 1,00 | 3 | 5 | 0,22 |
| 2008 | Turkey | TUR | 32,59 | 16,15 | 0,97 | 4 | 5 | 0,10 |
| 2008 | Uganda | UGA | 13,95 | 21,32 | 0,59 | 7 | 0 | -0,42 |
| 2008 | United Kingdom | GBR | 210,34 | 70,26 | 1,00 | 10 | 6 | 1,63 |
| 2008 | United States | USA | 190,36 | 82,10 | 0,94 | 9 | 6 | 1,63 |
| 2008 | Uruguay | URY | 27,12 | 0,50 | 0,84 | 4 | 6 | 0,56 |
| 2008 | Vietnam | VNM | 90,18 | 10,53 | 1,01 | 8 | 4 | -0,38 |
| 2009 | Argentina | ARG | 13,53 | 15,93 | 0,80 | 4 | 6 | -0,66 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2009 | Armenia | ARM | 23,12 | 1,62 | 1,00 | 6 | 5 | -0,40 |
| 2009 | Australia | AUS | 127,83 | 136,17 | 0,94 | 9 | 5 | 1,73 |
| 2009 | Austria | AUT | 126,87 | 14,03 | 0,99 | 7 | 6 | 1,76 |
| 2009 | Bangladesh | BGD | 41,51 | 7,91 | 0,95 | 7 | 2 | -0,72 |
| 2009 | Belgium | BEL | 97,92 | 55,28 | 0,99 | 7 | 4 | 1,37 |
| 2009 | Bolivia | BOL | 37,02 | 16,10 | 0,86 | 1 | 6 | -1,22 |
| 2009 | Botswana | BWA | 25,52 | 37,29 | 0,99 | 7 | 4 | 0,64 |
| 2009 | Brazil | BRA | 54,04 | 73,21 | 0,86 | 3 | 5 | -0,18 |
| 2009 | Bulgaria | BGR | 75,64 | 14,63 | 1,05 | 8 | 6 | -0,05 |
| 2009 | Canada | CAN | 114,54 | 125,67 | 0,97 | 7 | 6 | 1,78 |
| 2009 | Chile | CHL | 97,47 | 130,22 | 1,01 | 4 | 5 | 1,25 |
| 2009 | China | CHN | 127,33 | 100,33 | 0,88 | 6 | 4 | -0,35 |
| 2009 | Colombia | COL | 29,87 | 56,52 | 1,01 | 5 | 5 | -0,44 |
| 2009 | Costa Rica | CRI | 49,42 | 4,96 | 1,00 | 3 | 5 | 0,56 |
| 2009 | Cote d'Ivoire | CIV | 17,12 | 26,65 | 0,94 | 3 | 1 | -1,33 |
| 2009 | Croatia | HRV | 66,29 | 40,41 | 1,00 | 6 | 4 | 0,22 |
| 2009 | Czech Republic | CZE | 55,26 | 27,70 | 1,00 | 6 | 5 | 0,96 |
| 2009 | Denmark | DNK | 231,63 | 60,06 | 1,00 | 9 | 4 | 1,87 |
| 2009 | Ecuador | ECU | 25,32 | 8,17 | 0,92 | 3 | 5 | -1,28 |
| 2009 | Egypt, Arab Rep. | EGY | 36,22 | 47,60 | 0,74 | 3 | 6 | -0,03 |
| 2009 | El Salvador | SLV | 41,31 | 21,45 | 0,93 | 5 | 6 | -0,78 |
| 2009 | Estonia | EST | 110,19 | 13,77 | 1,00 | 6 | 5 | 1,13 |
| 2009 | Fiji | FJI | 49,94 | 55,83 | 0,96 | 7 | 4 | -0,76 |
| 2009 | Finland | FIN | 94,39 | 37,98 | 1,00 | 8 | 5 | 1,94 |
| 2009 | France | FRA | 110,27 | 75,14 | 0,99 | 7 | 4 | 1,43 |
| 2009 | Georgia | GEO | 31,21 | 6,81 | 1,10 | 6 | 6 | -0,17 |
| 2009 | Germany | DEU | 112,34 | 39,34 | 1,00 | 7 | 6 | 1,63 |
| 2009 | Greece | GRC | 91,70 | 17,00 | 0,97 | 4 | 5 | 0,64 |
| 2009 | Guyana | GUY | 36,49 | 14,17 | 0,80 | 4 | 0 | -0,59 |
| 2009 | Hungary | HUN | 71,34 | 22,34 | 1,01 | 7 | 5 | 0,82 |
| 2009 | India | IND | 46,77 | 85,62 | 0,98 | 8 | 4 | 0,05 |
| 2009 | Indonesia | IDN | 27,62 | 33,04 | 0,91 | 3 | 4 | -0,56 |
| 2009 | Iran, Islamic Rep. | IRN | 36,66 | 19,12 | 0,93 | 4 | 3 | -0,90 |
| 2009 | Ireland | IRL | 230,31 | 13,39 | 1,00 | 9 | 5 | 1,71 |
| 2009 | Israel | ISR | 84,52 | 93,20 | 0,99 | 9 | 5 | 0,83 |
| 2009 | Italy | ITA | 110,83 | 14,96 | 0,99 | 3 | 5 | 0,39 |
| 2009 | Jamaica | JAM | 28,45 | 49,31 | 0,97 | 8 | 0 | -0,49 |
| 2009 | Japan | JPN | 171,00 | 67,12 | 0,94 | 7 | 6 | 1,31 |
| 2009 | Jordan | JOR | 71,70 | 126,99 | 0,98 | 4 | 2 | 0,38 |
| 2009 | Kazakhstan | KAZ | 50,27 | 50,00 | 1,00 | 4 | 5 | -0,56 |
| 2009 | Kenya | KEN | 31,51 | 35,17 | 0,99 | 10 | 4 | -1,07 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2009 | Korea, Rep. | KOR | 107,55 | 100,29 | 0,98 | 8 | 6 | 1,00 |
| 2009 | Kyrgyz Republic | KGZ | 18,98 | 1,53 | 1,14 | 10 | 3 | -1,29 |
| 2009 | Lithuania | LTU | 70,86 | 12,15 | 1,00 | 5 | 6 | 0,72 |
| 2009 | Macedonia, FYR | MKD | 44,31 | 9,90 | 1,01 | 7 | 4 | -0,22 |
| 2009 | Malawi | MWI | 14,24 | 29,25 | 0,64 | 7 | 0 | -0,19 |
| 2009 | Malaysia | MYS | 117,05 | 132,68 | 0,99 | 10 | 6 | 0,55 |
| 2009 | Mauritius | MUS | 85,11 | 53,71 | 1,05 | 6 | 3 | 0,94 |
| 2009 | Mexico | MEX | 23,33 | 38,60 | 0,98 | 5 | 6 | -0,57 |
| 2009 | Morocco | MAR | 64,41 | 69,20 | 1,00 | 3 | 5 | -0,16 |
| 2009 | Nepal | NPL | 59,44 | 42,53 | 0,88 | 7 | 2 | -0,96 |
| 2009 | Netherlands | NLD | 215,29 | 68,38 | 1,00 | 6 | 5 | 1,78 |
| 2009 | New Zealand | NZL | 147,00 | 52,94 | 0,99 | 10 | 5 | 1,91 |
| 2009 | Nigeria | NGA | 37,60 | 19,77 | 1,35 | 9 | 0 | -1,22 |
| 2009 | Oman | OMN | 49,00 | 36,92 | 1,00 | 4 | 2 | 0,68 |
| 2009 | Pakistan | PAK | 23,54 | 20,54 | 0,91 | 6 | 4 | -0,93 |
| 2009 | Panama | PAN | 85,74 | 32,57 | 0,90 | 5 | 6 | -0,09 |
| 2009 | Papua New Guinea | PNG | 32,06 | 154,31 | 0,97 | 5 | 0 | -0,97 |
| 2009 | Peru | PER | 24,08 | 54,96 | 1,00 | 7 | 6 | -0,66 |
| 2009 | Philippines | PHL | 26,18 | 47,60 | 0,81 | 4 | 3 | -0,53 |
| 2009 | Poland | POL | 52,94 | 31,42 | 1,00 | 9 | 4 | 0,68 |
| 2009 | Portugal | PRT | 187,79 | 42,14 | 1,00 | 3 | 5 | 1,04 |
| 2009 | Russian Federation | RUS | 45,29 | 70,49 | 0,98 | 3 | 5 | -0,77 |
| 2009 | Singapore | SGP | 103,20 | 164,88 | 0,99 | 10 | 4 | 1,61 |
| 2009 | Slovak Republic | SVK | 47,58 | 5,35 | 1,00 | 9 | 4 | 0,65 |
| 2009 | Spain | ESP | 211,49 | 88,60 | 1,00 | 6 | 5 | 1,13 |
| 2009 | Sri Lanka | LKA | 24,79 | 19,33 | 0,98 | 4 | 5 | -0,07 |
| 2009 | St. Kitts and Nevis | KNA | 83,61 | 96,29 | 1,00 | 7 | 0 | 0,75 |
| 2009 | Sweden | SWE | 139,35 | 106,95 | 0,98 | 7 | 4 | 1,93 |
| 2009 | Switzerland | CHE | 174,75 | 217,50 | 1,00 | 8 | 5 | 1,75 |
| 2009 | Thailand | THA | 116,30 | 52,44 | 0,95 | 5 | 5 | -0,13 |
| 2009 | Trinidad and Tobago | TTO | 31,54 | 56,55 | 1,01 | 8 | 4 | -0,19 |
| 2009 | Tunisia | TUN | 68,37 | 20,96 | 1,01 | 3 | 5 | 0,22 |
| 2009 | Turkey | TUR | 36,48 | 36,73 | 0,99 | 4 | 5 | 0,12 |
| 2009 | Uganda | UGA | 13,08 | 23,70 | 0,57 | 7 | 0 | -0,43 |
| 2009 | United Kingdom | GBR | 213,52 | 128,79 | 1,00 | 10 | 6 | 1,71 |
| 2009 | United States | USA | 202,87 | 107,33 | 0,95 | 9 | 6 | 1,53 |
| 2009 | Uruguay | URY | 20,62 | 0,39 | 0,87 | 4 | 6 | 0,72 |
| 2009 | Vietnam | VNM | 112,72 | 21,81 | 1,02 | 8 | 4 | -0,43 |

# Chapitre 2:

# The gravity of financial development

**Abstract:** The article empirically tests the link between financial constraints with the extensive (proportion of exporters) and the intensive (volume of exports) margins of international trade. The main contribution is the macroeconomic analysis of this relationship – that is, the investigation of the effect of finance on trade of all economic sectors combined – which is further reaching than the manufactured-sector-based focus found in the current literature. The study is developed on the basis of a bilateral trade database on 104 countries between 1998 and 2007. The empirical section estimates a two-stage gravity equation using panel data and shows a positive impact of financial development on the marginal variation of the extensive margin. However, the estimate of the relationship between finance and the intensive margin shows an unexpected result. It finds inconsistent results demonstrating a relationship that is negative, positive or statistically null.

**Keywords:** Financial development; International trade.

**Résumé:** L'article teste empiriquement le lien entre les contraintes financières avec les marges extensive (proportion d'exportateurs) et intensive (volume des exportations) du commerce international. La principale contribution est une analyse macroéconomique de cette relation – c'est à dire, l'analyse de l'effet de la finance sur le commerce de tous les secteurs économiques confondus – qui est plus étendue que les analyses basées sur les secteurs manufacturiers retrouvées dans la littérature actuelle. L'étude est développée à partir d'une base de données du commerce bilatéral sur 104 pays entre 1998 et 2007. La section empirique estime une équation de gravité en deux étapes en utilisant des données en panel et montre un impact positif du développement financier sur la variation marginale de la marge extensive. Toutefois, l'estimation de la relation entre la finance et la marge intensive montre un résultat inattendu. Il trouve des résultats incohérents démontrant une relation qui est négative, positive ou statistiquement nulle.

**Mots clés:** Développement financier; Commerce international.

**Classification JEL:** F12, F4, G2.

# Introduction

This paper aims to empirically establish the relationship between firms' financial constraints and the international trade. More precisely, the paper studies the link between financial development with the extensive and the intensive margins of trade. The first margin is the proportion of exporting firms and the second is the volume exported by countries.

The main contribution of the study is its macroeconomic analysis of the effect of financial development on trade of all exporting sectors combined. As the literature mainly analyzes the effect of finance on international specialization or on manufactured exports (see next section), it is an important issue to study the effect of finance on overall trade. The article also provides new insight into exporting firms' behavior under financial constraints. Lastly, it uses a new specification of the gravity model with heterogeneous firms proposed by Helpman, Melitz & Rubinstein (2008), but using panel data.

Articles that use empirical approaches to test the effects of financial development on the international trade are relatively new and Beck (2002) is among the pioneers. He tests a Heckscher-Ohlin model, developed by Kletzer & Bardhan (1987), which discusses the role of credit market imperfections in international specialization. The paper shows that financially developed countries specialize in manufacturing sectors rather than in agricultural sectors. Subsequently, several articles test the proposition that financially developed countries have a comparative advantage in manufacturing industries, especially in industries intensive in external finance or with more intangible assets (see Beck 2003, Svaleryd & Vlachos 2005 or Hur et al. 2006). Latter, Manova (2008) introduces firms' heterogeneity into the debate and shows that financial development is positively correlated with the extensive and intensive

margins of trade and that this relationship is stronger in financially dependent industries.

In summary, literature points to a strong effect of financial sector development on trade. It is shown that the specialization driven by financial development modifies production patterns, and thus the trade patterns. However, all empirical studies use data on a narrow set of manufacturing industries. The number of sectors used in the analyses does not exceed 36 of a classification that counts more than 57 sectors. Therefore the effect of finance on the other sectors – and also on total trade – is not investigated.

This present study continues the discussion and explores the effect of financial development on trade of all economic sectors combined. Differently from others, it uses aggregate data on bilateral trade to gain a broader picture than the manufactured-sector-based effects sought by the literature. Data are annual and cover 104 countries between 1998 and 2007, resulting in an analysis that allows a better comprehension of the financial effect on trade performance.

The empirical section first examines the link between finance and the marginal variation of the extensive margin of trade, using a probit equation. The results show that financial development lowers the productivity cut-off above which firms export and raises the proportion of exporting firms. These outcomes are in line with other studies and confirm the positive and strong link between financial development and firms' access to international trade.

Subsequently, the effects of finance on the intensive margin are tested with a two-stage gravity model. In the first stage, the extensive margin is estimated and the second estimates bilateral trade flows with a traditional gravity equation controlling for the proportion of exporting firms. The findings indicate that the extensive margin affects positively trade flows, and so does the financial development through this indirect channel. Nonetheless, the estimates demonstrate an unexpected result for the

direct impact of financial development on the intensive margin of trade. The coefficients of the different indicators used to measure the level of financial development are incoherent, demonstrating a relationship that is negative, positive or statistically null, depending on each specification tested.

Previous studies (see next section) point to a positive relationship between financial development and exports in manufacturing. The results in this paper are therefore complementary to this finding and show that the overall effect is not conclusive. This finding can be explained by the decrease in exports in some sectors – caused by changes in the trade patterns induced by financial development – that offsets the export growth driven by financial development in some other manufacturing sectors. The "finance – intensive margin" relationship takes two distinct paths: financial development provokes a comparative advantage in some manufacturing sectors, as shown by previous studies, nonetheless the impact on the overall trade flows is inconclusive, as shown by this article.

The remainder of this article is organized as follows. Next section discusses the actual state of the literature and the importance of the macroeconomic investigation of the relationship. The second and the third sections present respectively the empirical methodology and the database. The forth section presents the results and the fifth the sensitivity analyses. Finally, the last section summarizes the main conclusions.

# I. Financial development, international specialization and trade

Many studies analyze the effects of financial development on several macroeconomic variables and the focus initially was on the link between finance and economic

growth. King & Levine (1993) show that financial development promotes GDP growth, rising investment rates and better physical capital performance, and these results are confirmed by numerous other studies (see, for example, Guiso et al. 2004 or Beck et al. 2008).

Financial development reflects the balance between savers and borrowers, and the maximization of their interest. To promote this equilibrium efficiently, the system must properly fulfill the main financial functions and reduce frictions between agents (Cezar, 2012). There are many channels for which financial systems affect the economic activity. First, financial intermediation mobilizes savings and allocates them to the most efficient projects; then, it produces and diffuses information about these projects. Financial systems influence the economic activity by exerting corporate governance and by monitoring investment projects; and also by reducing the transaction costs. Lastly, financial intermediation influences the economy by sharing, diversifying and managing risks (Levine, 2005).

The literature that analyzes the financial effect on international trade appears with Kletzer & Bardhan (1987), which show that financial differences between countries lead to comparative advantages according to the sectoral demand for capital. Beck (2002) constructs a theoretical model that assumes that manufacturing sectors face increasing returns to scale while the agricultural sectors face constant returns. The reduction of the financial frictions in the economy shifts incentives towards the sectors with increasing returns, so that financial development benefits the manufacturing production. Therefore, financial systems influence the sectoral specialization; and thus the international trade. The article confirms empirically the hypothesis that the export shares and trade balances in manufactured goods are higher in financially developed countries.

The studies that followed are mainly based on the results of Rajan & Zingales (1998). These authors construct a sectorial index of dependence on external finance[1] and show that financial development is more beneficial to strongly dependent sectors and that these sectors post higher growth rates in countries where the financial industry is more developed. Their results support empirically that financial development modifies countries' productive structure and thus that the international trade (and countries' specialization patterns) is also influenced by the financial sector.

Beck (2003) and Svaleryd & Vlachos (2005) explore empirically whether the level of financial constraint translates into a source of comparative advantage in the manufacturing industries and explains trade patterns across countries. Their results indicate a positive relation of the interaction between the external dependence index and the degree of financial constraint with export shares and trade balances across sectors and countries. Moreover, Svaleryd & Vlachos find that financial development has an even greater impact on the pattern of manufacturing specialization among OECD countries than differences in human capital. Using a similar methodology, Hur et al. (2006) investigate the interplay between financial constraint, asset tangibility and international trade and show that financially developed countries post higher export shares and trade balance in sectors with more intangible assets.

Latter, Chaney (2005) and Manova (2008) introduce firms' heterogeneity into the debate. The former author constructs a theoretical model where heterogeneous firms are subject to credit constraints to pay for trade costs, and they export only if their profit, added to a liquidity shock, is higher than their exporting costs. The study demonstrates that there is a set of firms that are productive enough to access foreign markets but that do not export because of credit constraints. The latter author develops a similar model and shows that financial development is positively associated with the extensive and intensive margins of trade and that this relationship

[1] More precisely, the financial dependence – that is, the capacity to self-finance capital needs – is defined as capital expenditures minus cash flow from operations divided by capital expenditures.

is stronger in financially dependent industries. The empirical analyses confirm the theoretical assumptions and indicate that financial systems are a major determinant of manufacturing trade. According to the results, financially developed countries export higher volume from a larger number of firms, and this phenomenon is even stronger than the sectoral level of financial dependence is high.

Despite the conclusions of these studies, the database used by them cover neither the totality of the economics sectors, nor all manufacturing sectors. For example, Beck's analysis uses a trade database on thirty-six 3-digit-ISIC manufacturing industries while the data used by Svaleryd & Vlachos cover thirty-two 3-digit-ISIC manufacturing industries and the data from Manova cover only twenty-seven. And the 3-digit-ISIC classification counts more than fifty-eight different sectors, so that the previous empirical studies do not cover even 60% of the overall trade. Moreover, Matsuyama (2005) shows that the manner in which finance affects trade varies according to the intrinsic characteristics of each economic sector even among manufacturing industries and that financial development provides a commercial advantage to sectors that are dependent on external finance, whereas countries with low financial endowment specialize in sectors with low agency problems (manufacturing included), i.e., in sectors only somewhat dependent on external finance. In a Heckscher-Ohlin-Samuelson interpretation of international trade, specialization in financially intensive sectors, induced by financial development, should lead to disengagement in less financially intensive sectors (Dornbusch et al. 1977). Therefore, a large financial endowment fosters advantage in some industries but not all manufacturing sectors. Hence, the impact of financial development on trade of all economic sectors is not yet well known.

# II. Estimation methodology

A gravity equation is used to empirically test the relationship between financial development and the two margins of the international trade. More precisely, the gravity equation framework is employed to study the impact of financial development on firms' selection into exporting markets (extensive margin) and on the volume traded between countries (intensive margin). The gravity model is one of the most successful models in international economics and numerous specifications have already been tested. This paper follows Helpman et al. (2008) and uses a two-stage gravity equation with control for the extensive margin of trade.

## II.1. Background theory

The model considers a simple analytical framework with i countries composed of $N_i$ heterogeneous firms each, as in Melitz (2003). Each firm produces a single variety of good and consumers share the same CES utility function below:

$$U = \left( \int_{\omega \epsilon \Omega} q(\omega)^{\frac{\varepsilon - 1}{\varepsilon}} d\omega \right)^{\frac{\varepsilon}{\varepsilon - 1}}$$

Where $\varepsilon > 1$ is the elasticity of substitution across products, $q(\omega)$ is the consumption of variety $\omega$ and $\Omega$ is the set of available varieties. If Y is the total income, demand for variety $\omega$ equals:

$$q(\omega) = \left( \frac{p(\omega)^{-\varepsilon}}{P^{1-\varepsilon}} \right) Y \quad (1)$$

Where $p(\omega)$ is the price of variety $\omega$, which is a mark-up of the marginal cost that equals $1/\alpha = \varepsilon/\varepsilon - 1$. $P = \left( \int_{\omega \epsilon \Omega} p(\omega)^{1-\varepsilon} d\omega \right)^{\frac{1}{1-\varepsilon}}$ is the ideal price index. Firms are

heterogeneous by their productivity level[2], noted $\varphi$, which can be represented by a cumulative distribution function $\mu(\varphi)$ with support $[\varphi_B , \varphi_H]$, where $\varphi_H > \varphi_B > 0$ and where $\varphi_H$ is the productivity of the most productive firm and $\varphi_B$ is the productivity of the less productive firm.

If firms in country i export to country j, they face two different types of costs: fixed costs and variable costs. Both are country-pair specific and they are the same for all firms exporting from i to j. The first cost equals $c_i f_{ij}$, where $c_i$ is the country-i's unilateral cost of a combination of inputs to produce a unit of good and $f_{ij}$ is specific to the country-pair. The variable cost takes the form of iceberg trade costs, so that $\tau_{ij} > 1$ units of goods are shipped in country i for each unit delivered in the destination. The total cost to export q units from i to j is:

$$c(q) = q\left(\frac{\tau_{ij} c_i}{\varphi}\right) + c_i f_{ij}$$

Firms export if the activity is profitable, i.e. if their profit from exporting is at least equal to zero. Exporters from country i, with productivity $\varphi$, know an income and a profit function from sales to country j equal, respectively, to:

$$r_{ij}(\varphi) = \left(\frac{\tau_{ij} c_i}{\alpha \varphi P_j}\right)^{1-\varepsilon} Y_j = \left(\frac{p_{ij}(\varphi)}{P_j}\right)^{1-\varepsilon} Y_j \qquad (2)$$

And:

$$\pi_{ij}(\varphi) = (1-\alpha)\left(\frac{p_{ij}(\varphi)}{P_j}\right)^{1-\varepsilon} Y_j - c_i f_{ij} \qquad (3)$$

The productivity cut-off above which firms export, denoted $\varphi^*$, is defined by the zero profit condition, such that $\pi(\varphi^*) = 0$. This cut-off is country-pair specific and only

[2] Thus, firms can be indexed by their productivity level instead of the variety they produce.

firms with productivity at least higher than $\varphi_{ij}^{*}$ export from i to j. The proportion of exporting firms is function of this threshold and equals 1- $\mu(\varphi^{*})$.

Given that firms' export decision is based on their profit function, the marginal variation of the extensive margin is captured by changes in the productivity cut-off, such that a set of less productive firms are able to export when $\varphi^{*}$ decreases and, inversely, the proportion of exporting firms decreases when $\varphi^{*}$ increases.

The intensive margin indicates the value of total exports between countries and is noted $X_{ij}$ for trade flows from i to j. It equals the sum of firms' individual exports and is functions of firms' export earnings ($\pi$), the size of the destination country (Y) and the number of exporters (captured by NV in the equation below). This margin can be calculated as follows:

$$X_{ij} = \left(\frac{\tau_{ij} c_i}{\alpha P_j}\right)^{1-\varepsilon} Y_j N_i V_{ij} \qquad (4)$$

Where $V_{ij}$ is the average productivity of the exporting firms and is defined in the following equation:

$$V_{ij} = \begin{cases} \int_{\varphi^{*}}^{\varphi_H} \varphi^{\varepsilon-1} d\mu(\varphi) & \text{if } \varphi^{*} \leq \varphi_H \\ 0 & \text{if } \varphi^{*} > \varphi_H \end{cases} \qquad (5)$$

# II.2. The estimation of the extensive margin

The study seeks to analyze the impact of the financial development on both trade margins. To estimate the relationship between the financial systems and the extensive margin of trade, we first define the latent variable $Z_{ij}$ as the ratio of the productivity of the most productive firm ($\varphi_H$) to the productivity cut-off above which firms export from i to j ($\varphi_{ij}^{*}$). If $\varphi_H < \varphi_{ij}^{*}$, the productivity cut-off is higher than the productivity of the most productive firm and no firm exports from i to j. But if $\varphi_H > \varphi_{ij}^{*}$, there is a set

of exporting firms whose productivity is higher than the productivity cut-off. Therefore, this latent variable reveals whether the two countries trade between them and it is defined in the equation below:

$$Z_{ij} = \left(\frac{\varphi_H}{\varphi_{ij}^*}\right)^{\varepsilon-1} = \frac{(1-\alpha)\left(P_j\frac{\alpha}{\tau_{ij}c_i}\right)^{\varepsilon-1}Y_j}{c_i f_{ij}}\varphi_H^{\varepsilon-1} \qquad (6)$$

We assume that $f_{ij} = \exp(\phi_i + \phi_j + \phi_{ij} + \upsilon_{ij})$, where $\phi_i$ and $\phi_j$ measure, respectively, trade costs of countries i and j, $\phi_{ij}$ measures the country-pair-specific costs and $\upsilon_{ij} \sim N(0, \sigma_\upsilon^2)$ is an i.i.d trade perturbation. Using these specifications and log linearizing the equation (6), $Z_{ij}$ can be expressed as below:

$$z_{ij} = \gamma_0 + \gamma_i + \gamma_j + \gamma_{ij} + \upsilon_{ij} \qquad (7)$$

Where $\gamma_i = \varepsilon\ln(c_i) - \phi_i$ and $\gamma_j = (\varepsilon - 1)\ln P_j + \ln(Y_j) - \phi_j$ represent, respectively, the characteristics of exporting and importing countries and $\gamma_{ij}$ are the fixed costs specific to the country pair.

As latent variable, $Z_{ij}$ is not observable. Nonetheless, whether countries trade between them is observed, and this information can be used as a proxy for $Z_{ij}$. Thus, we define the variable $T_{ij}$ as an indicator of the existence of trade flows between countries i and j. $T_{ij}$ = 1 if $Z_{ij} \geq 1$ and $T_{ij}$ = 0 if $Z_{ij}$ < 1, so that $Z_{ij}$ can be estimated from $T_{ij}$. Assuming that the disturbance $\upsilon_{ij}$ follows a normal distribution with variance $\sigma_\upsilon^2$, the standardization of this variance to the unit enables the estimation of $Z_{ij}$ by a probit model. The conditional probability that i export to j, noted $\rho_{ij}$, is given by the following probit equation:

$$\rho_{ij} = \begin{cases} \Pr(T_{ij} = 1 | \text{observed variables}) \\ \Pr(z_{ij} \geq 0 | \text{observed variables}) \\ \Pr(\gamma_0 + \gamma_i + \gamma_j + \gamma_{ij} \geq \upsilon_{ij}) \end{cases}$$

Defining Z* as:

$$Z^* = \left(\gamma_0 \gamma_i \gamma_j \gamma_{ij}\right)^{\frac{1}{\sigma_\upsilon}}$$

The probability $\rho_{ij}$ can be estimated using the following probit equation:

$$\rho_{ij} = \Phi(\beta z^*) \quad (8)$$

Where z* is the logarithm of Z* and $\Phi(\bullet)$ is the cumulative distribution function of a standard normal distribution.

Equation (8) enables $Z_{ij}$ to be estimated by a probit model using observable variables from the exporting and importing countries. Consequently, we can estimate the effect of these variables on $\varphi_{ij}^*$ (and thus on the marginal variation of the proportion of exporting firms, as we consider that $\mu(\varphi)$, and so $\varphi_H$, is constant) using a traditional gravity model framework (see Santos Silva & Tenreyro, 2009). The effect of the financial development on the extensive margin can also be estimated by the same procedure, as this variable is country specific.

Therefore, to estimate the impact of financial development on the extensive margin of trade (more precisely on the marginal variation of this margin), we estimate the conditional probability that i export to j from the probit equation below:

$$\rho_{ijt} = \Phi\left(\beta_{1t} \ln\theta_{it} + \beta_{2t} \ln\theta_{jt} + \beta_{3t}\psi_i + \beta_{4t}\psi_j + \beta_{5t}\psi_{ij} + \zeta_{0t}\right) \quad (9)$$

Where i and j denote the exporting and importing countries, respectively, and t the year. $\theta_{it}$ and $\theta_{jt}$ are the levels of financial development in countries i and j in the year t. $\psi_i$, $\psi_j$ and $\psi_{ij}$ are three sets of control variables specifics to country i, to country j and to the country-pair, respectively. The first and the second sets include the real GDP of both countries and their populations. The latter set of control variables includes: Distance, which measures the distance between both countries; Contiguity,

Language and Same-country that are dummy variables and, when equal to 1, indicate a common border, a common language and whether the two countries have been the same in the past, respectively. $\psi_{ij}$ also includes the variable Island that indicates the number of islands in the country pair. The three last variables included in $\psi_{ij}$ are FTA, WTO and Currency, which specify, respectively, the existence of a free trade agreement between the country-pair, if both countries are members of the World Trade Organization, and whether both countries share a same currency. $\zeta_{0t}$ is a constant term.

Incorporating panel data estimates from the selection equation into the primary equation (see next section) entails a potential autocorrelation bias. We follow Wooldridge (2005), who proposes estimating the selection equation for each year t and using the resulting estimates to compute $Z_{ij}$, so that we calculate one coefficient for each variable and for each year of the analysis.

It's important to note that this empirical specification uses an analytical gravity framework, with aggregate statistics, to analyze the microeconomic impact of heterogeneous firms' exporting decisions. The selection equation is thus derived from a firm-level decision framework, and shows how changes in countries characteristics affect firms' incentives to export. This property results from the fact that the characteristics of the marginal exporters (increase or decrease of the productivity cut-off) can be identified from the marginal variations in the features of exporting and importing countries and in the observable trade costs. However, it does not contain direct information on the endogenous proportion of exporting firms, but on its marginal variation. This is one of the major advantages of this approach, since it enables the use of a macroeconomic framework to extract firm-level information that, normally, would require a micro-database on firms.

# II.3. The estimation of the intensive margin

The intensive margin indicates the volume exported, so that we seek to determine the effect of financial development on trade flows. The log-linearization of equation (4) enables to write total exports from country i to j as follow:

$$\ln X_{ij} = (1-\varepsilon)\ln c_i + (1-\varepsilon)\ln \tau_{ij} + (\varepsilon-1)\ln \alpha \\ (\varepsilon-1)\ln P_j + \ln Y_j + \ln N_i + \ln V_{ij} \qquad (10)$$

To estimate $V_{ij}$, the model draws on Chaney (2008) and assumes that φ follows a truncated Pareto distribution[3] and that its distribution function respects $\mu(\varphi) = (\varphi^k - \varphi_B^k) / (\varphi_H^k - \varphi_B^k)$, where $k > (\varepsilon - 1)$. Equation (4) can thus be rewritten as:

$$V_{ij} = \frac{k}{(k-\varepsilon+1)\left(\varphi_H^k - \varphi_B^k\right)} \varphi_{ij}^{*(k-\varepsilon+1)} W_{ij}$$

Where $W_{ij} = \max\left\{\left(\frac{\varphi_H}{\varphi_{ij}^*}\right)^{k-\varepsilon+1} - 1, 0\right\}$ and $\varphi_{ij}^*$ is determined by the zero profit condition. Note that both $V_{ij}$ and $W_{ij}$ are monotonic functions of the proportion of exporting firms. As the distribution function of φ supports $[\varphi_B, \varphi_H]$ and $\varphi_H > \varphi_B > 0$, if $\varphi_H < \varphi_{ij}^*$, no firm is productive enough to export and $W_{ij} = 0$, and so does $X_{ij}$. And if $\varphi_H > \varphi_{ij}^*$, $W_{ij}$ captures the proportion of exporting firms. As $Z_{ij}$ is the ratio of the productivity of the most productive firm to the productivity cut-off, $W_{ij}$ can be rewritten as $W_{ij} = \max\left\{Z_{ij}^{\frac{k-\varepsilon+1}{\varepsilon-1}} - 1, 0\right\}$. If $\hat{\rho}_{ij}$ is the estimated probability that i exports to j, $\hat{z}_{ij}^* = \Phi^{-1}(\hat{\rho}_{ij})$, so that a proxy of the extensive margin can be estimated from observed variables using the following selection equation:

[3] Chaney (2008) argues that this distribution law is a good approximation of the true firm productivity distribution. Helpman et al. (2008) relax this distributional assumption and conclude, *"Pareto distribution does not appear to restrict the basic specification of the model"*.

$$\widehat{W}_{ij}^{*} = \max\{(\widehat{Z}_{ij}^{*})^{\iota} - 1{,}0\} = T_{ij}\{(\widehat{Z}_{ij}^{*})^{\iota} - 1{,}0\} \qquad (11)$$

Where $\iota = \frac{k-\varepsilon+1}{\varepsilon-1}\sigma_{\upsilon}$. Using these specifications, equation (10) can be estimated in two stages. The first is the estimation of $W_{ij}$ above using information from the probit equation (9). The second stage is the estimation of $X_{ij}$ controlling for the selection equation $W_{ij}$. Equation (10) can be rewritten as follows[4]:

$$x_{ij} = \chi_0 + \chi_i + \chi_j + \chi_{ij} + w_{ij} \qquad (12)$$

Where $\chi_i = (1-\varepsilon)\ln c_i + \ln N_i$ and $\chi_j = (\varepsilon-1)\ln P_j + \ln Y_j$ represent the trade barriers specific to the exporting and importing countries, respectively. $\chi_{ij} = \tau_{ij}^{1-\varepsilon} = \vartheta_{ij}e^{-u_{ij}}$ specifies country-pair specific trade barriers, where $\vartheta_{ij}$ is the bilateral trade costs and $u_{ij} \sim N(0, \sigma_u^2)$ an i.i.d error term. This new equation is very similar to a conventional gravity equation, as that presented by Anderson and Wincoop (2003). However the control for the selection equation $w_{ij}$ differentiates it from the traditional models.

As the level of financial development is country-i specific, equation (12) can be used to estimate the impact of the financial development on the intensive margin of trade. The selection equation can be estimated from $\hat{z}_{ij}^{*} = \Phi^{-1}(\hat{\rho}_{ij})$, and thus the bilateral flows from the gravity equation below:

$$x_{ijt} = \xi_1 \ln\theta_{it} + \xi_2 \ln\theta_{jt} + \xi_3 \mathfrak{H}_i + \xi_4 \mathfrak{H}_j + \xi_5 \mathfrak{H}_{ij} + \xi_6 \widehat{w}_{ijt}^{*} + \Upsilon_i + \Upsilon_j + \Upsilon_t - u_{ijt} \qquad (13)$$

Where $\mathfrak{H}_i$, $\mathfrak{H}_j$ and $\mathfrak{H}_{ij}$ are the set of variables presented in the previous section and control for country-i, country-j and for country-pair specific features, respectively. The selection equation is constructed with information from (9), such that $\widehat{w}_{ij}^{*} =$

[4] By substituting $v_{ij}$ for $w_{ij}$, (the constant term) $\left(\frac{k}{(k-\varepsilon+1)(\varphi_H^k - \varphi_B^k)}\right)$ is added in the constant.

$\ln\left(\exp\left(\iota\hat{z}_{ijt}^{*}\right)-1\right)T_{ij}$. $\Upsilon_i$, $\Upsilon_j$ and $\Upsilon_t$ are control dummies for exporter and importer fixed costs and for the time fixed effect, respectively.

Although the exogenous variables included in the two equations of the two-stages estimation procedure are the same (Bergstrand & Egger 2007), an additional variable not included in the primary equation is also required in the selection equation (Das, Newey & Vella, 2003). This variable should be correlated with the fixed costs and should not be directly correlated with the error term. This excluded variable is Island. This procedure is similar to the two-stages estimators of Heckman (1979); nonetheless, the specification used control for firms' heterogeneity, not for selection bias. To address zero flow observations, we employ the Santos Silva and Tenreyro (2010) Poisson pseudo-maximum-likelihood (PPML) estimator.

# III. Data

The empirical analysis uses an annual database on bilateral trade between 104 countries that covers the ten-years period between 1998 and 2007. The list of countries in the sample is available in table 7 on the appendix B. Trade data are in current and undeflated US millions dollars and are taken from the International Monetary Fund's Direction of Trade Statistics (DOTS). Gross Domestic Product are in current US dollars and come from the IMF's "World Economic Outlook Database". The population variable was constructed using information from the World Bank's Health, Nutrition and Population Statistics rounded out with data from the Pen World Table.

The distance variable is based on data weighted by the population's geographic distribution. This variable, as well the dummy variables Contiguity, Language and Same-country came from the database "Distance" of the Center for Studies,

Prospective and International Information (CEPII). Free Trade Agreements was constructed entirely from information on regional trade treaties made available by the World Trade Organization (data are available on the website: http://rtais.wto.org) and on information available on the WTO website (http://www.wto.org). By regional treaties, we mean free trade agreements and customs unions. Currency comes from an update of the database provided by Glick & Rose (2002).

The measure of the level of financial development should, ideally, be sensitive to the efficiency of intermediaries at fulfilling the functions of savings mobilization, capital allocation, risk management, firm monitoring and information sharing. Such measure is, unfortunately, not available for a sufficient number of countries or years to conduct an international comparative study. Therefore, this paper uses a wide range of indicators to measure the level of financial development among the countries in the sample. We use six different indicators on the effectiveness of financial systems. The indicators are: (i) Private credit and (ii) Market capitalization. The former measures the amount of available credit from private institutions to the private sector divided by GDP and measures the credit constraints in the economy. This indicator is made available by the database "Global Development Finance" from the World Bank. The latter indicator is the share price times the number of shares outstanding by the listed domestic companies. This index measures the size of financial market and thus the importance of this financing mode in the economy. (iii) Liquid liabilities (also known as "Financial Depth") equals the ratio of liquid liabilities to GDP and measures the extent of the financial intermediation. (iv) Stock traded measures the liquidity level in the financial markets and equals the ratio of the number of shares traded to GDP. The fifth indicator is (v) Bank, which measures the ratio of bank deposits to total deposits. These four latter indicators are available by the World Bank in the September 2012 version of the "Database on Financial Development and Structure"[5]. The last indicator employed is the (vi) Composite financial index, proposed by Cezar (2012)

[5] See Berk, Demirguc-Kent & Levine (2000).

and constructed from the principal component analysis (PCA)[6] of six different financial and institutional indicators. This indicator is the most comprehensive one used because it includes, in addition to traditional measures, institutional and political aspects of the financial development[7].

Tables 8 and 9 in the appendix present the main descriptive statistics of these six indicators. The indicator of private credit registers its maximum value in Iceland (319% in 2007) and its lowest in Sierra Leone (2.07% in 1999). Market capitalization ranges from 0.5% in Uruguay (2004) to 303% in the Switzerland (2000). Liquid liabilities range from 34.5% in Niger to 242% in Japan. The total value of stocks traded corresponds to 1678% of Macedon GDP (in 2000) and is close to 0% in Bolivia. Bank varies between 2.8% in Georgia (1998) and 230% in Japan (2000). The Composite index ranges from 0.03 in the Uganda in 2005 to 7.59 in the Switzerland in 2006.

# IV. Estimating trade margins

This section uses the empirical model presented in section II to test empirically the impact of financial development on the extensive and intensive margins of international trade. First, we analyze the effect of finance on the marginal variation of the proportion of exporting firms. As shown in the previous section, the empirical

[6] The method allows for the description of a set of multivariate observations from a linear combination of these data, maximizing the explained variance of the new variable. In particular, the original variables $x_{1i}, ..., x_{ni}$ are transformed into a new variable, y, such that the variance of y in the total sample is maximal and the information loss is minimal.

[7] This indicator is only available for the three years between 2005 and 2007.

methodology uses the gravity model framework to identify the effect of country-i, country-j and country-pair features on the productivity threshold above which firms export, so that the effect of these variables on the marginal variation of the extensive margin can be estimated. Specifically, variables that increase the productivity threshold increase the productivity required for exporting and reduce the number of firms that are able to access foreign markets. Inversely, if this threshold decreases, more firms export.

The effect of financial development on the marginal variation of the extensive margin is estimated from equation (9) using a probit model. Results are presented in Table 1 on the appendix A. It is important to note that equation (9) presents the model as proposed by Wooldridge (2005), which allows incorporating panel data estimates from the selection equation (equation 9) on the primary equation (equation 13). Hence, the coefficients are time-variants, such that one coefficient is estimated for each variable and for each year. The results are then used to construct $\hat{z}_{ijt}^{*}$ and $\hat{w}_{ij}^{*}$. Nonetheless, Table 1 presents the estimates using panel estimators and one single coefficient is calculated for each variable over the ten-years period. And, differently from equation (9), the panel model includes country and time fixed effects, as indicated in Table 1[8].

Each of the six columns of the table presents the estimates with one different financial indicator to measure the level of financial development. The dependent variable is a dummy variable that indicates whether the country pair trade ($T_{ij} = 1$) or not ($T_{ij} = 0$).

The control variables in the estimates have the expected sign and demonstrate a good fit of the model. The coefficient of Distance is negative and suggests that positive variations in this variable reduce $Z_{ij}$ and thus reduce the probability that two countries trade between them. In other words, an increase in the distance raises trade costs and

[8] The panel model is estimated to facilitate the presentation of the results.

increases the productivity cut-off above which firms export. This, in turn, reduces the proportion of exporting firms. It is the same for the share of a same language and for being part of a same country in the past. These features reduce costs and increase the number of exporting firms. The effect of a common border is an exception and Contiguity presents a negative coefficient. The effect of territorial border conflicts that stem trade between neighbors can explain this result. In the absence of such conflicts, common land borders enhance trade. The number of islands in the country pair also increases the probability of trade, which is explained by the fact that islands are normally more dependent on trade due to their economic size. The analysis also reveals a positive correlation between firms' selection into trade and the signature of a free trade agreement (FTA), World Trade Organization membership and sharing a common currency. The effect of these variables on easing trade relations reduces the productivity cut-off and increases the extensive margin.

The coefficients of the financial indicators are positive and statistically different from zero in four of the six specifications tested. These results indicate that financial systems play an active role in firms' selection into trade, so that when the financial constraint is relaxed, more firms are able to export. More specifically, improvements in the efficiency with which financial systems perform the main financial functions reduce trade barriers and decrease the productivity level required for exporting, as well as $Z_{ij}$. This allows that less productive firms access foreign markets, meaning that a higher proportion of firms are able to export.

Financial development is an important vehicle to promote firms' access to international markets, even when all economic sectors are analyzed together. The results in Table 1 converge with previous studies (see section I) and show the strength of the level of financial constraint to promote international trade, more precisely to increase the extensive margin. When financial constraints are eased, a higher proportion of firms access foreign markets. The only exceptions are the indicator of market capitalization and the composite index, which coefficients are statistically indistinguishable from zero. The results indicate that differences in the size of

financial markets or in the composite index do not lead to differences in firms' access to the international trade. We attribute this finding to the fact that firms able to access financial markets are already productive enough to overstep the trade profitability threshold and to the limited data on the second measure of financial development.

We also estimate the effect of the level of financial development in the destination country on the probability that country i exports to j. The sign and the level of statistic significance of the coefficients indicate that this probability is higher when the trade partner possesses a well functioning financial system. This finding suggests that financial systems reduce importing costs, and thus the productivity threshold from which firms export.

Next, we use the two-stage gravity model with panel data, presented in section II, to analyze the effect of financial development on the intensive margin, i.e. on trade flows. The selection equation is estimated in the first stage and the results are used to construct the control function for the proportion of exporting firms (i.e., the extensive margin). Supposing that the cdf of firms productivity can be represented by a Pareto distribution, the extensive margin can be calculated with the following equation: $\hat{w}_{ij}^{*} = \ln\left(\exp\left(\iota\hat{z}_{ijt}^{*}\right) - 1\right)T_{ij}$, where $\hat{z}_{ij}^{*} = \Phi^{-1}\left(\hat{\rho}_{ij}\right)$[9], $\hat{\rho}_{ij}$ is the estimated probability that country i exports to j calculated from equation (9) and $T_{ij}$ indicates the existence of trade flows between these two countries. Then, in the second-stage, the control function for the extensive margin is included in a traditional gravity equation to estimate the intensive margin, as demonstrated in equation (13).

The paper follows Silva & Tenreyro (2010)[10] and uses the PPML estimator to prevent for the zero trade flow observations[11], as about 30% of the countries in the sample do

[9] We follow Wooldridge (2005) and each coefficient in the construction of the control function for the extensive margin is time-variant.

[10] See also Silva & Tenreyro (2006).

not trade between them. As data are in panel, the specification control for countries' time-invariant trade costs using fixed-effects dummies and for the time fixed-effects using year's dummies (see Baldwin et al. 2006 for further information about the specification). In additional, even if the two-stages model is used to control firms' heterogeneity, the specification used is similar to the Heckman procedure (1979) to control for selection bias; and an excluded variable[12] – which is the variable Island – is required.

The results are presented in table 2, on the appendix. Specifications in each column are differentiated by the financial indicator employed to measure the level of financial development. More precisely, column (1) presents the results for Private credit; column (2) for Market capitalization; column (3) for Liquid liabilities; column (4) and (5) for Stock traded and Bank; and the last column (6) for the Composite index.

The coefficients of all control variables have the expected sign and show a good fit of the model. Distance has a negative coefficient indicating that distant countries trade less due to higher trade costs (fixed and variables). Common border increases trade flows, as well as sharing a same language. Table 1 showed that being part of a same country in the past increases the probability that two countries trade between them, nonetheless the effect on trade flows is inconclusive, being positive or statistically equal to zero depending on the specification tested. The variable that indicates the existence of free trade agreement between country pairs has positive coefficients and confirms the hypothesis that trade agreements raise trade flows. WTO is also positive, as is Currency; indicating that membership of the World Trade Organization and sharing the same currency both increase trade flows. These results are coherent with the recent gravity literature, even using this new specification of the gravity model (e.g. Baier & Bergstrand, 2007; Rose, 2004; and Glick & Rose, 2002). The GDP

[11] The dependent variable is thus not in log and the zero observations are able to be estimated.

[12] This variable should be correlated to the extensive margin but not with the trade flows.

coefficient is also positive and significant in the six specifications for the exporting and importing countries, indicating that economic growth raises imports and that big economies trade more. Population presents a negative effect such that, for a given level of GDP, increasing population decreases the demand.

The control function for the extensive margin ( $\widehat{w}_{ij}^{*}$) is calculated for each specification because the indicator of financial development in the selection equation is the same as in the primary equation. All the six controls function estimated have positive and significantly different from zero coefficients, as expected by the empirical model. These results show that an increase in the proportion of exporting firms induces a positive variation in export volume. This outcome confirms the robustness of this control and the importance of the extensive margin to properly estimate the gravity model. This finding also demonstrates that the financial variable plays a positive indirect role on international trade flows by increasing the proportion of exporting firms. More precisely, financial development drops the productivity threshold above which firms are able to export and, by this indirect channel, raises trade flows.

While the indirect link between financial development and trade (through $\widehat{w}_{ij}^{*}$) shows no surprises, the results of the direct effect of finance on trade flows are unexpected. The coefficients of the different indicators of financial development are incoherent, demonstrating a relationship between financial development and trade flows that is negative, positive or statistically null depending on each specification. The coefficients are negative and statistically significant in two of the six specifications tested; statistically indistinguishable from zero in others three specifications and one specification demonstrates a positive and significant coefficient.

According to the results, financial development in the source country, measured by the level of credit to the private sector and by the liquidity in the financial markets (specifications 1 and 4), has a negative impact on the intensive margin and thus reduces bilateral trade. These findings suggest that positive variations in these two

indicators during the ten-years period of the study induced a negative variation in exporting flows compared to the average value. In addition, the results in table 2 also indicate that financial development – measured by the ratio of liquid liabilities to GDP, by the proportion of the bank deposit in the GDP and by the Composite financial index (specifications 3, 4 and 6) – does not affect the international trade. These three specifications are not statistically significant. Finally, specification (4), which used the market capitalization of domestic companies to measure the level of financial development, suggests that better financial markets improve exporting performance.

The effect of financial development in the importing country is also tested. Five of the six specifications presented in table 2 indicate that trade partners' financial systems do not impact trade flows between the country pair. Only the indicator of market capitalization in the importing country is positive and statistically significant.

Unlike these findings, the previous studies find a positive effect of finance on the intensive margin of trade (see section I). Despite this apparent inconsistency, it's important to note that the relation sought is not the same. The previous studies analyze the patterns of trade and the international specialization using data on some manufacturing sectors. Yet, this paper focuses on the macroeconomic effects of financial development on exports across all economic sectors. Therefore the results presented in this section are complementary and they enrich the literature showing that, despite a positive effect on manufacturing trade, the effect of financial development on the overall bilateral trade flows is not conclusive, being negative, positive or indistinguishable from zero depending on the indicator employed to evaluate the financial systems.

As shown in section I, other studies find that financial development modifies the production patterns, and thus the trade structure, promoting a specialization effect in the manufacturing sectors, especially in industries that relies on a strong dependence on external finance or with more intangible assets. These findings are based on

sector-data analysis, which coverage exceeds neither all the manufacturing sectors nor all other non-manufacturing sectors. Therefore, the results presented in this section suggest that changes in the trade structure stimulated by financial development – that favor exports in the sectors analyzed by the previous studies – also induce an opposite effect on some other sectors. More precisely, the specialization effect caused a decrease in exports in some sectors, and this decrease offsets the export growth driven by financial development on some other sectors, so that the overall effect on trade during the analyzed period is inconclusive.

# V. Sensitivity analyses

This section performs a wide range of sensitivity analyses to assess the robustness of the empirical results presented in the previous section[13]. First, we test the robustness of the empirical model used to estimate the intensive margin. The specification used in the previous section to construct the control function for the extensive margin is based in the hypothesis that firms' productivity follows a Pareto distribution. To control this hypothesis, we relax this parametric assumption and, using equations (2) and (6), we assume that $w_{ij} \equiv \kappa(z_{ij})$ is an increasing function of $z_{ij}$. The control function for the extensive margin in equation (13) is then switched from $\widehat{w}_{ij}^{*}$ to $\kappa(z_{ijt}^{*})$, which is approximated with a polynomial in $z_{ijt}^{*}$. Equation (13) is then re-estimated with this new specification and the results are presented in Table 3. The changes in the coefficients and in the standard deviation are marginal under this non-parametric specification and the outcomes are quite similar to table 2 and confirm the previous results. The impact of financial development on trade is negative and significant when using Private credit and Stocks traded to measure financial systems, while the

[13] The first stage remains the same over all these specifications tested in this section.

impact is non-distinguishable from zero using Liquid liabilities, Bank and the Composite index. The effect of finance on the intensive margin is positive if market capitalization is used.

Then, we test the robustness of the results for a possible endogeneity bias. A major problem with financial variables is the possibility of a reverse causality bias with the dependent variable (see Do & Levchenko, 2007). Income and credit in the economy may vary with exports, which would result in an endogenization of the financial indicators. Therefore, trade flows could determine the level of financial development rather than the inverse. The results presented in the previous section already minimize the possibility of reverse causality. First, the fixed effects model in panel data and the control dummies reduce the possibility of this bias. Second, one of the financial indicators employed – the composite index – is constructed from institutional and political variables and is less sensitive to cyclical economic phenomena. However, to test the argument of reverse causality more directly and to assess the robustness of the coefficients presented in table 2, we use two different strategies: (i) the instrumental variable model and (ii) a 3- and 5- years moving average of the financial indicators. The former strategy is the usual procedure to control for endogeneity bias and the latter reduces the possibility of simultaneous adjustments between trade flows and the financial indicators.

We use as instrument two measures of the institutional endowment of each country, made available by the World Bank in the database "World Governance Indicators". The first variable measures the quality of legal systems and captures perceptions of the extent to which agents have confidence and abide by the rules of the society, in particular the quality of contract enforcement and property rights. The second measure is sensible to the government effectiveness and captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. As in La Porta et al. (1998), we assume that the level of financial development is

determined by the institutional environment, more precisely by the straight of the rule of law and the government effectiveness in each country. These instruments are correlated with financial endowment since institutional development is essential for financial sector, but they are statistically insignificant when explaining the dependent variable. In additional, they have been used successfully in other studies (e.g. Svaleryd & Vlachos, 2005).

The results for the instrumental variable estimates are presented in table 4 (the specification with the composite index is not estimated because this indicator is construct from one of the instruments). The F statistic in the first stage regression indicates the relevance of the instruments, as well as the Sargan's test (which p-value is superior to 10%). The sign of the coefficient in specification (1) is in line with the previous estimates, but the statistical significance level becomes superior to 10%. Nonetheless, the sign and the significance level of the coefficients in specifications (2) to (5) remain the same as before so that the results confirm those presented in the previous section.

The estimates with the 3- and 5- years moving average are presented in table 5 (the moving average of the composite index is not estimated because we dispose observations for this indicator only for the three years between 2005 and 2007). The results are in line with those presented in table 2. Both 3- and 5- years moving average of Private credit and Stock traded remain negative with the new specification and suggest that improvements in financial system conditions during the analyzed period decrease exports compared to the average value. If financial development is measured by Bank, results indicate a non-statistically relevant relationship, while the indicators of Market capitalization and Liquid liabilities suggest that better financial systems are translated by better commercial performance. This latter indicator becomes positive with the use of the moving average procedure, but the results are still inconclusive.

Lastly, we test for the linearity of the effect of improving financial systems over the exports along countries and their different levels of financial development. For that, we share the 104 countries into six groups, differentiated by the level of financial development of each country, and create a dummy variable for each of these six groups. Groups 1 and 6 regroup, respectively, the most and the least financially developed countries. These dummies variables are then interacted with the financial indexes so that the effect of financial development over each of these groups is estimated. More precisely, this test verifies if the results are due to some groups of countries and also if they are homogeneous among them.

The results are presented in table 6 on the appendix and they are in line with the findings on the previous section. Table 6 shows that the negative relationship between trade and the indicator of Private credit found in the others estimates is homogenous across the groups and is only statistically indistinguishable from zero in the group of the least financially developed countries (group 6). This means that almost all countries, at almost all levels of financial development, face this negative relationship. Furthermore, the results also suggest that the negative relationship found using Stocks traded is driven by two groups – groups 3 and 5. The others four groups of countries are not influenced by changes in this financial indicator. The effect of finance on trade is not statistically significant over all the six groups if the level of financial development is measure by Liquid liabilities, Bank and by the Composite index. These findings join those presented in table 2. And, as in the previous section, the relationship between trade and the indicator of market capitalization is positive; nonetheless it is statistically significant only for the four most financially developed groups in the sample.

# Conclusions

This article explores the relationship between the financial constraints and the margins of international trade. It contributes to a recent trend in the literature, mainly in three distinguished ways. First, the article examines the macroeconomic impact of finance on trade of all economic sectors, broadening the manufactured-sector-based focus found in the literature. Second, it provides new information about firms' exporting behavior under financial constraints and lastly it uses a new specification of the gravity model in panel data.

The empirical analysis draws on a bilateral trade database covering 104 countries between 1998 and 2007. A probit model is used to test the effect of financial development on the extensive margin and shows a positive relationship, suggesting that lower financial constraints raise this trade margin. The article then uses a two-stage gravity equation to analyze the effects of finance on the intensive margin. The results are unexpected and indicate an inconclusive relationship between the financial indicators and trade flows, which is negative, positive or statistically indistinguishable from zero, depending on the indicator of the level of financial system employed. These results are robust and confirmed by all the sensitivity tests.

There is a strong link between finance and firms' selection into trade. When the financial constraint is relaxed a greater proportion of firms are able to access foreign markets. In the other hand, the link between finance and trade flows follows two distinct paths. Using data on manufacturing sectors (which are not extensive), previous literature finds that financial development translates into comparative advantages in these sectors (e.g. Manova, 2008). Yet, this article estimates the relationship using bilateral trade data, which cover all the economic sectors, and demonstrates that the macroeconomic impact of financial development on overall exports is not conclusive. The specialization pattern induced by financial development on some manufacturing, as shown by Beck (2002), also provokes a

decrease in exports in other sectors, as shown by Cezar (2013). The results in this paper can thus be explained by these two opposite phenomena that cancel each other. More precisely, the decrease in exports offsets the export growth induced by the international specialization, so that the overall effect of finance on exporting flows in inconclusive.

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# Appendix A: Results and robustness

**Table 1. Financial development and the extensive margin**

| Variable | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Private Credit (i) | 0.245*** | | | | | |
| Private Credit (j) | 0.227*** | | | | | |
| Mk. Capitalization (i) | | 0.019 | | | | |
| Mk. Capitalization (j) | | -0.006 | | | | |
| Liq. Liabilities (i) | | | 0.421*** | | | |
| Liq. Liabilities (j) | | | 0.384*** | | | |
| Sk. Traded (i) | | | | 0.061*** | | |
| Sk. Traded (j) | | | | 0.107*** | | |
| Bank (i) | | | | | 0.348*** | |
| Bank (j) | | | | | 0.358*** | |
| Comp. Index (i) | | | | | | 0.152 |
| Comp. Index (j) | | | | | | -0.162 |
| GDP (i) | 0.869*** | 1.092*** | 0.879*** | 0.958*** | 0.885*** | 1.810*** |
| GDP (j) | 0.755*** | 1.028*** | 0.774*** | 0.870*** | 0.761*** | 1.974*** |
| Pop (i) | 0.013 | -0.203*** | 0.019 | -0.157*** | -0.003 | -0.380*** |
| Pop (j) | -0.026 | -0.360*** | -0.026 | -0.325*** | -0.033 | -0.805*** |
| Distance | -1.118*** | -1.051*** | -1.100*** | -0.889*** | -1.129*** | -1.396*** |
| Contiguity | -0.608** | 10.385 | -0.622** | 9.367 | -0.687** | -1.584 |
| Language | 0.812*** | 0.906*** | 0.776*** | 0.731*** | 0.746*** | 0.512 |
| Colony | 0.953 | 6.648 | 1.046 | 5.959 | 1.016 | 9.331 |
| Same-Country | 1.670*** | 8.614 | 1.687*** | 8.204 | 1.701*** | 12.354 |
| Number Island | 0.562*** | 0.561*** | 0.558*** | 0.433*** | 0.513*** | 0.490* |
| FTA | 0.630*** | 0.576 | 0.655*** | 0.905** | 0.642*** | 16.258 |
| WTO | 0.449*** | 0.472*** | 0.441*** | 0.546*** | 0.443*** | 1.384*** |
| Currency | 1.136*** | 4.061** | 1.376*** | 3.571** | 1.381*** | 2.971 |
| N | 107 120 | 49 700 | 101 000 | 51 120 | 105 060 | 14 632 |
| Time FE | Y | Y | Y | Y | Y | Y |
| Country-i FE | Y | Y | Y | Y | Y | Y |
| Country-j FE | Y | Y | Y | Y | Y | Y |

*** indicates the coefficient significance level at 1%, ** at 5% and * at 10%. Time, country, sector and sector-time specific effects as well as the constant estimates are not reported. Equations (1), (2), (3), (4), (5) and (6) are differentiated by the indicator of financial development. The dependent variable is a dummy that equals 1 if country-i exports to country-j and equals 0 otherwise.

## Table 2. The effect of financial development on trade flows

| Variable | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Private Credit (i) | -0.143*** | | | | | |
| Private Credit (j) | -0.034 | | | | | |
| Mk. Capitalization (i) | | 0.121*** | | | | |
| Mk. Capitalization (j) | | 0.063* | | | | |
| Liq. Liabilities (i) | | | 0.126 | | | |
| Liq. Liabilities (j) | | | 0.052 | | | |
| Sk. Traded (i) | | | | -0.039* | | |
| Sk. Traded (j) | | | | 0.006 | | |
| Bank (i) | | | | | 0.045 | |
| Bank (j) | | | | | 0.033 | |
| Comp. Index (i) | | | | | | 0.022 |
| Comp. Index (j) | | | | | | 0.186 |
| GDP (i) | 0.635*** | 0.533*** | 0.479*** | 0.577*** | 0.501*** | 0.564* |
| GDP (j) | 0.627*** | 0.621*** | 0.569*** | 0.643*** | 0.562*** | 0.723** |
| Pop (i) | -0.710 | -0.584 | -0.451 | -0.715 | -0.581 | -2.068 |
| Pop (j) | -0.979** | -1.248*** | -1.035*** | -1.074** | -1.099*** | -2.664 |
| Distance | -0.612*** | -0.605*** | -0.600*** | -0.603*** | -0.608*** | -0.598*** |
| Contiguity | 0.461*** | 0.450*** | 0.510*** | 0.450*** | 0.504*** | 0.442*** |
| Language | 0.167*** | 0.165*** | 0.176*** | 0.169*** | 0.170*** | 0.175*** |
| Colony | 0.139*** | 0.111*** | 0.115*** | 0.120*** | 0.117*** | 0.158*** |
| Same-Country | 0.033 | 0.040 | 0.168** | 0.044 | 0.191*** | -0.027 |
| FTA | 0.508*** | 0.531*** | 0.505*** | 0.536*** | 0.498*** | 0.607*** |
| WTO | 0.500*** | 0.428*** | 0.288*** | 0.522*** | 0.290*** | 0.457** |
| Currency | 0.023* | 0.038** | 0.010* | 0.033** | 0.007* | -0.027 |
| $\widehat{w}_{ij}^{*}$ (Private) | 0.471*** | | | | | |
| $\widehat{w}_{ij}^{*}$ (Market cap.) | | 0.393*** | | | | |
| $\widehat{w}_{ij}^{*}$ (Liq. Liabilities) | | | 0.461*** | | | |
| $\widehat{w}_{ij}^{*}$ (Sk. Traded) | | | | 0.406*** | | |
| $\widehat{w}_{ij}^{*}$ (Bank) | | | | | 0.482*** | |
| $\widehat{w}_{ij}^{*}$ (Comp. Index) | | | | | | 0.441*** |
| N | 91 807 | 49 094 | 85 657 | 50 509 | 89 697 | 14 280 |
| $R^2$ | 0.906 | 0.909 | 0.917 | 0.908 | 0.914 | 0.906 |
| Time FE | Y | Y | Y | Y | Y | Y |
| Country-i FE | Y | Y | Y | Y | Y | Y |
| Country-j FE | Y | Y | Y | Y | Y | Y |

*** indicates the coefficient significance level at 1%, ** at 5% and * at 10%. Time, country, sector and sector-time specific effects as well as the constant estimates are not reported. Equations (1), (2), (3), (4), (5) and (6) are differentiated by the indicator of financial development. All specifications use the Pseudo Poisson Maximum of Likelihood model (PPML) estimator.

## Table 3. Robustness: The non-parametric gravity model

| Variable | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Private Credit (i) | -0.143*** | | | | | |
| Private Credit (j) | -0.035 | | | | | |
| Mk. Capitalization (i) | | 0.121*** | | | | |
| Mk. Capitalization (j) | | 0.063* | | | | |
| Liq. Liabilities (i) | | | 0.125 | | | |
| Liq. Liabilities (j) | | | 0.050 | | | |
| Sk. Traded (i) | | | | -0.039* | | |
| Sk. Traded (j) | | | | 0.006 | | |
| Bank (i) | | | | | 0.044 | |
| Bank (j) | | | | | 0.031 | |
| Comp. Index (i) | | | | | | 0.031 |
| Comp. Index (j) | | | | | | 0.198 |
| GDP (i) | 0.631*** | 0.532*** | 0.479*** | 0.576*** | 0.501*** | 0.571* |
| GDP (j) | 0.624*** | 0.621*** | 0.567*** | 0.642*** | 0.561*** | 0.731** |
| Pop (i) | -0.702 | -0.584 | -0.455 | -0.710 | -0.584 | -2.120 |
| Pop (j) | -0.972** | -1.248*** | -1.032*** | -1.070** | -1.096*** | -2.694 |
| Distance | -0.610*** | -0.605*** | -0.599*** | -0.603*** | -0.607*** | -0.597*** |
| Contiguity | 0.465*** | 0.450*** | 0.514*** | 0.450*** | 0.509*** | 0.445*** |
| Language | 0.166*** | 0.165*** | 0.176*** | 0.169*** | 0.169*** | 0.174*** |
| Colony | 0.135*** | 0.110*** | 0.110*** | 0.119*** | 0.112*** | 0.156*** |
| Same-Country | 0.028 | 0.037 | 0.162** | 0.041 | 0.184*** | -0.031 |
| FTA | 0.500*** | 0.527*** | 0.496*** | 0.532*** | 0.488*** | 0.601*** |
| WTO | 0.498*** | 0.422*** | 0.289*** | 0.519*** | 0.290*** | 0.460** |
| Currency | 0.025* | 0.038** | 0.011* | 0.033** | 0.008* | -0.025 |
| $\hat{z}^{*}_{ijt}$ | 1.686*** | 1.658*** | 1.841*** | 1.912*** | 1.816*** | 1.950** |
| $\hat{z}^{*}_{ijt}$ | -0.599*** | -0.592*** | -0.650*** | -0.636*** | -0.651*** | -0.750** |
| $\hat{z}^{*}_{ijt}$ | 0.087*** | 0.083*** | 0.092*** | 0.084*** | 0.094*** | 0.108** |
| N | 107 120 | 49 700 | 101 000 | 51 120 | 105 060 | 14 632 |
| $R^2$ | 0.906 | 0.909 | 0.917 | 0.908 | 0.914 | 0.906 |
| Time FE | Y | Y | Y | Y | Y | Y |
| Country-i FE | Y | Y | Y | Y | Y | Y |
| Country-j FE | Y | Y | Y | Y | Y | Y |

*** indicates the coefficient significance level at 1%, ** at 5% and * at 10%. Time, country, sector and sector-time specific effects as well as the constant estimates are not reported. Equations (1), (2), (3), (4), (5) and (6) are differentiated by the indicator of financial development. All specifications use the Pseudo Poisson Maximum of Likelihood model (PPML) estimator.

## Table 4. Robustness: Instrumental variable estimates

| Variable | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Private Credit | -0.146 | | | | |
| Mk. Capitalization | | 0.943*** | | | |
| Liq. Liabilities | | | -0.138 | | |
| Sk. Traded | | | | -1.818*** | |
| Bank | | | | | -0.118 |
| N | 66 994 | 38 120 | 62 229 | 39 144 | 65 304 |
| $R^2$ | 0.795 | 0.841 | 0.790 | 0.750 | 0.791 |
| F (a) | 696.53*** | 129.87*** | 212.52*** | 9.10*** | 461.32*** |
| S (b) | 1.250 | 0.057 | 0.650 | 0.000 | 0.354 |
| Time FE | Y | Y | Y | Y | Y |
| Country-i FE | Y | Y | Y | Y | Y |
| Country-j FE | Y | Y | Y | Y | Y |

(a) The F statistic and p-value on the excluded instruments in the first stage regression (Fischer test). (b) The Sagan statistic and the Chi-square (1) P-value (overidentification test of all instruments). *** indicates the coefficient significance level at 1%, ** at 5% and * at 10%. Equations (1), (2), (3), (4), (5) and (6) are differentiated by the indicator of financial development. Time, country, sector and sector-time specific effects as well as the constant and the control variable estimates are not reported.

## Table 5. Robustness: 3- and 5- years Moving Average (MA)

| Variable | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Priv. Credit *3-years MA* | -0.109** | | | | | | | | | |
| Priv. Credit *5-years MA* | | -0.111* | | | | | | | | |
| Mk. Capit. *3-years MA* | | | 0.100*** | | | | | | | |
| Mk. Capit. *5-years MA* | | | | 0.125** | | | | | | |
| Liq. Liab. *3-years MA* | | | | | 0.221** | | | | | |
| Liq. Liab. *5-years MA* | | | | | | 0.217* | | | | |
| Sk. Traded *3-years MA* | | | | | | | -0.096*** | | | |
| Sk. Traded *5-years MA* | | | | | | | | -0.147*** | | |
| Bank *3-years MA* | | | | | | | | | 0.126 | |
| Bank *5-years MA* | | | | | | | | | | 0.129 |
| N | 91 807 | 82 874 | 49 094 | 44 199 | 85 657 | 77 339 | 50 509 | 45 470 | 89 697 | 80 976 |
| $R^2$ | 0.907 | 0.907 | 0.908 | 0.908 | 0.916 | 0.917 | 0.908 | 0.909 | 0.914 | 0.914 |
| Time FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Country-i FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Country-j FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

*** indicates the coefficient significance level at 1%, ** at 5% and * at 10%. Equations (1) to (10) are differentiated by the indicator of financial development and by the moving average employed .Time, country, sector and sector-time specific effects as well as the constant and the control variable estimates are not reported. All specifications use the Pseudo Poisson Maximum of Likelihood model (PPML) estimator.

## Table 6. Robustness: The (no) linear effect of finance on trade

| Variable | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Priv. Credit x Gr 1 | -0.151** | | | | | |
| Priv. Credit x Gr 2 | -0.155** | | | | | |
| Priv. Credit x Gr 3 | -0.126* | | | | | |
| Priv. Credit x Gr 4 | -0.154** | | | | | |
| Priv. Credit x Gr 5 | -0.151* | | | | | |
| Priv. Credit x Gr 6 | -0.136 | | | | | |
| Market Cap. x Gr 1 | | 0.159*** | | | | |
| Market Cap. x Gr 2 | | 0.084* | | | | |
| Market Cap. x Gr 3 | | 0.084* | | | | |
| Market Cap. x Gr 4 | | 0.131*** | | | | |
| Market Cap. x Gr 5 | | 0.077 | | | | |
| Market Cap. x Gr 6 | | 0.041 | | | | |
| Liq. Liab. x Gr 1 | | | 0.107 | | | |
| Liq. Liab. x Gr 2 | | | 0.031 | | | |
| Liq. Liab. x Gr 3 | | | -0.035 | | | |
| Liq. Liab. x Gr 4 | | | 0.114 | | | |
| Liq. Liab. x Gr 5 | | | 0.136 | | | |
| Liq. Liab. x Gr 6 | | | 0.127 | | | |
| St. Traded. x Gr 1 | | | | -0.022 | | |
| St. Traded. x Gr 2 | | | | -0.051 | | |
| St. Traded. x Gr 3 | | | | -0.057** | | |
| St. Traded. x Gr 4 | | | | -0.008 | | |
| St. Traded. x Gr 5 | | | | -0.067* | | |
| St. Traded. x Gr 6 | | | | -0.063 | | |
| Bank x Gr 1 | | | | | 0.029 | |
| Bank x Gr 2 | | | | | -0.031 | |
| Bank x Gr 3 | | | | | -0.096 | |
| Bank x Gr 4 | | | | | 0.032 | |
| Bank x Gr 5 | | | | | 0.056 | |
| Bank x Gr 6 | | | | | 0.049 | |
| Comp. Index x Gr 1 | | | | | | 0.121 |
| Comp. Index x Gr 2 | | | | | | 0.096 |
| Comp. Index x Gr 3 | | | | | | 0.031 |
| Comp. Index x Gr 4 | | | | | | -0.026 |
| Comp. Index x Gr 5 | | | | | | -0.027 |
| Comp. Index x Gr 6 | | | | | | -0.068 |
| N | 91 807 | 49 094 | 85 657 | 50 509 | 89 697 | 14 280 |
| $R^2$ | 0.906 | 0.909 | 0.917 | 0.908 | 0.914 | 0.906 |

*** indicates the coefficient significance level at 1%, ** at 5% and * at 10%. Time, country, sector and sector-time specific effects as well as the constant and the control variable estimates are not reported. All specifications use the Pseudo Poisson Maximum of Likelihood model (PPML) estimator.

# Appendix B: Data

**Table 7. Selected countries**

| Country | Code | Country | Code | Country | Code |
|---|---|---|---|---|---|
| Algeria | DZA | Germany | DEU | New Zealand | NZL |
| Argentina | ARG | Ghana | GHA | Niger | NER |
| Armenia | ARM | Greece | GRC | Nigeria | NGA |
| Australia | AUS | Guatemala | GTM | Norway | NOR |
| Austria | AUT | Guyana | GUY | Pakistan | PAK |
| Bangladesh | BGD | Honduras | HND | Panama | PAN |
| Belgium | BEL | Hungary | HUN | Papua New Guinea | PNG |
| Benin | BEN | Iceland | ISL | Paraguay | PRY |
| Bolivia | BOL | India | IND | Peru | PER |
| Brazil | BRA | Indonesia | IDN | Philippines | PHL |
| Bulgaria | BGR | Iran | IRN | Poland | POL |
| Burkina Faso | BFA | Ireland | IRL | Portugal | PRT |
| Cambodia | KHM | Israel | ISR | Russia | RUS |
| Cameroon | CMR | Italy | ITA | Senegal | SEN |
| Canada | CAN | Jamaica | JAM | Sierra Leone | SLE |
| Cape Verde | CPV | Japan | JPN | Singapore | SGP |
| Chile | CHL | Jordan | JOR | Slovak Republic | SVK |
| China, P.R. | CHN | Kazakhstan | KAZ | Slovenia | SVN |
| Colombia | COL | Kenya | KEN | South Africa | ZAF |
| Congo, Republic of | COG | Korea | KOR | Spain | ESP |
| Cote d'Ivoire | CIV | Lao People's Dem. Rep. | LAO | Sri Lanka | LKA |
| Croatia | HRV | Latvia | LVA | Sweden | SWE |
| Czech Republic | CZE | Lithuania | LTU | Switzerland | CHE |
| Denmark | DNK | Macedonia, FYR | MKD | Syrian Arab Republic | SYR |
| Dominica | DMA | Madagascar | MDG | Tanzania | TZA |
| Dominican Republic | DOM | Malawi | MWI | Thailand | THA |
| Ecuador | ECU | Malaysia | MYS | Togo | TGO |
| Egypt | EGY | Mali | MLI | Tunisia | TUN |
| El Salvador | SLV | Mexico | MEX | Turkey | TUR |
| Estonia | EST | Mongolia | MNG | Uganda | UGA |
| Finland | FIN | Morocco | MAR | United Kingdom | GBR |
| France | FRA | Mozambique | MOZ | United States | USA |
| Gabon | GAB | Myanmar | MMR | Uruguay | URY |
| Gambia, The | GMB | Nepal | NPL | Venezuela | VEN |
| Georgia | GEO | Netherlands | NLD | | |

## Table 8. Correlations between the financial indicators

| | Private Credit | Mk. Cap. | Liq. Liabilities | Stock Traded | Bank | Comp. Index |
|---|---|---|---|---|---|---|
| **Private Credit** | 1.0000 | | | | | |
| **Mk. Cap.** | 0.6525 | 1.0000 | | | | |
| **Liq. Liabilities** | 0.7223 | 0.5285 | 1.0000 | | | |
| **Stock Traded** | 0.3723 | 0.2639 | 0.2538 | 1.0000 | | |
| **Bank** | 0.7629 | 0.5544 | 0.9907 | 0.2637 | 1.0000 | |
| **Comp. Index** | 0.8821 | 0.6522 | 0.7151 | 0.5304 | 0.6219 | 1.0000 |

## Table 9. Descriptive statistics: financial indicators

| Variable | Observations | Mean | Std. Deviation | Min | Max |
|---|---|---|---|---|---|
| Private Credit | 107 120 | 53.50% | 49.84% | 2.07% | 319.56% |
| Mk. Capitalization | 73 130 | 54.35% | 54.88% | 0.47% | 303.44% |
| Liq. Liabilities | 104 030 | 51.60% | 34.50% | 6.91% | 242.20% |
| Stock Traded | 74 160 | 57.51% | 96.69% | 0.04% | 1678.02% |
| Bank | 106 090 | 45.40% | 33.74% | 2.82% | 230.14% |
| Comp. Index | 21 733 | 3.552 | 1.776 | 0.037 | 7.594 |

# Chapitre 3:

# Financial development & commercial advantage

**Abstract**: The article seeks to clarify the relationship between financial development and the marginal variation in the proportion of exporting firms (extensive margin) and the volume exported by each economic sector (intensive margin). We develop a theoretical model with two countries facing different levels of financial restrictions and input costs, several sectors differentiated by their dependence on external finance and heterogeneous firms producing with a combination of inputs. The model shows that financially developed countries experience a commercial advantage in financially dependent sectors and countries with more competitive cost structures experience an advantage and specialize in low financially dependent sectors. This relationship is true even within the manufacturing sectors. The model also indicates that financial development only affects trade in financially constrained sectors.

**Keywords:** International trade; International specialization; Financial development; Heterogeneous firms.

**Résumé**: L'article analyse la relation entre le développement financier et la variation marginale de la proportion de firmes exportatrices (marge extensive) et le volume des exportations dans chaque secteur économique (marge intensive). Un modèle théorique est développé avec deux pays à différents niveaux de restriction financière et de coûts. Les secteurs d'activité sont différenciés par leur dépendance au financement externe. Les firmes sont hétérogènes et produisent avec une combinaison de facteurs de production. Le modèle montre que le pays à faible restriction sur les marchés de crédit connaît un avantage commercial dans les secteurs à forte dépendance externe. Le pays dont la structure de coût est relativement moins chère connaît un avantage et se spécialise dans les secteurs à faible niveau de dépendance externe. Cette relation est vraie dans tous les secteurs, y compris les secteurs manufacturiers. Le modèle montre également que le développement financier impacte uniquement le commerce des secteurs contraints par l'endettement pour exporter.

**Mots clés:** Commerce international ; Spécialisation internationale ; Développement financier ; Firmes hétérogènes.

**JEL Classification:** F12, G20, 016.

# Introduction

Firms wishing to export face a strong need for capital to finance the costs of this activity (Das et al. 2007). Therefore, the financial constraints faced by firms determine their access to foreign markets (Berman & Héricourt, 2010). The demand for external capital is specific to each industry (Rajan & Zingales, 2008) and to trade costs, which are specific to countries and country-pairs. As financial systems are heterogeneous across countries, their development level defines the patterns of international trade (Greenaway et al. 2007). Previous studies have highlighted the specialization of financially developed countries in the manufacturing sectors (Beck, 2002). According to Manova (2008), financial development increases the proportion of exporting firms and the volume of exports in the manufacturing sectors, and this effect is more intense in sectors that strongly rely on external finance for their capital needs.

The present study continues the discussion and seeks to clarify the impact of financial constraints on the marginal variation in the proportion of exporting firms and on the export volume of each economic sector. For these purposes, it is supposed that the specialization effect of financial development on trade only depends on the sectoral level of dependence on external finance and not on the dichotomy "manufacturing sectors – primary sectors". In this manner, financially developed countries specialize in sectors that strongly rely on external finance whereas low financially developed countries specialize in sectors weakly dependent on external finance, which include manufacturing and primary sectors.

The article proposes a simple theoretical framework based on the heterogeneous firms model, as in Melitz (2003) and Ghironi & Melitz (2007), on the comparative advantage model, as proposed by Dornbusch et al. (1977), and also on Matsuyama

(2005), who analyses how credit market imperfections affect trade patterns. The methodological approach is based on the analysis of the productivity cut-off above which firms export. Firms are divided into economic sectors (with no distinction between manufacturing and primary sectors) and each sector faces a different level of dependence on financial systems[1]. Firms face two trade constraints to access foreign markets and they export only if income from this activity oversets these both constraints. The first constraint is the debt constraint, which is defined by the amount of external finance needed to pay for trade fixed costs. This constraint depends on firms' productivity level, on the sectoral demand for external finance and on the level of credit market restrictions in each country. The second constraint is the profitability constraint and states that firms export only if the profit from this activity is at least equal to zero. This constraint is function of firms productivity level and of trade and production costs.

The model shows that, to export, firms in sectors that strongly rely on external finance require a developed financial system to overcome the debt constraint. Thus, countries with low restrictions in credit markets have a commercial advantage, characterized by a higher proportion of exporting firms and trade flows, in these financially dependent sectors. Furthermore, for a given relative production cost, a decrease in the relative level of financial constraint spreads this commercial advantage of these countries to a higher number of sectors.

The reduction of the sectoral demand for external finance decreases the debt constraint until that the profitability constraint outweighs the former. This relation allows the calculation of the threshold from which sectors face only the second constraint to export. This constraint depends on the production costs, so that countries

[1] i.e., the sectoral degree of dependence on external finance for capital needs, which is defined as capital expenditures minus cash flow from operations divided by capital expenditures.

that present relative low costs possess lower trade constraint in low financially dependent sectors. Thereby, these countries have a commercial advantage in these sectors that only somewhat depend on external finance for their capital expenditures. Moreover, as the profitability constraint does not depend on the countries level of financial constraint, financial development only affects trade in high financially dependent sectors that faces the debt constraint to export.

The remainder of this paper is organized as follows. The next section briefly discusses the theoretical literature and the focus of this analysis. The following section develops the theoretical model. The final section presents the main conclusions.

# I. Financial development and international trade

The development of financial systems positively affects economic activity (King & Levine, 1993). Five functions explain this relationship: financial development (i) contributes to mobilize and then allocate savings to the most efficient projects; (ii) improves available information, (iii) firms' governance and monitoring .(iv) Financial development also facilitates the exchange of goods and services; and (v) eases the trading, diversification and management of risk (Levine, 2005).

The literature that studies the impact of financial development on international trade focuses mainly on the first of these five functions, i.e., on the capital allocation. Kletzer & Bardhan (1987) construct a Heckscher-Ohlin-based model with two countries that differ in their financial constraint level, two sectors – a manufacturing and an agricultural sector, whereas only the former relies on external financing to

produce – and two factors of production. The authors show that the country with low financial restrictions specializes in the manufacturing sector, that is in the sector relying on the financial system to produce. The country with high financial costs specializes in the agricultural sector. Beck (2002) empirically analyzes these results and shows that financial development provides a technological advantage in manufacturing sectors and therefore a comparative advantage in these sectors.

However, different manufacturing sectors face neither the same credit constraints nor the same dependence on external finance for their capital expenditure. These differences are due to the intrinsic characteristics of each sector, such as the technology employed in the production, the techniques or the assets structure (Ju & Wei, 2005). Hence, financial development affects economic activity differently depending on each sector, more precisely depending on its levels of dependence on external finance (Demirgüc-Kunt & Maksimovic, 1998)[2]. Rajan & Zingales (1998) confirm this hypothesis and demonstrate that sectors that strongly rely on external finance experience higher growth rates in financially developed countries.

These results indicate that financial development modifies countries' productive structures. Thus, according to Svaleryd & Vlachos (2005), it should also influences trade patterns and international specialization. These two authors show that countries with developed financial systems possess a better export performance in all manufacturing sectors, and that this trade advantage is stronger in higher financially dependent ones. Manova (2008) confirms this thesis and develops a model with countries at different stages of financial development, heterogeneous firms and sectors differentiated by their dependence on external finance. Firms are credit constrained to export, and the most dependent sectors face stronger constraints. The

[2] For example, some sectors are composed predominantly of small firms, which are more likely to be financially constrained. These firms are often managed by their owners, whose personal wealth often determines their debt capacity (Wynne, 2005). Another example is the asset structure of firms, which differs according to each sector and defines the collateral for obtaining external funding.

study shows that countries with developed financial systems have a higher probability to export and, consequently, a higher proportion of exporting firms. Financial development also increases the volume of exports and the number of trade partners. According to the author, this effect is common to all manufacturing sectors but is more pronounced in sectors with strong reliance on external funds.

According to these studies, financial systems appear to be a major determinant of international trade and financially developed countries have a nearly absolute advantage on trade in manufacturing sectors. Nonetheless, Cezar (2011) notes a heterogeneous effect of finance on trade. The results in this study suggest that financial development increases exports in financially high-dependent sectors but decreases exports in low-dependent sectors, so that the overall effect is not necessarily positive. Matsuyama (2005) meets these results and shows that the manner finance affects trade varies according to the intrinsic characteristics of each economic sector and that financial development does not concede an absolute advantage in manufacturing sectors. More precisely, the author indicates that financial development concedes an advantage in sectors with high agency problems, while low financial endowment countries have an advantage in manufacturing sectors with low agency problems.

In this study, we follow the discussion and develop a theoretical model seeking to better explain the sectoral heterogeneity within the relationship between financial systems and the international trade. Differently from the previous literature, we suppose that the specialization pattern of financial development affects all economic sectors, including the manufacturing. In this manner, the impact of finance on trade is analyzed for each sector, sectors which are differentiated by their level of financial dependence on external finance, in a heterogeneous firms framework. And, in addition to their level of financial constraint, countries are also differentiated by their costs structures.

# II. The theoretical model

The model assumes a simple framework with i countries, $N_i$ heterogeneous firms and z economic sectors, with $z \in [0,1]$. Each firm produces a variety of goods, denoted ω, and consumers maximize the following constant elasticity of substitution (CES) utility function:

$$U = \prod_z C_z, \quad C_z = \left( \int_{\omega \in \Omega_z} q(\omega)^{\frac{(\varepsilon-1)}{\varepsilon}} d\omega \right)^{\varepsilon/(\varepsilon-1)} \qquad (1)$$

Where $C_z$ is the consumption of goods produced by firms in sector z, $\varepsilon > 1$ is the elasticity of substitution between goods, q(ω) is the consumption of variety ω and $\Omega_z$ is the set of varieties in sector z. If Y is the total income, the demand for the variety ω equals:

$$q(\omega) = \left( \frac{p(\omega)^{-\varepsilon}}{P_z^{1-\varepsilon}} \right) Y \qquad (2)$$

Where p(ω) is the price of variety ω and $P_z = \left( \int_{\omega \in \Omega_z} p(\omega)^{1-\varepsilon} d\omega \right)^{\frac{1}{1-\varepsilon}}$ is the ideal price index for sector z. Firms are heterogeneous, and their productivity level is denoted φ[3]. This parameter indicates the quantity of goods produced with one unit of a specific basket of inputs, noted ς. Firms productivity is represented by the cumulative density function (cdf) μ(φ), with support $[\varphi_B, \varphi_H]$, with $\varphi_H > \varphi_B > 0$ and whereas $\varphi_B$ and $\varphi_H$ indicate the productivity of the least and most productive firms, respectively. The cdf is assumed to be the same across countries.

[3] Because firms are heterogeneous, the model indexes the $\omega \in \Omega$ varieties of goods by the productivity level φ.

# II.1. Trade costs and export income

The model focuses on firms' export projects. The basket ς is the same across countries, but its cost is specific to each one of them. The cost of producing a unit of good is $c_i/\varphi$ and it depends on firms' productivity level and on countries' specific costs.

Firms face trade barriers to export, such as geography, customs duties and transportation costs. These barriers are the variable costs of trade, and are modeled as iceberg costs, such that the delivery of 1 unit in the destination requires that $\tau_{ij} > 1$ units are shipped[4]. Exporting also involves fixed costs, such as marketing costs, product adaptation, certifications and regulations. These costs are represented as an exogenous fraction ($f_{ij}$) of input costs ($c_i$).

Variable and fixed costs are specific to each trade partners and are the same for all firms exporting from i to j. The total cost for a firm with productivity φ to export from country i to j equals:

$$c(\varphi) = q\left(\frac{\tau_{ij}c_i}{\varphi}\right) + c_i f_{ij} \qquad (3)$$

Each firm is monopolistic in its own variety of good, and price is a mark-up of the marginal costs. The price charged by a firm from country i in the importing country j is a function of its productivity level and of trade costs specific to the country pair, as follows:

$$p_{ij}(\varphi) = \frac{\varepsilon}{\varepsilon-1}\left(\frac{\tau_{ij}c_i}{\varphi}\right) \quad (4)$$

And the exporting income equals:

[4] Where $(\tau_{ij} - 1)(c_i/\varphi)$ indicates the unit transportation cost, which is modeled as a proportion of the production cost.

$$r_{ij}(\varphi) = q(\varphi)p_{ij}(\varphi) = \left(\frac{\tau_{ij}c_i}{\alpha\varphi P_{zj}}\right)^{1-\varepsilon} Y_j = \left(\frac{p_{ij}(\varphi)}{P_{zj}}\right)^{1-\varepsilon} Y_j \qquad (5)$$

Where the exporting income is an increasing function of firm's productivity level as $\varepsilon > 1$, such as $\delta r_{ij}(\varphi)/\delta\varphi > 0$. The parameter $\alpha = \frac{\varepsilon-1}{\varepsilon}$ measures the firm's margin and equals the inverse of the differentiation degree between varieties.

# II.2. Export constraints

Trade fixed costs are necessary to export and firms must pay these costs before selling abroad. We suppose that firms do not self-finance these costs with their past earnings, and that these costs are paid at each period. Thus, firms incur these costs before receiving the exporting revenue, and the totality of these fixed costs need to be financed. We also suppose that firms rely on the financial system to overcome this constraint.

Credit markets are restricted and cannot entirely fulfill firms' demand for capital. Specifically, credit markets in country i can lend a fraction $\lambda_i$ of firms' future export income. This parameter is between 0 and 1[5], is country-specific and depends on the level of development of the financial system of each country. More precisely, financially developed countries have low credit constraint and the fraction $\lambda$ is relatively close to 1. Symmetrically, high financially constraint countries have a fraction $\lambda$ relatively close to 0.

Firms' productivity level and the demand for their product are known, as well as their future export revenues. With these information, each firm may borrow from the financial system an amount equal to $\lambda_i r_{ij}(\varphi)$ such as, for a given country, the amount

[5] The model is static and firms cannot finance this amount over time, so firms cannot borrow more than their income in a given period.

borrowed depends on firms' future export income, which is a positive function of firms' productivity level[6]. Therefore, the most productive firms experience lower credit constraint because fixed costs are the same for all firms in a same country. Moreover, for a given productivity level, the debt constraint varies across countries and their level of credit restriction. The fraction $\lambda$ increases with financial development, which reduces firms' debt constraint.

To export, the amount borrowed must be at least equal to the fixed costs. If it is the case, firms borrow from the financial system in the first period, pay the fixed costs, export and then refund the amount due after profits are made[7]. However, if the amount that firms are able to borrow is lower than the fixed costs, they do not export. This export constraint is defined below:

**Debt constraint:** *Only firms that obtain from the financial system a loan that is higher than the fixed costs are able to export*. The following equation summarizes this constraint:

$$\lambda_i r_{ij}(\varphi) \geq c_i f_{ij} \qquad (6)$$

The export project must also be profitable; that is, the export income must at least cover production, transportation and fixed costs. Otherwise, to avoid losses, firms do not export. Specifically, firms export if, and only if, the benefit from this activity is equal to or greater than zero. This constraint is defined below:

[6] The model poses an implicit assumption about the absence of information asymmetry because financial systems are able to perfectly observe firms' productivity levels. This is a strong assumption and is a simplification that allows focusing on the probability of exporting, which decreases as firms are less productive and financial systems are less developed.

[7] The cost of using financial systems is not considered in the model. Because this cost is country-specific, it is supposed to be included in the input cost $c_i$.

**Profitability constraint:** *Firms are constrained by the profitability and export only if profits are at least equal to zero.* The equation below summarizes this constraint:

$$\pi_{ij}(\varphi) \geq 0, \quad r_{ij}(\varphi) \geq q\left(\frac{\tau_{ij}c_i}{\varphi}\right) + c_i f_{ij} \qquad (7)$$

# II.3. Firms' program, export cut-offs and trade flows

Equations (6) and (7) determine the productivity cut-off above which firms export. Firms' productivity level must be high so that the amount borrowed from the financial system covers the fixed costs. In addition, revenue from sales must be greater than the total costs. Firms in country i face the following program to export to j:

$$\begin{cases} \text{Max } \pi_{ij}(\varphi) = (1-\alpha)\left(\frac{p_{ij}(\varphi)}{P_{zj}}\right)^{1-\varepsilon} Y_j - c_i f_{ij} \\ \text{u.c. } (1)\ \lambda_i r_{ij}(\varphi) \geq c_i f_{ij} \\ \qquad (2)\ r_{ij}(\varphi) \geq q\left(\frac{\tau_{ij}c_i}{\varphi}\right) + c_i f_{ij}\ . \end{cases} \qquad (8)$$

Both export constraints must be satisfied simultaneously for a firm to export from i to j. The resolution of the program provides the productivity cut-off above which firms make enough income to cover both constraints and export. However, the productivity level is hardly observed and we use the income function as a proxy for this parameter, as $r_{ij}(\varphi)$ is a continuous and increasing function of φ. If φ* is the productivity of the marginal exporter, the income cut-off is defined in the following equation:

$$r_{ij}(\varphi^*) = \text{Max}\left\{\left(\frac{c_i f_{ij}}{\lambda_i}\right), q\left(\frac{\tau_{ij}c_i}{\varphi}\right) + c_i f_{ij}\right\} \qquad (9)$$

Where $r_{ij}(\varphi^*)$ indicates the cut-off below which no firms are able to export and above which firms export. All firms in i that respect $r_{ij}(\varphi) \geq r_{ij}(\varphi^*)$ export to j. A

reduction in this income cut-off allows a set of less productive firms to access external markets, and increases the proportion of exporting firms.

The income of the marginal exporter is function of trade bilateral costs ($f_{ij}$ and $\tau_{ij}$) and of two country-specific parameters ($c_i$ and $\lambda_i$). The input cost $c_i$ affects both exporting constraints, and its increase raises $r_{ij}(\varphi^*)$ and hinders the access to external markets. However, $\lambda_i$ only affects the debt constraint. If this constraint is greater than the profitability constraint, improving access to credit reduces the export cut-off and increases the number of firms that sell abroad. Nonetheless, if the debt constraint is less than the profitability constraint, financial development does not affect the number of exporting firms.

Export flows from i to j are defined by the following equation:

$$X_{ij} = \left(\frac{\tau_{ij} c_i}{\alpha P_j}\right)^{1-\varepsilon} Y_j N_i V_{ij} \qquad (10)$$

Where $V_{ij} = \int_{\varphi^*}^{\varphi_H} \varphi^{\varepsilon-1} d\mu(\varphi)$ if $\varphi^* \leq \varphi_H$ and $V_{ij} = 0$ otherwise. This variable indicates the average productivity of the exporting firms from i to j and the existence of trade between the two countries. Equation (10) indicates that trade flows are a function of the demand (Y), country size (N) and the number of exporting firms (captured by V). Thus, a positive variation in the productivity cut-off reduces trade flows and an opposite variation in this cut-off increases $X_{ij}$.

# II.4. Decomposing the debt constraint

The debt constraint is country specific, but distinct characteristics of each sector influence firms' access to external finance. Rajan & Zingales (1998) show that sectors' demand for external finance is heterogeneous and that technical and

technological characteristics, as well as the asset structure, determine the level of credit constraint among sectors.

Following Matsuyama (2005), we decompose the fraction $\lambda_i$ into two distinct parameters: one specific to countries financial constraint and another specific to the financial constraint specific to each sector. Specifically, $\lambda_i = \gamma_i \Lambda(z)$, where $\gamma_i$ is country-i specific and $\Lambda(z)$ is sector-z specific. The two parameters are strictly positive, and their values are between 0 and 1. The first parameter is function of country-i's financial constraint level and is the same for all sectors in this country. As in section II.2, relatively financially developed countries have a lower level of financial restriction, such as $\gamma_i$ is relatively close to 1 in these countries. The sectoral financial parameter individually identifies each sector and is the same in all countries for a same sector z. $\Lambda(z)$ is continuous and increasing with z, meaning that the sectoral debt constraint decreases as z approaches 1. More precisely, sectors indexed with z=0 and z=1 are, respectively, the most and the least financially constrained sectors.

## II.5. Financial development and the absolute commercial advantage

We assume a simple open economy with two countries, A and B. These countries are similar to that in the previous analysis and have identical parameters, except for their level of financial constraint. Precisely, $\lambda_A = \gamma_A \Lambda(z)$ and $\lambda_B = \gamma_B \Lambda(z)$, where $\gamma_A$ and $\gamma_B$ indicate the financial constraint in countries A and B. We assume that the financial sector is relatively more developed in country A than in country B; that is, $\gamma_B < \gamma_A$. Hence, $\lambda_B < \lambda_A$ for a same sector z. This assumption implies that, for any given sector, the debt constraint is lower in country A. Specifically, the amount loaned by the financial sector in A to a firm with productivity $\varphi$ is always higher than that of a

firm with the same productivity level in country B. With these specifications, equation (9) can be rewritten as follows:

$$r_{ij}(\varphi^*) = \text{Max}\left\{\left(\frac{cf}{\Lambda(z)\gamma_i}\right), q\left(\frac{\tau c}{\varphi}\right) + cf\right\} \qquad (11)$$

Where c, $\tau$ and f are not indexed because they are identical in the two countries, i.e., $c_A = c_B$, $f_{AB} = f_{BA}$ and $\tau_{AB} = \tau_{BA}$. The parameters on the right side of equation (11) are exogenous for a firm with productivity $\varphi$ in sector z. The profitability constraint is equal in both countries for a given $\varphi$, and the debt constraint differs in both countries by $\gamma_i$ and $\Lambda(z)$.

Figure 1 in the appendix presents the income cut-off to export from country i to j for each sector. Sectors for which $\Lambda(z)$ is close to 0 are strongly constrained and firms in these sectors face the debt constraint to export. As z approaches 1, the sectoral financial constraint decreases as $\Lambda(z)$ increases, which reduces the debt constraint, and also $r(\varphi^*)_z$, until that $\Lambda(z^{*A}) = \left(\frac{cf}{\left(\frac{\tau c}{\varphi}\right)+cf}\right)\frac{1}{\gamma_A}$ in country A and that $\Lambda(z^{*B}) = \left(\frac{cf}{\left(\frac{\tau c}{\varphi}\right)+cf}\right)\frac{1}{\gamma_B}$ in country B. From these thresholds ($z^{*A}$ and $z^{*B}$), $\left(q\left(\frac{\tau c}{\varphi}\right) + cf\right) > \left(\frac{cf}{\Lambda(z)\gamma}\right)$, and firms are no longer constrained by the financial system to access the foreign market and export when this activity is profitable.

Figure 1 shows that the debt constraint is lower in country A until sector $z^{*B}$ and $r_{AB}(\varphi^*)_z < r_{BA}(\varphi^*)_z$ in all sectors between $[0, z^{*B}]$. Country A has a commercial advantage over B in all these sectors and this advantage increases when the distance between $\gamma_A$ and $\gamma_B$ growths. This commercial advantage is characterized by a lower export cut-off and by a higher proportion of exporting firms and higher trade flows on these sectors. Furthermore, in the presence of high trade costs, the most constrained

sectors require low levels of country credit constraint (i.e., a high $\gamma$) or, otherwise, $\left(\frac{cf}{\Lambda(z)\gamma}\right) > r_{ij}(\varphi_H)$, and no firm are able to exports in these sectors[8].

The set of sectors between $[z^{*A}, 1]$ is not constrained by debt in country A, and firms in this country export to country B whenever the activity is profitable. Firms in country B face the same profitability constraint from sector $z^{*B}$. From this sector, all firms in both countries face the same constraint, and $r_{AB}(\varphi^*) = r_{BA}(\varphi^*)$ because $\left(q\left(\frac{\tau c}{\varphi}\right) + cf\right)_A = \left(q\left(\frac{\tau c}{\varphi}\right) + cf\right)_B$. Therefore, trade flows and the number of exporting firms in sectors between $[z^{*B}, 1]$ is symmetric, and no country has a specific advantage.

In summary, the relative low level of financial constraint in country A confers to this country an almost absolute commercial advantage over country B. The first country exports from a broader set of sectors, has a large proportion of exporting firms and experiences higher trade flows. This advantage is stronger when sectoral level of financial dependence is high, but it is neutral in sectors that are not constrained by credit to finance the trade costs.

## II.6. Financial development and commercial advantage

This section uses the same analytical strategy employed in the previous section and assumes that countries A and B are identical but differ in their level of financial constraint and in their input costs. It is shown that the financially developed country has an advantage in financially dependent sectors, whereas the country with relative

[8] That is, the debt constraint is higher than the export income of the most productive firm. In this case, no firm is able to pay the fixed costs or to export. To show this graphically, the figure should represent $r(\varphi_H)_z$, and each country would export in sectors for which $r(\varphi_H)_z > r(\varphi^*)_z$.

low input costs possesses an advantage in low financially dependent sectors. The sectoral extent of these advantages depends on the relative costs $\left(\frac{c_B}{c_A}\right)$ and on the relative financial constraint $\left(\frac{\gamma_B}{\gamma_A}\right)$.

Country A is relatively more financially developed, and inputs are supposed to be relatively better paid in this country: $c_A > c_B$. With this new specification, equation (9) is rewritten as follows:

$$r_{ij}(\varphi^*) = \text{Max}\left\{\left(\frac{c_i f}{\Lambda(z)\gamma_i}\right), c_i\left(q\frac{\tau}{\varphi} + f\right)\right\} \qquad (12)$$

As shown in the previous section, the relative higher level of financial development in country A concedes to this country a lower debt constraint than in country B. Nonetheless, because $c_B < c_A$ and $q_B = q_A$ for a given $\varphi$, country B's profitability constraint is lower than in A; that is, $c_B\left(q\frac{\tau}{\varphi} + f\right) < c_A\left(q\frac{\tau}{\varphi} + f\right)$. Figure 2 in the appendix shows the export thresholds in country A and B with the new specification and summarizes the main results.

The export income cut-off in sector z – $r(\varphi^*)_z$ – decreases as the sectoral financial constraint – $\Lambda(z)$ – is relaxed (i.e., when z approaches to 1). Financially constrained sectors face the debt constraint until this constraint is exceeded by the profitability constraint. This change in the constraint faced by firms to export occurs in sectors $z^{*A}$ and $z^{*B}$ and is represented in the figure by the thresholds $\Lambda(z^{*A})$ and $\Lambda(z^{*B})$ in countries A and B, respectively. From these sectors, firms are no longer constrained by debt and they export whenever the income from this activity is greater than the total costs. As the input costs are higher in country A, the profitability constraint is also higher in this country, such that $\Lambda(z^A) = c_A\left(q\frac{\tau}{\varphi} + f\right) > \Lambda(z^B) = c_B\left(q\frac{\tau}{\varphi} + f\right)$. Thus, firms in sectors constrained by profitability in country B face lower export cut-off than their competitors in country A.

Furthermore, as the profitability constraint is independent from the level of financial constraint (both the country level and the firm level), when this constraint exceeds the debt constraint, changes in the sectoral level of financial dependence no longer affect the export cut-off. This explains the reason why all sectors from $z^{*A}$ have the same export cut-off in country A. Nonetheless, export cut-off continues to decrease in country B as long as $\left(\frac{c_B f}{\Lambda(z)\gamma_B}\right) > c_B\left(q\frac{\tau}{\varphi}+f\right)$. Consequently, the country-B's export cut-off outstrips the export cut-off of country A from sector z*, such that $\Lambda(z^*) = \frac{c_B}{c_A}\left(\frac{f}{\left(\frac{\tau}{\varphi}\right)+f}\right)\frac{1}{\gamma_B}$. From this threshold, firms from B experience a lower export cut-off than firms in A, even those that are constraints by debt. z* indicates the sector for which $r_{AB}(\varphi^*) = r_{BA}(\varphi^*)$ or, more precisely, the sector for which $c_A\left(q\frac{\tau}{\varphi}+f\right) = \left(\frac{c_B f}{\Lambda(z)\gamma_B}\right)$. It shares sectors between whose export income cut-off is lower in each country. The productivity cut-off above which firms export is lower in country A in all sectors for which $z < z^*$ and in country B in all sectors for which $z > z^*$. Therefore, country A has a commercial advantage in sectors between $[0, z^*[$, and country B has an advantage in those between $]z^*, 1]$.

As previously demonstrated, the commercial advantage in a given sector indicates that the productivity of the marginal exporting firm is relatively lower, so that a set of less productive firms is able to export from the country that possesses this advantage compared to the other country. Thus, the proportion of exporting firms is higher in the country offering the lowest export cut-off, and the trade flows are higher in this country (see equations 8 and 10).

The relatively low level of financial restriction in country A gives this country an advantage in the most financially dependent sectors, i.e. sectors with high sectoral financial constraints (represented by a parameter $\Lambda$ close to 0). Country B has a commercial advantage in sectors constrained by profitability (sectors from $z^{*B}$) and in some sectors weakly constrained by debt in country A (sector between $z^*$ and $z^{*B}$).

This advantage is due to the lower input cost in this country, which reduces the zero-profit constraint.

The sectoral extent of the commercial advantage of each country is represented in figure 2 by the distance between z* and $z^{*A}$, which depends on the relative input price – $\frac{c_B}{c_A}$ – and on the relative level of financial constraints – $\frac{\gamma_B}{\gamma_A}$. For example, if $\frac{c_B}{c_A} = \frac{\gamma_B}{\gamma_A}$, the difference between input prices would be perfectly compensated by the gap between the financial constraint levels, and the export cut-off would be the same in both countries in all sectors. An increase in the relative level of financial development between the two countries increases the commercial advantage for a larger number of sectors, and the same is true for a reduction in relative costs. Based on these observations, the first theoretical proposition is developed below.

**Proposition 1:** *The most financially developed country has a commercial advantage in financially dependent sectors, i.e., sectors that strongly rely on external finance. The advantage of the country offering the lowest input cost is in sectors that are weakly dependent on external finance. This advantage is even more important when the relative cost* $(\frac{c_B}{c_A})$ *is low and the relative level of financial constraint* $(\frac{\gamma_B}{\gamma_A})$ *is high.*

It is important to note that the analysis does not distinguish between manufacturing or primary sectors. Thus, the proposition 1 indicates that the advantage of the relative low financially develop country is in sectors that weakly rely on the financial systems to produce, and these sectors are of both manufacturing and primary sectors. It is the same for the financially developed country that can specialize in primary sectors that are strongly dependent on the financial systems.

Figure 2 (and equation 12) shows that a decrease in credit restrictions increases the number of exporting firms and the export volume only in sectors constrained by debt. Financial development also reduces the number of sectors constrained by debt and increases those that export when the activity is profitable. A decrease in the relative

input cost causes an inverse reaction and reduces the number of sectors constrained by profitability and increases those constrained by debt. A reduction in the relative input costs also increases the proportion of exporting firms and the volume exported. However, in contrast to $\gamma_i$, because $c_i$ affects both constraints simultaneously, a reduction in the cost parameter raises trade margins in all economic sectors. The following proposition summarizes these main points.

**Proposition 2:** *Financial development affects trade patterns only in sectors previously constrained by debt, increasing the number of exporting firms and export volume in these sectors. A reduction in input costs affects trade in all economic sectors, reducing both trade constraints and increasing exports and the commercial advantage.*

There are two important thresholds in figure 2. First, $\Lambda(z^*)$ indicates the sector from which the cost advantages of country B outweighs the financial advantage of country A (or below which the financial advantage of A outweighs B's relatively lower costs). The second threshold divides the sectors constrained by debt and those constrained by profitability. This threshold is specific to each country and is represented in the figure by $\Lambda(z^{*A})$ and $\Lambda(z^{*B})$ in country A and B, respectively.

Firms in low $\Lambda(z)$ index sectors (high constraint) must have access to a developed financial system to compensate their difficulty to pay for trade cost and to export. These sectors are characterized by a strong dependence on external finance, that is, by difficulties in obtaining external funding. Because country A has a relatively more developed financial system, it possesses a commercial advantage and exports from a higher number of firms and export greater volume than B in these sectors. The commercial gains of B are in sectors with high $\Lambda(z)$ index, which have a low level of dependence on external financing. Because their debt constraint is low, these sectors usually face the profitability constraints for exporting. Therefore, as B provides a relatively lower cost structure, this constraint is lower in this country. This feature

confers a commercial advantage in these sectors such that the cost advantage compensates for the financial disadvantages of country B.

In summary, the results indicate that financially dependent sectors face lower export cut-off in countries with financial systems that allocate resource efficiently and that these sectors possess a greater number of exporting firms and export higher volumes. This advantage spreads to more sectors when the difference between the level of financial imperfections and costs is high. Moreover, the reduction of the sectoral financial constraint reduces the debt constraint, which hampers firms' access to international markets until the profitability constraint outweighs the debt constraint. This mechanism provides a commercial advantage to countries offering relatively low production costs. These countries have an advantage in high-indexed sectors, specifically, in sectors that self-finance a high proportion of their capital expenditures.

# Conclusions

The paper develops a theoretical model of international trade with two countries facing different levels of financial constraint and input costs, several sectors differentiated by their level of dependence on external finance and with heterogeneous firms producing using different combinations of inputs. The relatively financially developed country is also relatively more expensive, i.e., input costs are higher in this country. Firms experience two constraints to export. First, they are constrained by debt to pay for the trade fixed costs, and they use financial systems to overcome this restriction. Second, firms are constrained by profitability and export only if income from this activity overcomes the trade costs. The first constraint is lower in countries with developed financial systems and decreases as sectoral

financial dependence decreases. The second constraint is function of input and trade costs and is lower in countries with low input costs.

Financially dependent sectors are constrained by the first trade constraint, whereas less financially dependent sectors export when the activity is profitable. Therefore, financially developed countries have a commercial advantage, reflected by a higher proportion of exporting firms and export volume, in financially developed sectors. This advantage is even more important than the relative costs ($\frac{c_j}{c_i}$) are low and the relative financial constraints ($\frac{\gamma_j}{\gamma_i}$) are high. Countries with restricted financial systems that offer competitive input costs have an advantage and specialize in low financially dependent sectors. The model also shows that financial development affects trade only in sectors previously constrained by debt, increasing the number of exporting firms and export volume in these sectors. The decrease in input costs causes the same effect, but it affects trade in all economic sectors.

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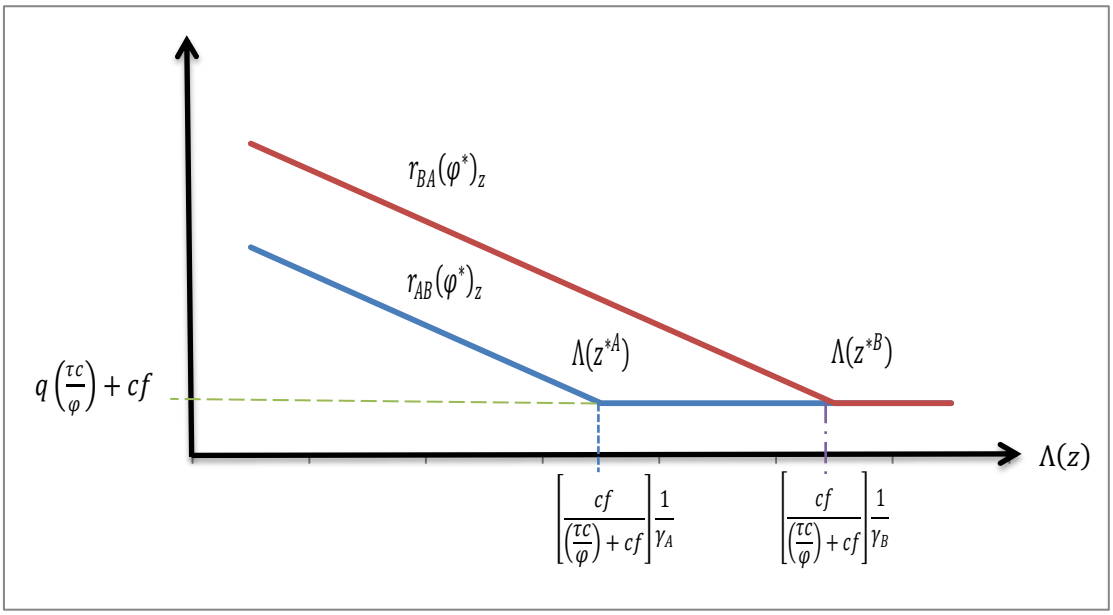
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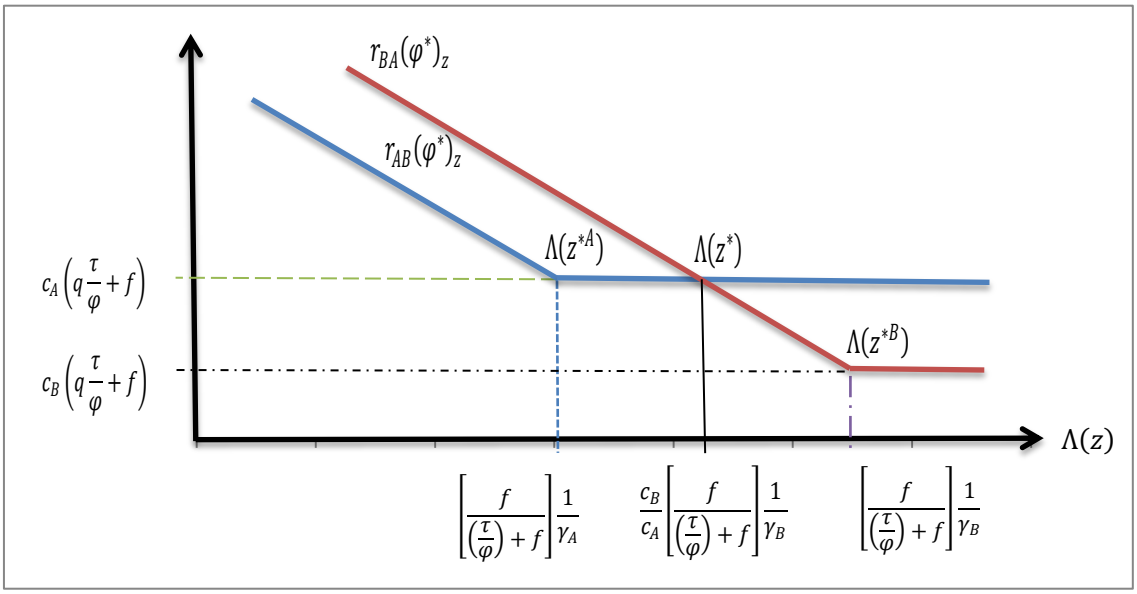
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# Appendix

## Figure 1: Financial development and absolute advantage




## Figure 2: Financial development and commercial advantage



# Chapitre 4:

# The heterogeneous effect of finance on international trade

**Abstract**: Is the impact of financial development on international trade homogeneous across manufacturing sectors? And is it dependent on the level of sectoral requirement on external finance for capital need? To examine these questions this article uses a panel trade database on twenty-five manufacturing sectors in eighty countries between 2000 and 2009. The analysis demonstrates that the effect of financial development on trade is indeed heterogeneous by estimating a coefficient for each sector and showing that the signs and significance levels vary across them. The article also demonstrates that sectors with strong reliance on external finance export higher volume from countries with developed financial system and that financial development reduces trade in industries with low financial dependence level.

**Keywords:** International trade; International specialization; Financial development.

**Résumé** : L'impact du développement financier sur le commerce international est-il homogène à travers des secteurs manufacturiers? Et est-il dépendant du niveau sectoriel de dépendance du financement externe pour les dépenses en capital? Pour examiner ces questions, cet article utilise une base de données en panel sur le commerce de vingt-cinq secteurs manufacturiers dans quatre-vingt pays entre 2000 et 2009. L'analyse démontre que l'effet du développement financier sur le commerce est en effet hétérogène en estimant un coefficient pour chaque secteur et en démontrant que les signes et les niveaux de signification varient selon les secteurs économiques. L'article montre également que les secteurs qui dépendent fortement du financement externe exportent davantage à partir des pays avec un système financier développé et que le développement financier réduit les échanges des secteurs avec un faible niveau de dépendance financière.

**Mots clés:** Commerce international; Spécialisation international; Développement financier.

**Classification JEL:** F12, G20, 016.

# Introduction

Financial systems affect economic activity. Levine et al. (2000) show that efficient financial intermediation positively affects countries' economic growth. However, the effect of financial intermediation on economic activity is not symmetric across sectors and depends on the sectoral financial intensity, that is, on the degree of dependence on external finance for capital expenditures. Rajan & Zingales (1998) and Demirgüc-Kunt & Maksimovic (1998) show that growth induced by financial development is higher among financially intensive sectors compared to low financially intensive sectors. Based on the analysis of these results using a Heckscher-Ohlin-Samuelson model framework, Kletzer & Bardhan (1987) and Beck (2002) show that financial systems also affect patterns of international specialization. According to Svaleryd & Vlachos (2005) and Manova (2008), financial development promotes overall manufacturing trade, and its impact is greater in financially intensive sectors.

These results indicate that financial systems are a major determinant of international trade and increases exports in all manufacturing sectors. However, according to the Ricardian logic of trade, the comparative advantage of countries with developed financial systems in financially intensive manufacturing sectors should engender specialization of relatively less financially developed countries in low financially intensive manufacturing sectors (Dornbusch et al., 1977). In this sense, financial development should increase trade among the first group of sectors and reduce it among the second group (Trefler, 1993).

The present article continues the study of the relationship between finance and manufacturing trade and empirically tests the hypothesis that the effect of financial development on trade of these sectors is heterogeneous, differing according to their level of financial intensity. In particular, the hypothesis states that the relationship is not

necessarily positive across all sectors, being positive in financially intensive sectors and negative in less financially intensive sectors.

The empirical analysis is based on a panel dataset of trade in twenty-five manufacturing sectors in eighty countries between 2000 and 2009. The analysis is divided into three stages. Firstly, methodology used in previous literature is employed (e.g., Beck, 2003 or Hur et al. 2006) to calculate the overall effect of finance on manufacturing trade. Secondly, sectors are divided into groups, and a single coefficient for each group is calculated to assess the contribution of each of them to the average effect of finance on manufacturing trade. In the final stage, the impact of finance on the exports of each of the twenty-five selected sectors is estimated, which gives a widely analysis of the impact and tests for the robustness of the results. These last two stages also identify the role of sectoral financial intensity in the relationship by sharing each group or sector by their level of dependence on external finance.

The empirical results are consistent with the hypotheses tested. The estimate of the average impact of finance on trade indicates a positive overall relationship, as shown in previous literature (e.g., Becker et al., 2013). Then, estimates of the individual effects in each sector indicate a heterogeneous relationship, which is positive in twelve manufacturing sectors, negative in eleven, and statistically indistinguishable from zero in others two. Furthermore, among the twelve sectors with a financial-intensity index below the median value, nine have a negative coefficient. And among the twelve sectors with a financial intensity index above the median value, eight have a positive coefficient. These indicate that countries with developed financial systems have commercial advantages in financially intensive manufactured sectors, while countries with low financial endowment have advantages in less financially intensive manufactured sectors.

The paper is organized as follows. Section I briefly discusses the prior literature and presents the theoretical proposition considered. The methodology and data are described

in sections II and III. Section IV presents the empirical results, while section V tests the robustness of those results. A final section concludes the paper.

# I. Finance, international specialization and trade

Financial development is defined as the efficiency of capital intermediation between surplus and deficit agents (Levine, 2005). Financial development plays major role in economic activity since financial intermediary identifies and finances investment projects, and produces information about them. Once capital is allocated, financial system monitors investments and exerts corporate governance over public and private firms. Financial development facilitates trade, diversification and risk management and reduces transaction costs, easing the exchange of goods and services. In general, financial development has a positive impact on the economy and growth (Fisman & Love, 2007).

Previous literature has shown that financial development also affects international trade patterns. Kletzer & Bardhan (1987) show that financial differences between countries lead to comparative advantages according to the sectoral demand for capital. The theoretical conclusions of Beck (2002) indicate that financial development leads to technological advantage and thus to a comparative advantage in manufacturing sectors. Other models – such as Wynne (2005) and Acemoglu et al. (2007) – present similar results.

Subsequent empirical studies have tested the effects of improvements in financial intermediation on manufacturing exports. Based on Rajan & Zingales (1998), who construct an index of sectoral dependence on financial intermediation for capital

expenditures, these studies test the hypothesis that financially developed countries specialize in manufacturing sectors and that this specialization is stronger in industries with high demand for external finance. Svaleryd & Vlachos (2005) confirm this view. Using data from thirty-two manufacturing sectors in twenty OECD countries, they empirically examine the impact of the interaction between financial development and the index of sectoral financial dependence on the international trade. Their results show a positive and statistically significant relationship. In particular, they show that countries with a developed financial system export more in all manufacturing sectors and that this advantage is stronger in industries strongly dependent on external finance. According to the authors, financial differences between countries have a higher effect on international trade patterns than differences in human capital. Using similar methodologies, Beck (2003), Hur et al. (2006) and Becker et al. (2013) confirm the positive relationship between financial development and manufacturing exports.

Matsuyama (2005) shows, however, that the manner finance affects trade varies according to the intrinsic characteristics of each economic sector even in manufacturing sectors. In particular, his model indicates that financial development provides a commercial advantage to sectors that are dependent on external finance, whereas countries with low financial endowment specialize in sectors with low agency problems, i.e., in sectors only somewhat dependent on the financial sector. The model presented by Cezar (2012b) suggests similar conclusions. This paper demonstrates that the effect of finance on trade is limited to financially intensive sectors and that the extent of commercial advantage depends on relative degrees of financial constraint and production costs. Furthermore, the model suggests that financially developed countries have an advantage in sectors that rely on external finance and that the advantages of relatively undeveloped countries lie in sectors with low levels of financial dependence.

These two theoretical models indicate that the effect of finance on trade varies across the manufacturing sectors. In a Heckscher-Ohlin-Samuelson interpretation of international trade, specialization in financially intensive sectors, induced by financial development, should lead to disengagement in less financially intensive sectors

(Dornbusch et al. 1977). Therefore, a large financial endowment fosters advantage in some sectors, but not in all manufacturing sectors.

Based on these analyses, the paper suggests the following proposition:

**Theoretical proposition:** *The effect of financial development on manufacturing trade is heterogeneous and differs according to the sectoral level of dependence on external finance for capital expenditure. Countries with a developed financial system have an advantage in financially intensive manufacturing sectors, while countries with relatively low financial endowment have an advantage in less financially intensive manufacturing sectors. Therefore, financial development increases exports in the first group of sectors and reduces exports in the second group*[1].

# II. Methodology

The objective is to empirically test the theoretical proposition presented in the previous section, i.e., that the effects of financial development on manufacturing exports are heterogeneous across sectors and whether an improvement in financial conditions benefits exports in financially intensive sectors and reduces exports in less financially intensive sectors.

Previous literature (Beck, 2003; Svaleryd & Vlachos, 2005; Hur, et al., 2006 and Manova, 2008) has examined this relationship using the coefficient of interaction

[1] This proposition does not contradict results reported in previous literature. The proposal indicates that within the overall positive relationship between financial development and manufacturing trade (shown in the literature), there are positive, negative and non-significant relationships. The manner of the effect in each industry depends on the sectoral degree of dependence on the external finance.

between a financial development indicator and an index of financial intensity. The results of these analyses show the average impact of financial development on trade over all manufacturing sectors. However, in calculating a single coefficient, this methodology neglects possible heterogeneity within the overall relationship. Therefore, to capture this possible heterogeneity, the empirical methodology employed in this paper is divided into three stages. First, we follow the methodology of the previous literature and calculate the average effect of finance on manufacturing trade, differentiating sectors by their level of dependence on external finance. In the second stage, sectors are divided into groups, with one single coefficient calculated for each group. Finally, in the third stage, we estimate the impact of finance on exports for each of the twenty-five sectors in the sample. These latter two stages allow for a more detailed analysis of the relationship and for identification of the impact of financial development on trade in each group and sector.

The first model tested is taken from the existing literature. The effect of financial development on exports is estimated using an interaction term between the financial indicator and the index of financial intensity. The model is as follows:

$$\ln\left(\frac{X_{ist}}{GDP_{it}}\right) = \alpha(\ln FinDev_{it} * FinDep_s) + \sum_i \gamma_i Country_i + \sum_s \theta_s Sect_s \\ \sum_{st} \varphi_{st} Sect_{st} + \sum_t \delta_t Year_t + \beta_i K_{it} + \mathfrak{H} + u_{ist} \quad (1)$$

The dependent variable is the log of the share of exports in GDP, where $X_{ist}$ is exports of country i in sector s in year t and $GDP_{it}$ is the GDP of country i in year t. $FinDev_{it}$ measures the level of financial development in country i in year t, while $FinDep_s$ indicates the degree of financial dependence[2] of sector s. The parameter $\alpha$ indicates the overall effect of financial development on manufacturing trade, given the level of financial intensity.

[2] For more details on this variable, see next section.

$\text{Country}_i$ is a dummy variable that controls for country fixed effects and $\text{Year}_t$ controls for time fixed effects. $\text{Sect}_s$ and $\text{Sect}_{st}$ control for sectoral constant and time-variant fixed effects, respectively. $K_{it}$ is a matrix of country-time-specific explanatory variables, which includes total exports to the rest of the world, population, GDP per capita and a dummy variable that equals 1 if the country is part of the World Trade Organization in year t and zero otherwise. $\mathfrak{H}$ is a constant and $u_{ist} \sim N(0, \sigma_u^2)$ is a trade i.i.d. disturbance.

The second empirical model divides sectors into different groups. It is presented in equation (2), as follows:

$$\ln\left(\frac{X_{ist}}{GDP_{it}}\right) = \sum_s \alpha_g(\ln FinDev_{it} * Group_g) + \sum_i \gamma_i Country_i + \sum_s \theta_s Sect_s \sum_{st} \varphi_{st} Sect_{st} + \sum_t \delta_t Year_t + \beta_i K_{it} + \mathfrak{H} + u_{ist} \quad (2)$$

Where $\text{Group}_g$ is a dummy variable that divides the twenty-five sectors into five distinct groups, each composed of five sectors. Sectors are grouped in ascending order of their level of financial intensity, such that groups 1 and 5 are composed of the five sectors least and most dependent on external finance, respectively. $\alpha_g$ is the coefficient that measures the impact of financial development on trade in each of the five groups.

Finally, the third model individually calculates the impact of financial development on trade in each of the twenty-five sectors. The variable of interest is the interaction term between the financial indicator and a sectoral dummy variable. The model is represented in the equation below:

$$\ln\left(\frac{X_{ist}}{GDP_{it}}\right) = \sum_s \alpha_s(\ln FinDev_{it} * Sect_s) + \sum_i \gamma_i Country_i + \sum_s \theta_s Sect_s \sum_{st} \varphi_{st} Sect_{st} + \sum_t \delta_t Year_t + \beta_i K_{it} + \mathfrak{H} + u_{ist} \quad (3)$$

Where $\text{Sect}_s$ are twenty-five binary variables that identify each sector. $\alpha_s$ is the coefficient of the product of the financial indicator and the sectoral dummy and

measures the effect of financial development on trade in each selected sector. By identifying sectors and groups by their level of financial intensity, the estimated coefficients in models (2) and (3) also assess the role of financial intensity in the relationship.

# III. Data

Trade data are in current US$ and cover sectoral exports from eighty countries over the ten years from 2000 to 2009. These data are available in the CHELEM database from the Center for Studies, Prospective and International Information (CEPII). GDP data are also in current US$ and come from the World Economic Outlook database of the International Monetary Fond (IMF). The list of countries used in the sample is available in table 7 of appendix B.

Twenty-five manufacturing industries are selected according to their level of financial intensity, i.e., their degree of dependence on external financing for capital needs[3]. Intrinsic features of each sector as, for example, technological and organizational characteristics, explain individual sectors' specific demands for capital and their capacities to self-finance these demands. Therefore, each sector has its own level of

[3] Thus, the sample consists of twenty-five different industries. The term "Industry" is therefore employed as a synonym for sector.

financial intensity[4]. Specifically, this level measures the amount of investment that cannot be financed by firms' internal cash flows[5].

To measure the level of sectoral financial dependence, we use data provided by Rajan & Zingales (1998)[6]. The details of each sector and of the financial intensity index are presented in table 8[7]. The data indicate that "Tobacco" and "Pharmaceutical", respectively, are the least and most financially intensive industries among the twenty-five industries in the sample. The former has a negative index, with cash flows exceeding capital expenditures, while the latter has an index that exceeds unity, with capital expenditures exceeding cash flows.

The indicators used to measure the level of financial development should be sensitive to the efficiency of financial systems in capital allocation, risk management, corporate governance and information availability. Such measure, however, is available neither for a large number of countries nor for a large period. Therefore, we use five different

[4] These sectoral differences are expected to persist across countries and time. Such assumptions about factors of production – such as physical and human capital – are standard in the empirical literature on international trade (Trefler, 1993).

[5] More precisely, financial intensity – that is, the capacity to self-finance capital needs – is defined as capital expenditures minus cash flow from operations divided by capital expenditures.

[6] According to the authors, the credit supply is highly elastic when the financial system is efficient, and sectoral demand for external finance reflects the actual demand for this financing mode. Assuming that the U.S. financial system fulfills the criteria of efficiency, the authors construct the index, using data on the financing mode of American companies. To smooth fluctuations, data over a period of ten years are used and, to avoid excessively weighting large firms, median rather than average values are used.

[7] Sectors sampled in the article are in the 3-digit category of the International Standard Industrial Code. Trade data are in revision 3 of this classification. For consistency with data on external dependence, which are in Revision 2, the article uses the concordance tables available from the Statistics Division of the United Nations (http://unstats.un.org).

indicators of the effectiveness of financial systems to measure the level of financial development. The indicators are as follows: (i) The financial composite index, proposed by Cezar (2012a) and constructed from the principal component analysis (PCA)[8] of seven different financial and institutional indicators. This indicator is the most comprehensive one employed because it includes, in addition to traditional measures, institutional and political aspects of financial development. (ii) Private credit and (iii) Liquid liabilities. The former is a measure of credits from private institutions to the private sector divided by GDP and measures credit constraints. This indicator is made available by the database Global Development Finance from the World Bank. The latter is equal to the ratio of liquid liabilities to GDP and measures the extent of financial intermediation. Two indicators of the efficiency of financial markets are also employed: (iv) Market capitalization, which indicates the size of financial markets, and (v) Stocks traded, which measures market liquidity and corresponds to the ratio of number of shares traded to GDP. The three latter indicators are available from the World Bank in the September 2012 version of the Database on Financial Development and Structure.

Tables 9 and 10 in the appendix present the main descriptive statistics of these five indicators. The composite index varies between 0.003 in Nigeria (2005) and 8,998 in the United Kingdom (2009). The indicator of private credit registers its maximum value in Iceland (319% in 2006) and its lowest in Kazakhstan (3.8% in 2001). Liquid liabilities range from 10.7% in Kazakhstan to 316% in Hong Kong. Market capitalization ranges from 0.2% in Macedonia (2000) to 617% in Hong Kong (2008). The total value of stocks traded corresponds to 673% of Swiss GDP (in 2009) and is close to 0% in several countries (Uruguay, Bolivia, Paraguay, Slovakia). The composite index is available for the six years between 2004 and 2009, and data on the other four indicators cover the entire period of the study.

[8] The method allows for the description of a set of multivariate observations from a linear combination of these data, maximizing the explained variance of the new variable. In particular, the original variables $x_{1i}, \ldots, x_{ni}$ are transformed into a new variable, y, such as the variance of y in the total sample is maximal and the information loss is minimal.

Data on total exports come from the Direction of Trade Statistics of the IMF. Data on population come from the Penn World Table (http://pwt.econ.upenn.edu). Data on GDP per capita are in current US$ and come from the World Economic Outlook database. The dummy variable of membership in the World Trade Organization takes a value of 1 if the country is a signatory of the organization in year t and 0 otherwise. This dummy variable was developed from information available on the WTO website (http://wto.org).

# IV. Empirical results

The results of the empirical estimations of equations (1), (2) and (3) are presented in tables 1, 2 and 3, respectively, of appendix A. These tables report the estimates of the relationship between financial development and sectoral exports of twenty-five manufacturing industries identified by their level of financial intensity, i.e., the degree of use of financial systems for capital expenditures. Tables are presented by level of disaggregation. Table 1 reports the estimates of the average relationship and thus the overall effect. Table 2 presents the results by groups of industries and table 3 by individual industries, indicating the effects of financial development on each of them.

The dependent variable is the exports of each of the twenty-five industries covered as the share of GDP of each of the eighty countries in the sample. Five measures of the level of financial development are employed, and for each financial indicator, the tables present the results using the Fixed Effect model (odd columns) and the Poisson Pseudo Maximum Likelihood model[9] (even columns). The dependent variable in the latter model is in value, so that estimates consider observations of zero trade flows. A set of

[9] See Santos & Tenreyro (2006).

time-variant-country-specific control variables as well as time-, country-, sector- and sector-time- fixed-effects control variables are added in the estimates.

The first table presents the overall effect of finance on manufacturing exports. The results show the relationship between the dependent variable and the interaction between the financial indicator and the index of financial dependence. All estimated coefficients on the ten specifications are statistically significant and positive. This indicates that countries with developed financial sectors export more in all covered manufacturing industries and that this effect is stronger in industries highly dependent on external finance. The empirical model reproduces the methodology employed in previous studies, and the results are consistent with their findings (e.g., Svaleryd & Vlachos, 2006 or Manova, 2008).

To interpret these results, the following experiment may be useful[10]. Consider two industries, one in the seventy-fifth percentile of financial intensity and the other in the twenty-fifth percentile. Specifically, these would be the "Transport equipment" and "Petroleum refineries" industries in our sample, respectively. Now suppose that these two industries are located in a hypothetical country, where each country characteristics are near to the mean values. The only exception is the level of financial development, which is equivalent to the country in the twenty-fifth percentile (in the sample, this country is Russia). Next, assume that these two industries move to a country with almost all the same features but with a different level of financial development, which is equivalent to the level of the country in the seventy-fifth percentile (i.e. close to Finland's financial system). The first column in table 1 shows that the coefficient on the interaction term between the composite financial indicator and the financial intensity

[10] This experience is proposed by Rajan & Zingales (1998) and means performing the following calculation:

$$\text{Coef} * \left(\text{Fin. Indicator}_{0.75} * (\text{Fin. Dep.}_{0.75} - \text{Fin. Dep.}_{0.25}) - \text{Fin. Indicator}_{0.25} * (\text{Fin. Dep.}_{0.75} - \text{Fin. Dep.}_{0.25})\right).$$

index is 0.769. Therefore, the increase in the level of financial development, as measured by this indicator, leads to an increase in exports that is 19% larger in the first sector than in the second sector. If the effects are analyzed individually, the estimates show that the transition from the least to the most financially developed country increases exports in the "Transport equipment" industry by 22%, compared to the average value, and exports in the "Petroleum refineries" industry by 3%.

The example demonstrates that improving financial endowments increases exports in all manufacturing sectors and that this effect is more pronounced in financially intensive sectors. However, these results pertain to the average effect of financial development on manufacturing exports, and the effect may be, within this positive relationship, negative or non-significant for some industries. To test whether the impact of financial development on manufacturing trade is heterogeneous – and thus whether the signs and significance levels of the coefficients in table 1 differ across sectors – we now estimate equations (2) and (3).

Table 2 reports the estimates for equation (2). The variable of interest is the interaction between the financial indicator and a binary variable that divides the twenty-five industries into five groups, each composed of five industries. The industries are grouped in ascending order of their level of dependence on external finance, so that groups 1 and 5 include the least and the most dependent industries in the sample, respectively. The coefficients indicate the effect of financial development on trade in each group and show whether this effect is uniform across industries. In addition, they indicate the role of financial intensity in the relationship.

Given the coefficient values presented in table 2, the hypothesis that the effect of finance on trade is homogeneous is rejected. The signs and significance levels of the coefficients differ across groups and financial indicators, confirming the proposition that the relationship is heterogeneous. Table 2 shows that financial development does not affect trade in certain groups for which the relationship is not significant. For those groups whose coefficients are significant, the results indicate both negative and positive

relationships. Trade in some industries benefits from improvements in financial conditions, with exports in these industries higher in countries with developed financial systems. Other industries experience the opposite effect, i.e., a decline in trade performance with financial development.

For example, analysis of the results for specifications (3) and (4), in table 2, shows that each group responds differently to changes in the level of financial constraints. Exports of the first group – composed of weakly dependent sectors – decline with an increase in private credit. Group 2, with a sectoral financial dependence level between 0.03 and 0.14, also shows a negative relationship between exports and level of financial development. Contrary to these results, exports of group 3, with an intermediate degree of financial dependence (between 0.18 and 0.24), benefits from improvements in private credit. The relationship is not statistically significant for group 4. Finally, exports of group 5, composed of the most financially intensive industries (with an index above 0.45), increase with financial development. These results are reproduced with the other four measures of financial development, with only marginal changes in the values and the degree of significance of the coefficients.

The results in table 2 also indicate that the impact of financial development on manufacturing trade depends on the degree of financial intensity. On the one hand, financially intensive groups experience an improvement in their export performance when financial systems improve. Group 5 has a positive and significant coefficient in the ten specifications tested, while group 3 has a positive and significant coefficient in nine specifications. On the other hand, the less financially intensive groups export more from countries with low financial endowment, and financial development reduces their exports. This finding is illustrated by the coefficients of groups 1 and 2, which are negative in the ten specifications tested.

Table 3 presents the estimates of equation (3) and tests the relationship between sectoral exports and the interactions between each of five financial indicators and a sectoral dummy that identifies each industry in the sample. The results indicate the impact of

financial development on exports in each of the twenty-five industries. In addition, they provide a test of the robustness of the results presented in table 2.

The signs and significance levels of the coefficients for each industry confirm the results presented in table 2 and validate the hypothesis that the effect of finance on manufacturing trade is heterogeneous. As in the previous table, the coefficients for each of the twenty-five sectors differ, being positive, negative or statistically indistinguishable from zero. Thus, the effects of financial development differ across industries within the positive average effect observed in table 1.

Financial development reduces exports in twelve of the twenty-five industries and increases exports in eleven others. Moreover, within the twelve industries with indices of financial dependence below the median value (0.219), nine have a negative coefficient. Furthermore, within the twelve industries with financial dependence indices above the median value, eight have a positive coefficient. These results are in line with those presented in table 2 and confirm that countries with a developed financial system have commercial advantages in the most financially intensive manufacturing sectors, which rely on external finance for their capital expenditures, and experience higher growth in financially developed countries (Beck et al. 2008). Therefore, exports of these sectors are also favored by financial development. The commercial advantages of countries with low financial endowment are in less financially intensive manufacturing sectors.

The results in table 3 show that the impact of finance on exports of the four less financially dependent industries – "Tobacco", "Pottery", "Leather products" and "Footwear" – is negative. Of the six industries that follow, exports of four — "Wearing apparel", "Petroleum refineries", "Other non-metallic mineral products" and "Food products," with low financial intensity levels ranging from 0.029 and 0.137 — are also negatively affected by improvements in financial conditions. "Rubber products", "Wood products", "Misc. Petroleum and coal product" and "Textiles," with intermediate-high levels of financial intensity, also have significantly negative coefficients.

The impact of financial development on trade in the "Beverage" industry is not significantly different from zero in six of ten specifications, while the coefficients are statistically significant at the 10% level in two other specifications. Half of the coefficients for the "Non-ferrous metals" industry are non-significant, while the other half show both negative and positive values. These results do not allow for identification of a specific relationship. The "Transport equipment" industry shows an overall positive relationship, although four of the ten tested specifications are non-significant.

The coefficients of the five most financially intensive industries — "Pharmaceutical", "Plastic products", "Professional & scientific equipment", "Machinery electric" and "Machinery, except electrical" — are all positive and significant, indicating that exports in these industries grow with higher levels of financial development. "Paper and products", "Printing and publishing" and "Other chemicals" industries, which have financial intensity levels close to the average, also have positive coefficients and benefit from improvements in financial conditions. The coefficients for "Fabricated metal products" and "Basic exclude fertilizes" are also positive.

The experiment performed in table 1 may be useful in interpreting these results on table 3 and the differences between them and the estimates of equation (1). Let us reconsider the "Transport equipment" and "Petroleum refinery" industries, which have, respectively, positive and negative coefficients, as seen in table 3. Consider now a hypothetical country that improves its financial system from a level equivalent to that of Russia to one equivalent to that of Finland. The first column of table 3 shows that the coefficient of the relationship between financial development and exports in the first industry is 0.439, and in the second industry it is -0.999. Therefore, the improvement in the level of financial development leads to an increase in exports of "Transport equipment" by 13% compared to the average value, while exports of "Petroleum refineries" fall by -4% (the relative increase in exports is of 17%).

# V. Robustness

A set of tests was performed to ensure the robustness of the results presented in the previous section. First, we examine whether the results are influenced by outliers. Two strategies are employed: (i) residuals are analyzed, and all observations with residuals larger than two and a half standard deviations are removed from the sample; and (ii) the five countries with the highest and lowest trading volumes are removed from the sample[11]. Only the PPML model is estimated in these specifications. The results of these tests, presented in table 4 of appendix A, are consistent with those presented in the previous section. They show heterogeneous effects of financial development on trade, which are positive for financially intensive sectors and negative for less financially intensive sectors.

Next, the independence of the relationship between financial development and trade is tested. In particular, a growing literature shows that the institutional and political environment promote international trade (see Levchenko, 2007). Thus, the correlation between these country-specific features and the level of financial development may explain the results presented in the previous section (see La Porta et al., 1998). Omitted variable bias as such is, in part, already controlled for by the control variables incorporated into the estimates. These control for all time variant and invariant sectoral effects, countries' intrinsic characteristics and time effects. However, as an additional control, the interactions of two indicators of institutional quality with sectoral dummies are introduced into the estimates, and the results are reported in Table 5. The institutional variables are "Rule of Law" and "Quality Regulation", made available by the World Bank. The effect of financial development on trade in some sectors becomes

[11] The five lowest exporting countries are Albania, Kyrgyzstan, Bosnia and Herzegovina, Macedonia and Bolivia. The five highest exporting countries are Germany, China, the United States, Japan and France.

statistically irrelevant under these new specifications; however, the main conclusions remain unchanged.

Finally, we examine the causality between finance and trade. While the empirical model assumes that the level of financial development is exogenous, an alternative explanation for the results is that financial systems develop in response to demand of financially intensive sectors. For example, some country-specific factors (such as natural resources) are likely to favor the development of industries that are, coincidentally, financially intensive (such as "Wood products" or "Mining"). Such industries mainly develop in countries abundant in these factors; therefore, the financial systems of these countries could develop to meet the financial needs of these industries.

The results presented in the previous section already minimize the possibility of reverse causality. First, the influence of natural resources is reduced because the sample consists only of manufacturing industries. In addition, the fixed effects model and the four control dummies also reduce the possibility of reverse causality. Finally, one of the financial indicators employed – the composite index – is constructed from institutional and political variables that are unlikely to be correlated with omitted factors that increase exports of financially intensive sectors. However, to test the argument of reverse causality more directly, we conduct a test, used by Rajan and Zingales (1998) and Beck (2003), that splits the sample into two sub-samples: one with industries whose export shares are above the median value for the country, the other with industries whose exports shares are below the median value. Indeed, as industries are located in countries with the resources and talents necessary for their development, this restriction reduces the portion of countries' commercial performance explained by differences in factors endowments.

Estimations using these two sub-samples are presented in table 6. Only the PPML model is employed. The coefficients for some sectors change and become statistically insignificant. For example, the impact of finance on the "Printing and publishing" industry becomes statistically indistinguishable from zero in seven of the ten models

tested. Nonetheless, the results under this new specification do not change the main conclusions. The relationship between finance and trade is still heterogeneous, and the financial impact is positive, negative or indistinguishable from zero, depending on each industry. Moreover, the relationship is (more often) positive among the financially intensive sectors, while it is (generally) negative among the less financially intensive sectors.

# Conclusions

When the effect of financial development on manufacturing exports is estimated by the interaction between a financial indicator and a sectoral financial intensity index, the coefficients show the average overall impact of finance on exports of the sectors in the sample. This article begins the study of this relationship by calculating this overall effect of financial development on manufacturing exports and thus replicates the analyses conducted in previous studies (see section I). The results show a positive effect of finance on manufactured trade, and that the effect is stronger in financially intensive sectors (see table 1). The results indicate that financial systems are major determinants of manufacturing trade patterns.

The overall effect is – certainly – positive. However, within this general result, the impact of financial systems on trade can vary across sectors and be either negative or statistically indistinguishable from zero. To verify this assumption, the paper empirically tests the hypotheses that (i) the relationship between finance and manufacturing trade is heterogeneous across sectors; and that (ii) financial development promotes trade in financially intensive manufacturing sectors and reduces trade in financially less intensive manufactured sectors.

To test these propositions, we use a trade database on twenty-five manufacturing industries over eighty countries and we estimate a single coefficient of the interaction of five financial indicators with a sector dummy that identifies each industry individually (the dependent variable is the ratio of sectoral exports to GDP of eighty countries between 2000 and 2009). The results are consistent with both hypotheses (see Table 3). The estimated coefficients, as well as their signs and levels of statistical significance, differ across the different industries. Financial development promotes trade in some industries and reduces or does not impact it in others. Among the twenty-five coefficients calculated, twelve are negative, eleven are positive and two are not statistically significant. Furthermore, among the twelve industries with levels of financial intensity below the median value, nine have a negative coefficient; and among those with a financial intensity level above the median value, eight have a positive coefficient. This suggests that financial development enhances trade in financially intensive sectors and reduces it in less financially intensive sectors.

The following thought experiment is suggested to illustrate these results: Consider two industries in the twenty-fifth and seventy-fifth percentiles of financial intensity, specifically, the industries of "Petroleum refineries" and "Transport equipment", respectively. Now assume a hypothetical country that at time $t_1$ has a financial system equivalent to that of the country at the twenty-fifth percentile of financial development (Russia) and that at time $t_2$ has a financial system equivalent to that of the country at the seventy-fifth percentile (Finland). Estimates of the average effect of finance on trade (Table 1) indicate that this change increases exports of both sectors but that exports of "Petroleum refineries" increase by 3% compared to the average value, while exports of "Transport equipment" increase by 22%. Estimates on the effect of financial development on each individual sector (Table 3) show highly varying results: the same change in the level of financial development results in a -4% decline in exports in the first sector and a 13% increase in exports in the second sector.

Hence, the article shows that the effect of financial development on trade in manufacturing is indeed heterogeneous. Furthermore, improving financial conditions

promotes exports in financially intensive manufacturing sectors and reduces exports in financially less intensive manufacturing sectors. Financially developed countries export more in the first group of manufactured sectors, and less financially developed countries export more in the second group of manufactured sectors.

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# Appendix A: Results and robustness

## Table 1. The heterogeneous effect of financial development on trade

| Variable | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| Fin. Index | 0.769*** | 1.338*** | | | | | | | | |
| Private credit | | | 0.714*** | 1.232*** | | | | | | |
| Liquid liabilities | | | | | 0.839*** | 1.832*** | | | | |
| Market cap. | | | | | | | 0.392*** | 0.722*** | | |
| Stock traded | | | | | | | | | 0.238*** | 0.436*** |
| Observation | 9275 | 9300 | 16818 | 16875 | 16344 | 16400 | 16013 | 16050 | 14918 | 14950 |
| $R^2$ | 0.624 | 0.485 | 0.621 | 0.457 | 0.616 | 0.505 | 0.615 | 0,490 | 0.619 | 0.469 |
| Time FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Country FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Sector FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Sector-time FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

*** indicates the coefficient significance level at 1%, ** at 5% and * at 10%. Time, country, sector and sector-time specific effects as well as the constant and the control variable estimates are not reported. Equations (1), (3), (5), (7) and (9) present results using the fixed effect model. Equations (2), (4), (6), (8) and (10) present results using Pseudo Poisson Maximum of Likelihood model (PPML).

## Table 2. The heterogeneous effect of financial development on trade by group of sectors

| Variable | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| (Fin. Index * group1) | -0.173 | -0.272*** | | | | | | | | |
| (Fin. Index * group 2) | -0.267** | -0.494*** | | | | | | | | |
| (Fin. Index * group 3) | 0.281*** | 0.608*** | | | | | | | | |
| (Fin. Index * group 4) | -0.071 | 0.119** | | | | | | | | |
| (Fin. Index * group 5) | 0.794*** | 1.163*** | | | | | | | | |
| (Priv. Credit * group 1) | | | -0.123 | -0.377*** | | | | | | |
| (Priv. Credit * group 2) | | | -0.268*** | -0.514*** | | | | | | |
| (Priv. Credit * group 3) | | | 0.308*** | 0.459*** | | | | | | |
| (Priv. Credit * group 4) | | | -0.070 | -0.091 | | | | | | |
| (Priv. Credit * group 5) | | | 0.744*** | 0.632*** | | | | | | |
| (Liq. Liab.* group 1) | | | | | -0.189 | -0.776*** | | | | |
| (Liq. Liab.* group 2) | | | | | -0.511*** | -0.809*** | | | | |
| (Liq. Liab.* group 3) | | | | | 0.174 | 0.567*** | | | | |
| (Liq. Liab.* group 4) | | | | | -0.304** | -0.152* | | | | |
| (Liq. Liab.* group 5) | | | | | 0.827*** | 1.138*** | | | | |
| (M. Cap.* group 1) | | | | | | | -0.111*** | -0.234*** | | |
| (M. Cap.* group 2) | | | | | | | -0.193*** | -0.286*** | | |
| (M. Cap.* group 3) | | | | | | | 0.236*** | 0.261*** | | |
| (M. Cap.* group 4) | | | | | | | -0.033 | -0.125*** | | |
| (M. Cap.* group 5) | | | | | | | 0.408*** | 0.471*** | | |
| (S. Trade * group 1) | | | | | | | | | -0.097*** | -0.110*** |
| (S. Trade * group 2) | | | | | | | | | -0.144*** | -0.190*** |
| (S. Trade * group 3) | | | | | | | | | 0.076*** | 0.200*** |
| (S. Trade * group 4) | | | | | | | | | -0.031 | 0.038* |
| (S. Trade * group 5) | | | | | | | | | 0.213*** | 0.309*** |
| Observations | 9275 | 9300 | 16818 | 16875 | 16013 | 16050 | 16344 | 16400 | 14918 | 14950 |
| $R^2$ | 0.629 | 0.484 | 0.627 | 0.453 | 0.622 | 0.494 | 0.623 | 0.505 | 0.626 | 0.466 |
| Time; country; sector; sector-time FE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

*** indicates the coefficient significance level at 1%, ** at 5% and * at 10%. Time, country, sector and sector-time specific effects as well as the constant and the control variable estimates are not reported. The order of groups follows the level of financial dependence; Group 1 is the least dependent and Group 5 is the most dependent on external financing. Equations (1), (3), (5), (7) and (9) present results using the fixed effect model. Equations (2), (4), (6), (8) and (10) present results using Pseudo Poisson Maximum of Likelihood model (PPML).

## Table 3. The heterogeneous effect of financial development on trade by industrial sector

| Variable | Fin. Dep. | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tobacco | -0.451 | -0.432** | -0.399*** | -0.154 | -0.443*** | -0.284 | -0.517*** | -0.229*** | -0.097** | -0.212*** | -0.072*** |
| Pottery, china, earthenware | -0.146 | 0.473*** | -0.357*** | 0.158 | -0.429*** | 0.250 | -0.444*** | -0.175*** | -0.079* | -0.025 | -0.050* |
| Leather products | -0.140 | -0.665*** | -0.545*** | -0.375*** | -0.588*** | -0.297* | -0.548*** | -0.327*** | -0.474*** | -0.213*** | -0.232*** |
| Footwear, except rubber or plastic | -0.078 | -0.133 | -0.176** | -0.165** | -0.532*** | -0.314** | -0.843*** | -0.124*** | -0.388*** | -0.056** | -0.133*** |
| Non-ferrous metals | 0.006 | -0.201 | -0.104 | -0.080 | -0.255*** | -0.293** | -1.012*** | 0.299*** | 0.222*** | 0.021 | -0.016 |
| Wearing apparel, except footwear | 0.029 | 0.334** | -0.580*** | 0.061 | -0.949*** | 0.288* | -0.674*** | -0.341*** | -0.659*** | -0.158*** | -0.326*** |
| Petroleum refineries | 0.042 | -0.999*** | -0.547*** | -0.935*** | -0.915*** | -1.276*** | -0.962*** | -0.119 | 0.014 | -0.140*** | -0.110*** |
| Other non-metalic mineral prod. | 0.062 | -0.188 | -0.144** | -0.259*** | -0.373*** | -0.518*** | -0.411*** | -0.267*** | -0.252*** | -0.136*** | -0.105*** |
| Beverages | 0.077 | 0.072 | 0.051 | 0.133 | -0.134* | -0.187 | -0.321*** | 0.018 | -0.148*** | -0.036 | -0.048* |
| Food products | 0.137 | -0.591*** | -0.530*** | -0.340*** | -0.266*** | -0.854*** | -0.835*** | -0.257*** | -0.239*** | -0.248*** | -0.188*** |
| Paper and products | 0.176 | 0.556*** | 0.913*** | 0.469*** | 0.527*** | 0.340*** | 0.117 | 0.319*** | 0.503*** | 0.093*** | 0.364*** |
| Printing and publishing | 0.204 | 0.469*** | -0.016 | 0.483*** | -0.006 | 0.401*** | -0.007 | 0.339*** | 0.168*** | 0.087*** | 0.051** |
| Other chemicals | 0.219 | 0.426*** | 2.011*** | 0.514*** | 1.364*** | 0.374*** | 1.325*** | 0.263*** | 0.465*** | 0.093*** | 0.355*** |
| Rubber products | 0.227 | -0.404*** | -0.317*** | -0.226** | -0.384*** | -0.431*** | -0.147 | 0.025 | -0.116*** | -0.014 | -0.085*** |
| Fabricated metal products | 0.237 | 0.318** | 0.927*** | 0.298*** | 0.329*** | 0.196* | 0.413*** | 0.236*** | -0.015 | 0.121*** | 0.104*** |
| Basic exclud fert | 0.250 | 0.176* | 1.182*** | 0.153* | 0.514*** | 0.240* | 0.658*** | 0.246*** | 0.339*** | 0.069*** | 0.235*** |
| Wood products, except furnit. | 0.284 | -0.669*** | -0.645*** | -0.586*** | -0.892*** | -1.198*** | -1.877*** | -0.289*** | -0.441*** | -0.281*** | -0.354*** |
| Transport equipment | 0.307 | 0.439*** | 0.906*** | 0.355*** | 0.099 | 0.067 | 0.092 | 0.115* | -0.065 | 0.130*** | 0.122*** |
| Misc. Petroleum and coal prod. | 0.334 | -0.263 | -0.597*** | -0.297* | -0.710*** | -0.818*** | -1.075*** | -0.018 | -0.044 | 0.035 | -0.075*** |
| Textiles | 0.401 | -0.101 | -0.465*** | -0.008 | -0.641*** | 0.116 | -0.261*** | -0.218*** | -0.492*** | -0.099*** | -0.083*** |
| Machinery, except electrical | 0.445 | 0.636*** | 1.620*** | 0.584*** | 0.697*** | 0.530*** | 0.772*** | 0.379*** | 0.218*** | 0.204*** | 0.292*** |
| Machinery electric | 0.768 | 0.914*** | 0.937*** | 0.809*** | 0.267*** | 1.126*** | 0.827*** | 0.533*** | 0.445*** | 0.278*** | 0.219*** |
| Professional & scientific equip. | 0.961 | 1.037*** | 2.128*** | 1.033*** | 1.207*** | 1.350*** | 1.935*** | 0.688*** | 0.894*** | 0.370*** | 0.519*** |
| Plastic products | 1.140 | 0.270*** | 0.465*** | 0.326*** | 0.170** | 0.248** | 0.247** | 0.100** | 0.012 | 0.017 | 0.044* |
| Drugs | 1.490 | 1.074*** | 2.352*** | 0.970*** | 1.745*** | 0.888*** | 1.792*** | 0.341*** | 0.724*** | 0.194*** | 0.513*** |
| Observations | | 9275 | 9300 | 16818 | 16875 | 16344 | 16400 | 16013 | 16050 | 14918 | 14950 |
| $R^2$ | | 0.646 | 0.499 | 0.639 | 0.475 | 0.634 | 0.516 | 0.630 | 0.506 | 0.637 | 0.470 |
| Time; country; sector; sector-time FE | | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

*** indicates the coefficient significance level at 1%, ** at 5% and * at 10%. Time, country, sector and sector-time-specific effects as well as the constant and the control variable estimates are not reported. Equations (1), (3), (5), (7) and (9) present results using the fixed effect model. Equations (2), (4), (6), (8) and (10) present results using Pseudo PPML model. Fin. Dep. indicates the level of financial dependence. The financial indicators used in each specification are: (1) & (2) Composite index; (3) & (4) Private credit; (5) & (6) Liquid liabilities; (7) & (8) Market capitalization; and (9) & (10) Traded value.

## Table 4. Robustness: outliers

| Variable | Fin. Dep. | *(i) Without +or- 2.5 standard deviations* | | | | | *(ii) Without the 5 highest and lowest exporters* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** | **(9)** | **(10)** |
| Tobacco | -0.451 | -0.613*** | -0.385*** | -0.490*** | -0.104** | -0.141*** | -0.475*** | -0.530*** | -0.670*** | -0.204*** | -0.096*** |
| Pottery, china, earthenware | -0.146 | -0.568*** | -0.369*** | -0.418*** | -0.085* | -0.119*** | -0.455*** | -0.554*** | -0.667*** | -0.212*** | -0.079*** |
| Leather products | -0.14 | -0.729*** | -0.524*** | -0.525*** | -0.439*** | -0.281*** | -0.647*** | -0.742*** | -0.856*** | -0.654*** | -0.283*** |
| Footwear, except rubber or plastic | -0.078 | -0.342*** | -0.389*** | -0.691*** | -0.352*** | -0.171*** | -0.002 | -0.409*** | -0.869*** | -0.443*** | -0.126*** |
| Non-ferrous metals | 0.006 | -0.354*** | -0.163** | -0.840*** | 0.254*** | -0.060** | -0.064 | -0.182** | -0.997*** | 0.203*** | 0.006 |
| Wearing apparel, except footwear | 0.029 | -1.034*** | -0.750*** | -0.538*** | -0.747*** | -0.392*** | -0.558*** | -0.851*** | -0.590*** | -0.800*** | -0.336*** |
| Petroleum refineries | 0.042 | -1.036*** | -0.939*** | -0.963*** | -0.173*** | -0.219*** | -0.542*** | -0.888*** | -0.987*** | -0.079 | -0.116*** |
| Other non-metalic mineral products | 0.062 | -0.382*** | -0.315*** | -0.387*** | -0.228*** | -0.162*** | -0.182** | -0.404*** | -0.537*** | -0.340*** | -0.124*** |
| Beverages | 0.077 | -0.204*** | -0.102 | -0.310*** | -0.144*** | -0.116*** | 0.029 | -0.122 | -0.341*** | -0.193*** | -0.053** |
| Food products | 0.137 | -0.900*** | -0.213** | -0.750*** | -0.301*** | -0.288*** | -0.512*** | -0.230** | -0.872*** | -0.338*** | -0.170*** |
| Paper and products | 0.176 | 0.544*** | 0.490*** | 0.078 | 0.448*** | 0.245*** | 0.942*** | 0.597*** | 0.179* | 0.415*** | 0.388*** |
| Printing and publishing | 0.204 | -0.256*** | 0.027 | -0.025 | 0.142*** | -0.027 | -0.077 | -0.055 | -0.103 | 0.049 | 0.033 |
| Other chemicals | 0.219 | 1.334*** | 1.001*** | 1.247*** | 0.498*** | 0.234*** | 1.976*** | 1.388*** | 1.391*** | 0.365*** | 0.340*** |
| Rubber products | 0.227 | -0.521*** | -0.305*** | -0.136 | -0.093** | -0.137*** | -0.373*** | -0.451*** | -0.245** | -0.265*** | -0.124*** |
| Fabricated metal products | 0.237 | 0.533*** | 0.307*** | 0.332*** | 0.003 | 0.025 | 0.912*** | 0.342*** | 0.330*** | -0.128*** | 0.088*** |
| Basic exclud fert | 0.25 | 0.700*** | 0.434*** | 0.571*** | 0.315*** | 0.138*** | 1.110*** | 0.497*** | 0.619*** | 0.220*** | 0.212*** |
| Wood products, except furniture | 0.284 | -0.729*** | -0.738*** | -1.604*** | -0.361*** | -0.346*** | -0.616*** | -0.860*** | -1.991*** | -0.572*** | -0.363*** |
| Transport equipment | 0.307 | 0.903*** | 0.357*** | 0.497*** | 0.151*** | 0.112*** | 0.702*** | -0.004 | -0.100 | -0.219*** | 0.071* |
| Misc. Petroleum and coal products | 0.334 | -0.760*** | -0.628*** | -0.999*** | -0.048 | -0.141*** | -0.663*** | -0.830*** | -1.333*** | -0.174*** | -0.104*** |
| Textiles | 0.401 | -0.597*** | -0.485*** | -0.205** | -0.449*** | -0.106*** | -0.477*** | -0.662*** | -0.381*** | -0.650*** | -0.098*** |
| Machinery, except electrical | 0.445 | 1.349*** | 0.772*** | 0.867*** | 0.315*** | 0.226*** | 1.492*** | 0.631*** | 0.606*** | 0.089* | 0.259*** |
| Machinery electric | 0.768 | 0.620*** | 0.320*** | 0.818*** | 0.194*** | 0.094*** | 0.814*** | 0.219** | 0.723*** | 0.346*** | 0.192*** |
| Professional & scientific equipment | 0.961 | 1.016*** | 0.634*** | 1.138*** | 0.568*** | 0.296*** | 2.039*** | 1.163*** | 1.909*** | 0.790*** | 0.497*** |
| Plastic products | 1.140 | 0.146** | 0.162** | 0.186* | 0.005 | -0.033 | 0.423*** | 0.144** | 0.141 | -0.108*** | 0.020 |
| Drugs | 1.490 | 1.680*** | 1.451*** | 1.523*** | 0.671*** | 0.364*** | 2.353*** | 1.797*** | 1.909*** | 0.645*** | 0.530*** |
| N | | 9000 | 16334 | 15963 | 15607 | 14488 | 8400 | 15375 | 14900 | 14550 | 13625 |
| $R^2$ | | 0,356 | 0,309 | 0,31 | 0,321 | 0,332 | 0,511 | 0,483 | 0,515 | 0,517 | 0,475 |
| Time, country, sector, sector-time FE | | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

*** indicates the coefficient significance level at 1%, ** at 5% and * at 10%. Time, country, sector and sector-time-specific effects as well as the constant and the control variable estimates are not reported. Fin. Dep. indicates the level of financial dependence. The financial indicators used in each specification are: (1) & (6) Composite index; (2) & (7) Private credit; (3) & (8) Liquid liabilities; (4) & (9) Market capitalization; and (5) & (10) Traded value.

## Table 5. Robustness: omitted variable bias

| Variable | Fin. Dep. | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tobacco | -0.451 | 0.301 | -0.042 | 0.264 | 0.113 | 0.434* | -0.033 | -0.030 | -0.044 | 0.071 | 0.027 |
| Pottery, china, earthenware | -0.146 | 0.171 | -0.129 | 0.233 | 0.092 | 0.370 | -0.096 | 0.003 | 0.006 | 0.086 | 0.052 |
| Leather products | -0.14 | -1.670*** | -0.597 | -0.592*** | -0.154 | -0.209 | -0.176 | -0.666*** | -0.624*** | -0.211*** | -0.223*** |
| Footwear, except rubber or plastic | -0.078 | -1.757*** | -2.252*** | -0.673*** | -0.785*** | -0.944*** | -1.061*** | -0.300*** | -0.371*** | -0.067 | -0.111** |
| Non-ferrous metals | 0.006 | -1.668*** | -2.939*** | -0.428* | -1.024*** | -1.248*** | -1.692*** | 0.534*** | 0.344*** | -0.049 | -0.121** |
| Wearing apparel, except footwear | 0.029 | -5.347*** | -2.842*** | -1.725*** | -0.947*** | -2.510*** | -1.192*** | -0.742*** | -0.562*** | -0.290*** | -0.188*** |
| Petroleum refineries | 0.042 | -0.180 | -0.949** | -0.407 | -0.565** | 0.154 | -0.173 | 0.389*** | 0.271** | 0.058 | -0.035 |
| Other non-metalic mineral products | 0.062 | -0.279 | -0.691* | 0.040 | -0.074 | -0.010 | -0.269 | -0.192** | -0.246*** | 0.009 | -0.024 |
| Beverages | 0.077 | -0.167 | -0.689* | 0.200 | -0.046 | -0.018 | -0.443** | -0.296*** | -0.362*** | -0.053 | -0.115** |
| Food products | 0.137 | -0.857 | -0.413 | -0.109 | -0.028 | -0.291 | -0.395* | -0.432*** | -0.368*** | -0.176*** | -0.174*** |
| Paper and products | 0.176 | -2.892*** | -2.417*** | -1.105*** | -0.844*** | -1.991*** | -1.904*** | -0.127 | -0.137* | 0.104* | 0.061 |
| Printing and publishing | 0.204 | 0.372 | -0.325 | 0.168 | -0.043 | 0.396 | -0.249 | 0.003 | -0.006 | 0.069 | 0.004 |
| Other chemicals | 0.219 | 2.378*** | 2.081*** | 1.439*** | 1.284*** | 0.902*** | 0.807*** | 0.037 | 0.098 | 0.182*** | 0.159*** |
| Rubber products | 0.227 | -0.664 | 1.559*** | -0.438* | 0.546** | 0.404 | 1.126*** | -0.123 | 0.052 | -0.018 | 0.056 |
| Fabricated metal products | 0.237 | -1.545*** | -1.870*** | -0.823*** | -0.793*** | -0.842*** | -0.850*** | -0.286*** | -0.379*** | -0.046 | -0.102** |
| Basic exclud fert | 0.25 | 1.186*** | 1.085*** | 0.719*** | 0.685*** | 0.565** | 0.449** | 0.108 | 0.115 | 0.104* | 0.092** |
| Wood products, except furniture | 0.284 | -2.167*** | -2.040*** | -0.764*** | -0.626*** | -1.831*** | -1.558*** | -0.407*** | -0.458*** | -0.212*** | -0.258*** |
| Transport equipment | 0.307 | -1.045** | -1.397*** | -0.503** | -0.575*** | -0.379 | -0.670*** | -0.237** | -0.255*** | 0.004 | -0.033 |
| Misc. Petroleum and coal products | 0.334 | -0.117 | -1.756*** | -0.310 | -0.431** | 0.345 | -1.033*** | 0.198** | 0.436*** | 0.194*** | 0.073 |
| Textiles | 0.401 | -3.289*** | -2.050*** | -1.192*** | -0.760*** | -1.539*** | -1.067*** | -0.525*** | -0.483*** | -0.130** | -0.119*** |
| Machinery, except electrical | 0.445 | 0.089 | -0.371 | 0.044 | -0.063 | -0.009 | -0.204 | 0.013 | -0.009 | 0.165*** | 0.109** |
| Machinery electric | 0.768 | 0.436 | 0.252 | -0.019 | -0.054 | 0.621** | 0.287 | 0.359*** | 0.351*** | 0.137** | 0.130** |
| Professional & scientific equipment | 0.961 | 2.922*** | 2.436*** | 0.934*** | 0.849*** | 1.789*** | 1.470*** | 0.728*** | 0.710*** | 0.416*** | 0.397*** |
| Plastic products | 1.140 | -0.893** | -0.689* | -0.522** | -0.348* | -0.277 | -0.291 | -0.295*** | -0.334*** | -0.045 | -0.078* |
| Drugs | 1.490 | 3.541*** | 2.899*** | 2.161*** | 1.801*** | 1.263*** | 1.016*** | 0.141 | 0.112 | 0.285*** | 0.204*** |
| N | | 5350 | 5820 | 5294 | 5775 | 5269 | 5750 | 5350 | 5820 | 4945 | 5246 |
| $R^2$ | | 0,603 | 0,608 | 0,598 | 0,605 | 0,606 | 0,601 | 0,618 | 0,622 | 0,544 | 0,568 |
| Time; country; sector; sector-time FE | | | | | | | | | | | |

*** indicates the coefficient significance level at 1%, ** at 5% and * at 10%. Time, country, sector and sector-time-specific effects as well as the constant and the control variable estimates are not reported. Fin. Dep. indicates the level of financial dependence. Equations (1), (3), (5), (7) and (9) present results using the institutional variable "rule of law" and equations (2), (4), (6), (8) and (10) "regulation quality". The financial indicators used in each specification are: (1) & (2) Composite index; (3) & (4) Private credit; (5) & (6) Liquid liabilities; (7) & (8) Market capitalization; and (9) & (10) Traded value.

## Table 6. Robustness: causality tests

| Variable | Fin. Dep. | *Above median* | | | | | *Below median* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** | **(9)** | **(10)** |
| Tobacco | -0.451 | 0.926** | -0.360* | 0.024 | -0.110 | 0.019 | -0.304*** | -0.120* | -0.061 | -0.290*** | -0.037 |
| Pottery, china, earthenware | -0.146 | | -2.600 | 0.228 | -1.563 | -0.469 | -0.491*** | -0.290*** | -0.099** | -0.392*** | -0.062** |
| Leather products | -0.14 | -0.110 | -0.272** | -0.466*** | -0.487*** | -0.275*** | -0.414*** | -0.153** | 0.014 | -0.157 | -0.008 |
| Footwear, except rubber or plastic | -0.078 | -0.027 | -0.392*** | -0.342*** | -0.680*** | -0.120*** | 0.164 | 0.349 | 0.091 | 0.431 | 0.062 |
| Non-ferrous metals | 0.006 | -0.168* | -0.144 | 0.035 | -0.784*** | -0.078** | 0.247* | 0.177** | 0.214*** | 0.046 | 0.089*** |
| Wearing apparel, except footwear | 0.029 | -0.861*** | -0.530*** | -0.384*** | -0.203 | -0.184*** | 0.135 | 0.093 | -0.101** | 0.053 | -0.041 |
| Petroleum refineries | 0.042 | -0.352*** | -0.637*** | 0.008 | -0.654*** | -0.090*** | -0.267 | 0.006 | 0.013 | -0.464*** | 0.074* |
| Other non-metalic mineral products | 0.062 | 0.459*** | 0.058 | 0.181*** | 0.042 | 0.057 | -0.104 | -0.102 | -0.195*** | -0.289*** | -0.089*** |
| Beverages | 0.077 | 0.341*** | -0.008 | -0.108** | -0.240 | -0.050 | 0.049 | 0.144** | -0.033 | -0.164 | 0.004 |
| Food products | 0.137 | -0.398*** | -0.176* | -0.226*** | -0.706*** | -0.176*** | -2.495*** | -0.022 | 0.054 | -0.656*** | 0.071* |
| Paper and products | 0.176 | 1.039*** | 0.455*** | 0.369*** | -0.358** | 0.314*** | 0.165** | 0.194*** | 0.095** | 0.089 | 0.060** |
| Printing and publishing | 0.204 | 1.058 | 0.285 | -0.054 | -0.044 | -0.068 | -0.009 | 0.147** | 0.153*** | -0.017 | 0.057** |
| Other chemicals | 0.219 | 1.681*** | 1.019*** | 0.306*** | 0.883*** | 0.227*** | 0.296** | 0.340*** | 0.163* | 0.216 | 0.101** |
| Rubber products | 0.227 | -0.017 | -0.108 | 0.030 | -0.187 | -0.048 | -0.220* | -0.173** | -0.075* | -0.237** | 0.009 |
| Fabricated metal products | 0.237 | 0.390*** | 0.036 | -0.174*** | 0.052 | -0.041 | 0.613*** | 0.412*** | 0.205*** | 0.342*** | 0.131*** |
| Basic exclud fert | 0.25 | 0.769*** | 0.292*** | 0.194*** | 0.312** | 0.131*** | 0.533*** | 0.380*** | 0.129 | 0.356** | 0.140*** |
| Wood products, except furniture | 0.284 | -0.307*** | -0.457*** | -0.302*** | -1.274*** | -0.149*** | -0.255** | -0.182** | -0.262*** | -0.342*** | -0.127*** |
| Transport equipment | 0.307 | 0.664*** | 0.070 | -0.045 | 0.100 | 0.080** | 0.520*** | 0.238** | -0.001 | 0.036 | 0.052 |
| Misc. Petroleum and coal products | 0.334 | 1.152*** | 0.912*** | 0.745*** | 0.251 | 0.217*** | -0.396*** | -0.275*** | -0.018 | -0.239** | -0.026 |
| Textiles | 0.401 | -0.309*** | -0.484*** | -0.322*** | -0.254** | 0.008 | 0.242** | 0.223*** | -0.005 | 0.292** | -0.027 |
| Machinery, except electrical | 0.445 | 1.089*** | 0.435*** | 0.102** | 0.419*** | 0.183*** | 0.075 | -0.178 | 0.141 | -0.046 | 0.120** |
| Machinery electric | 0.768 | 0.566*** | 0.135 | 0.362*** | 0.545*** | 0.130*** | -0.070 | -0.096 | 0.095 | -0.240 | 0.075* |
| Professional & scientific equipment | 0.961 | 1.241*** | 0.562*** | 0.573*** | 1.112*** | 0.259*** | 0.382*** | 0.460*** | 0.072 | 0.268* | 0.100*** |
| Plastic products | 1.140 | 0.261** | -0.047 | -0.115** | -0.081 | -0.048 | 0.425*** | 0.388*** | 0.150*** | 0.313*** | 0.096*** |
| Drugs | 1.490 | 2.287*** | 1.209*** | 0.354*** | 1.158*** | 0.228*** | 0.145 | 0.168** | 0.073 | -0.043 | 0.091*** |
| N | | 4836 | 8775 | 8346 | 8528 | 7774 | 4836 | 8775 | 8346 | 8528 | 7774 |
| $R^2$ | | 0,499 | 0,472 | 0,507 | 0,499 | 0,464 | 0,746 | 0,728 | 0,734 | 0,727 | 0,735 |
| Time; country; sector; sector-time FE | | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

*** indicates the coefficient significance level at 1%, ** at 5% and * at 10%. Time, country, sector and sector-time-specific effects as well as the constant and the control variable estimates are not reported. Fin. Dep. indicates the level of financial dependence. The financial indicators used in each specification are: (1) & (6) Composite index; (2) & (7) Private credit; (3) & (8) Liquid liabilities; (4) & (9) Market capitalization; and (5) & (10) Traded value.

# Appendix B: Data

## Table 7. Selected countries

| Country | Code | Country | Code | Country | Code |
|---|---|---|---|---|---|
| Albania | ALB | Greece | GRC | Poland | POL |
| Argentina | ARG | Hong Kong | HKG | Portugal | PRT |
| Australia | AUS | Croatia | HRV | Paraguay | PRY |
| Austria | AUT | Hungary | HUN | Romania | ROM |
| Bangladesh | BGD | Indonesia | IDN | Russian Fed. | RUS |
| Bulgaria | BGR | India | IND | Saudi Arabia | SAU |
| Bosnia Herzeg. | BIH | Ireland | IRL | Singapore | SGP |
| Belarus | BLR | Iceland | ISL | Slovakia | SVK |
| Bolivia | BOL | Israel | ISR | Slovenia | SVN |
| Brazil | BRA | Italy | ITA | Sweden | SWE |
| Brunei Daruss. | BRN | Japan | JPN | Thailand | THA |
| Canada | CAN | Kazakhstan | KAZ | Tunisia | TUN |
| Switzerland | CHE | Kenya | KEN | Turkey | TUR |
| Chile | CHL | Kyrgyzstan | KGZ | Taiwan | TWN |
| China | CHN | South Korea | KOR | Ukraine | UKR |
| Cote Ivoire | CIV | Libya | LBY | Uruguay | URY |
| Cameroon | CMR | Sri Lanka | LKA | United States | USA |
| Colombia | COL | Lithuania | LTU | Venezuela | VEN |
| Czech Rep. | CZE | Latvia | LVA | Viet Nam | VNM |
| Germany | DEU | Morocco | MAR | Serbia Montenegro | YUG |
| Denmark | DNK | Mexico | MEX | | |
| Algeria | DZA | Macedonia | MKD | | |
| Ecuador | ECU | Malaysia | MYS | | |
| Egypt | EGY | Nigeria | NGA | | |
| Spain | ESP | Netherlands | NLD | | |
| Estonia | EST | Norway | NOR | | |
| Finland | FIN | New Zealand | NZL | | |
| France | FRA | Pakistan | PAK | | |
| Gabon | GAB | Peru | PER | | |
| United Kingdom | GBR | Philippines | PHL | | |

## Table 8. Industries and financial dependence level

| Industry | ISIC-3 code | Fin. dependence |
|---|---|---|
| Food products | 311 | 0.137 |
| Beverages | 313 | 0.077 |
| Tobacco | 314 | -0.451 |
| Textiles | 321 | 0.401 |
| Wearing apparel, except footwear | 322 | 0.029 |
| Leather products | 323 | -0.140 |
| Footwear, except rubber or plastic | 324 | -0.078 |
| Wood products, except furniture | 331 | 0.284 |
| Paper and products | 341 | 0.176 |
| Printing and publishing | 342 | 0.204 |
| Other chemicals | 352 | 0.219 |
| Petroleum refineries | 353 | 0.042 |
| Misc. Petroleum and coal products | 354 | 0.334 |
| Rubber products | 355 | 0.227 |
| Plastic products | 356 | 1.140 |
| Pottery, china, earthenware | 361 | -0.146 |
| Other non-metalic mineral products | 369 | 0.062 |
| Non-ferrous metals | 372 | 0.006 |
| Fabricated metal products | 381 | 0.237 |
| Machinery, except electrical | 382 | 0.445 |
| Machinery electric | 383 | 0.768 |
| Transport equipment | 384 | 0.307 |
| Professional & scientific equipment | 385 | 0.961 |
| Basic exclud fert | 3511 | 0.250 |
| Drugs | 3522 | 1.490 |

## Table 9. Correlations between financial indicators

| | Fin. index | Domestic credit | Liquid liabilities | Market cap. | Stock traded |
|---|---|---|---|---|---|
| Fin. index | 1.0000 | | | | |
| Private credit | 0.9209 | 1.0000 | | | |
| Liquid liabilities | 0.8479 | 0.7694 | 1.0000 | | |
| Market cap. | 0.5826 | 0.5257 | 0.5442 | 1.0000 | |
| Stock traded | 0.6046 | 0.6367 | 0.5109 | 0.5928 | 1.0000 |

## Table 10. Descriptive statistics of financial indicators

| Variable | Observations | Mean | Std. Deviation | Min | Max |
|---|---|---|---|---|---|
| Financial index | 9900 | 3.946 | 2.156 | 0.003 | 8.988 |
| Private credit | 19325 | 67.013 | 53.929 | 3.829 | 319.461 |
| Liquid liabilities | 17925 | 65.535 | 43.829 | 10.709 | 316.964 |
| Market cap. | 17225 | 57.974 | 68.136 | 0.198 | 617.014 |
| Stock traded | 16325 | 61.514 | 96.068 | 0.000 | 673.071 |

# Chapitre 5[a]:

# Institutional distance & foreign direct investment

[a] This chapter was co-authored with Octavio ESCOBAR, associate professor of economics at ESG Management School of Paris.

**Abstract:** This paper studies the link between Foreign Direct Investment (FDI) and institutional distance. Using a heterogeneous firms framework, we develop a theoretical model to explain how institutional distance influences FDI and it is shown that institutional distance reduces both the likelihood that a firm will invest in a foreign country and the volume of investment it will undertake. We test our model, using inward and outward FDI data on OECD countries. The empirical results confirm the theory and indicate that FDI activity declines with institutional distance. In addition, we find that firms from developed economies adapt more easily to institutional distance than firms from developing economies.

**Keywords:** Foreign Direct Investment; Institutions; Heterogeneous firms; Gravity model.

**Résumé:** Ce chapitre étudie le lien entre les investissements directs étrangers (IDE) et la distance institutionnelle. En utilisant le cadre des firmes hétérogènes, nous développons un modèle théorique pour expliquer la façon dont la distance institutionnelle impacte les IDE et il est démontré que celle-ci réduit à la fois la probabilité qu'une firme investisse à étranger et le volume investi. Ensuite nous testons le modèle avec les données d'IDE entrants et sortants des pays de l'OCDE. Les résultats empiriques confirment la théorie et indiquent que les IDE baissent avec la distance institutionnelle. En outre, nous constatons que les entreprises des économies développées s'adaptent plus facilement à la distance institutionnelle que les entreprises des pays en développement.

**Mots clés :** Investissements Directs Etrangers ; Institutions ; Firmes hétérogènes ; Modèle de gravité.

**JEL:** F12, F23, H80, K20.

# Introduction

Developing and transition economies increasingly attract Foreign Direct Investment (FDI) flows (UNCTAD, 2012). Three important patterns, observable in UNCTAD (2012) data, are helpful in understanding this trend. First, most FDI outflows are from developed economies, but their share in total FDI outflows is decreasing over time. Since 2003, the share of FDI outflows of developing and transition economies has consistently increased, reducing the share of FDI from developed economies to approximately 75% in 2011. Second, firms primarily invest in countries with similar levels of development as their own. More than 70% of outward FDI from developing and transition economies goes to other developing and transition economies, and approximately 50% of this outward FDI goes to economies located in the source economy's region. Developed economies also locate most of their operations in other developed economies. Third, developed economies have a greater capacity to diversify their operations than developing and transition economies. Approximately 45% of outward FDI from developed economies goes to developing and transition economies. Moreover, developed economies are the main source of FDI in developing and transition economies.

Differences in the quality of institutions across countries are the main determinant of differences in economic development (Acemoglu and Robinson, 2010); we thus expect that institutional distance is an important determinant of FDI, and helps to explain recent FDI patterns. We develop a theoretical model, using a heterogeneous firms framework, to explain how institutional distance influences decisions to invest in a country and the volume of investment undertaken. According to the heterogeneous firms literature (Helpman et al., 2008; Yeaple, 2009), a productivity threshold must be overcome to make FDI profitable. Thus, only the most productive firms, mainly from developed countries, can invest abroad.

When entering foreign markets, multinational enterprises (MNEs) must adapt their strategies to the requirements of local institutions, which may differ from the institutions of their home countries. Our model suggests that MNEs face an adaptation cost in adjusting to the institutional environments of host countries. As adaptation costs increase with institutional distance, institutional distance determines the productivity threshold at which FDI is more profitable than exporting as a means of accessing foreign markets. Thus, increasing institutional distance reduces the number of firms that undertake FDI. In addition, adaptation costs reduce firm profits and the profitability of FDI. Accordingly, firms' FDI declines with institutional distance.

Firms perform better in foreign markets similar to their home markets than in markets that are dissimilar, as similarities are easier for firms to manage (Johanson and Vahlne, 2009). In addition to institutional similarities, development, geographical and cultural proximity are important determinants of FDI (Head and Ries, 2008; Helpman et al., 2008; Guiso et al., 2009). To control for differences in all of these factors across countries, when studying the determinants of FDI, the empirical literature uses gravity equations. Studies show that institutional distance matters for bilateral FDI. Differences between host and source countries in terms of corruption (Habib and Zurawicki, 2002), legal rules (Guiso et al., 2009), credit market regulations, legal constraints in recruiting and firing, and decentralisation of wage bargaining (Bénassy-Quéré et al., 2007) reduce bilateral FDI flows. However, the costs of institutional distance may differ for firms from developed and developing countries, owing to firm heterogeneity. Firms from developed countries may have more experience and better networks, which reduce the cost of institutional distance, than firms from developing countries (Johanson and Vahlne, 2009).

We proceed to an empirical validation of our model. Using alternative indicators of institutional distance, the results suggest that FDI activity declines as institutional distance increases. When investing in countries with weak institutions, firms from countries with weak institutions face lower costs than firms from countries with

strong institutions. The results also suggest that institutional distance more strongly influences firms' decisions to invest in developing than in developed economies. Once investment decision is made, institutional distance equally affects the amount of investment from developed and developing economies.

This paper is organised as follows. Section I presents the theoretical model. Section II describes the empirical specification of the model and the estimation strategy. Section III describes the data and the measures of institutional distance used. The empirical results are presented in Section IV. The last section concludes.

# I. The model

The model, based on Melitz (2003), Helpman et al. (2004) and Yeaple (2009), focuses on firms' arbitrage between exporting and producing abroad. The world economy features i countries with N firms in each. Each firm produces a single variety of good ω and is monopolistic in this variety. Consumer preferences, which are identical across countries, are represented by the following constant elasticity of substitution (CES) utility function:

$$U = \left( \int_{\omega \epsilon \Omega_i} q(\omega)^{\frac{(\varepsilon-1)}{\varepsilon}} d\omega \right)^{\varepsilon/(\varepsilon-1)},$$

where $\varepsilon > 1$ is the elasticity of substitution between goods and $\Omega_i$ denotes the set of varieties available in country $i$. Maximisation of the utility function entails the following demand function for variety ω:

$$q_i^d(\omega) = \frac{p_i(\omega)^{-\varepsilon}}{P_i^{1-\varepsilon}} Y_i, \quad (1)$$

where $p_i(\omega)$ is the price of variety $\omega$, $P_i = (\int p_i(\omega)^{1-\varepsilon} d\omega)^{1/(1-\varepsilon)}$ is the ideal price index, and $Y_i$ is total income. The market is characterised by monopolistic competition, and the price of variety $\omega$ is a mark-up over marginal cost:

$$p_i(\omega) = \frac{1}{\alpha} m, \tag{2}$$

where $\alpha = \frac{\varepsilon - 1}{\varepsilon}$ is a parameter that measures the inverse of the degree of differentiation between goods so that $\frac{1}{\alpha}$ indicates firms' unit margin, and $m$ is marginal cost.

Labor is the only input, and firms are heterogeneous in their firm-specific productivity levels, denoted by $\varphi$. This parameter indicates the quantity of goods produced with one unit of labor, and we assume that a cumulative distribution function (cdf) $\mu(\varphi)$, with support $[\varphi_B, \varphi_H]$, describes the distribution of $\varphi$ across firms, where $\varphi_H > \varphi_B > 0$, and $\varphi_B$ and $\varphi_H$ indicate the productivity levels of the least and most productive firms, respectively. The cdf is assumed to be identical across countries. Labor costs are country specific, with the wage in country i denoted by $w_i$. The marginal cost of output $w_i/\varphi$ is decreasing in productivity, constant at a given productivity level, and specific to each country.

# I.1. Costs of internationalization

The model focuses on firms' internationalization decisions and only firms already operating in the domestic market are considered in the analysis. Firms wishing to sell their products abroad face a tradeoff between two internationalization strategies: exporting or FDI that enables it to produce within the economy of its trading partner.

To export, firms face two additional costs: fixed and variable trade costs. Fixed trade costs relate to marketing, certifications, regulations, etc. These costs are bilateral and

denoted by $f_{ij}$ for the pair $i, j$. Firms also face variable costs in selling their products abroad, modeled as iceberg transportation costs. Specifically, the delivery of one unit of a good in country j requires that $\tau_{ij} > 1$ units be shipped and the marginal cost of exporting from country i to country j is $\tau_{ij} w_i / \varphi$. These costs are country-pair specific. The total cost of exporting q units by a firm with productivity $\varphi$ is

$$Cx_{ij}(q) = q\left(\frac{\tau_{ij} w_i}{\varphi}\right) + f_{ij}.$$

Firms can also open a subsidiary to produce directly in the destination country. This alternative allows firms to economize on transportation costs but incurs management costs and high fixed costs related to the construction of new facilities and adaptation to the host country. The management and communication costs affect technology transfers and affect firms' productivities and marginal costs. These costs are modeled as iceberg costs with $T_{ij} \geq 1$. Therefore, the variable cost of FDI faced by a firm from country i with productivity $\varphi$ and that produces in country j is $w_j / \left(T_{ij}^{-1} \varphi\right)$. The fixed costs associated with this activity are $F_{ij}$. The total cost of producing q units in country j is

$$Cfdi_{ij}(q) = q\left(\frac{w_j}{T_{ij}^{-1} \varphi}\right) + F_{ij}.$$

# I.2. Firms' arbitrage

To focus on the tradeoff between exports and FDI, firms are assumed to only use FDI to access the host country's market. It is used neither as an export platform nor for outsourcing production. Transportation costs are assumed to be relatively high compared to the difference between labor costs and technology transfer costs (i.e., $\tau_{ij} w_i > T_{ij} w_j$ for all country-pairs), and exporting fixed costs are always lower than FDI fixed costs (i.e., $F_{ij} > f_{ij}$).

From Equations 1 and 2, income from this activity can be represented as a function of firms' marginal costs. Specifically, $r_{ij}(\varphi) = \left(\alpha P_j\right)^{\varepsilon-1} Y_j m(\varphi)^{1-\varepsilon}$ denotes income from sales to country j by a firm in country i with productivity $\varphi$, where $m(\varphi)$ is the firm's marginal cost. The variable income of this project can also be represented as a function of marginal costs: $R_{ij}(\varphi) = \frac{r_{ij}}{\varepsilon} = \psi_j m(\varphi)^{1-\varepsilon}$, where $\psi_j = \frac{\left(\alpha P_j\right)^{\varepsilon-1}}{\varepsilon} Y_j$ is specific to country j and measures demand adjusted for the elasticity of substitution. Let us define $\pi_x(\varphi)_{ij}$ as export profits and $\pi_I(\varphi)_{ij}$ as FDI profits. They are, respectively:

$$\begin{aligned} \pi_x(\varphi)_{ij} &= \psi_j\left(\tau_{ij} w_i\right)^{1-\varepsilon} \varphi^{\varepsilon-1} - f_{ij}, \\ \pi_I(\varphi)_{ij} &= \psi_j\left(T_{ij} w_j\right)^{1-\varepsilon} \varphi^{\varepsilon-1} - F_{ij}. \end{aligned} \tag{3}$$

Marginal costs are decreasing in $\varphi$; thus, $R_{ij}(\varphi)$ and profits are increasing in productivity, that is, $\frac{\delta R(\varphi)}{\delta \varphi} > 0$ and $\frac{\delta \pi(\varphi)}{\delta \varphi} > 0$, for both internationalization strategies. Because firms only sell their products abroad if their profits are at least zero – that is, if variable income at least equals fixed costs – two productivity thresholds can be defined. The first, denoted $\varphi_x$, indicates the productivity level above which firms generate sufficient variable income to pay fixed export costs. The second, denoted $\varphi_I$, indicates the productivity threshold above which firms can pay fixed FDI costs. These two thresholds are defined as $\pi(\varphi_x)_{ij} = 0$ and $\pi(\varphi_I)_{ij} = 0$, respectively. Firms with productivity levels equal to or greater than $\varphi_x$ export, and all multinational firms have productivity at least equal to $\varphi_I$.

The marginal cost of firms that export from country i to j is $\tau_{ij} w_i / \varphi$. The marginal cost of firms from country j that open a subsidiary in country i is $\left(T_{ij} w_j\right)/\varphi$. As $\tau_{ij} w_i > T_{ij} w_j$ and $\varepsilon > 1$, the variable income for MNEs – and their marginal profit – is always higher than the marginal income of exporting firms, as $\frac{\delta \pi_I(\varphi)}{\delta \varphi} > \frac{\delta \pi_x(\varphi)}{\delta \varphi}$. However, as fixed FDI costs are higher than fixed export costs, the productivity

threshold above which firms will export is typically lower than the productivity threshold for FDI.

Figure 1 in the appendix illustrates the productivity thresholds and profits that determine whether firms export or engage in FDI. $\varphi_I$ indicates productivity above which FDI is profitable. However, at this productivity level, exporting is more profitable than FDI. Production is moved abroad only if profits thereby generated exceed those of exporting, that is, if $\pi_I(\varphi) \geq \pi_x(\varphi)$. This threshold is represented in Figure 1 by $\varphi_I^*$. Specifically, $\varphi_I^*$ is such as $\pi_I(\varphi_I^*) = \pi_x(\varphi)$ and represents the productivity of the marginal multinational firm. This productivity threshold is country-pair specific, and all firms in country i with productivity above $\varphi_I^*$ produce directly in country j.

As productivity levels are not observable, firms' income function is used as a proxy for the FDI threshold. Income is a good proxy for φ, as it is an increasing function of productivity. From Equation 3, the income level above which firms from country i invest (and produce) in country j is

$$r\left(\varphi^*_{I\,ij}\right) = \varepsilon \frac{\left(F_{ij} - f_{ij}\right)}{1 - \left(\frac{\tau_{ij} w_i}{T_{ij} w_j}\right)^{1-\varepsilon}}. \qquad (4)$$

All firms from country i with income levels higher than or equal to $r\left(\varphi^*_{I\,ij}\right)$ engage in FDI in country j. As productivity follows the cdf $\mu(\varphi)$ with $\varphi \in [\varphi_B, \varphi_H]$, only the fraction $\left(1 - \mu\left(\varphi^*_{I\,ij}\right)\right)$ of the $N_i$ firms from country i invest in country j. Moreover, it is possible that this proportion equals zero if $\varphi^*_{I\,ij} > \varphi_H$, with no firm sufficiently profitable to reach the threshold.

Equation 4 indicates that $\varphi^*_{I\,ij}$ depends on the difference between the fixed costs of FDI and the fixed costs of exporting and on the ratio between the marginal costs of FDI and the marginal costs of exporting. An increase in fixed FDI costs raises the

marginal income required to delocalise production and reduces the number of firms able to produce abroad. A reduction in fixed trade costs produces the same result. Specifically, an increase in the difference between $F_{ij}$ and $f_{ij}$ makes exports relatively more attractive than FDI.

As the ratio between marginal costs is always greater than one, $\left(\frac{\tau_{ij}w_i}{T_{ij}w_j}\right)^{1-\varepsilon}$ is less than unity. Therefore, $\varphi^*_{I\,ij}$ is larger when the distance between $\tau_{ij}w_i$ and $T_{ij}w_j$ is small, while an increase in variable trade costs – such as customs barriers, poor infrastructure or distance – reduces the income threshold required to engage in FDI and raises FDI. Communication problems with the subsidiary or increasing labor costs in the host country have the opposite effect, reducing FDI.

Figure 1 divides firms into three distinct groups: i) firms with productivity below $\varphi_x$ that produce only for the domestic market; ii) exporting firms with productivity between $\varphi_x$ and $\varphi^*_I$; and iii) MNEs with productivity of at least equal to $\varphi^*_I$ that produce in the destination country through FDI[1].

# I.3. Institutional distance and fixed FDI costs

Firms face two types of fixed FDI costs: i) construction of new facilities, and ii) adaptation costs — costs required to produce in the institutional, political and economic environment of the host country.

Equation 1 indicates that the demand of goods rises as price falls, and price – according to Equation 2 – decreases as firm productivity rises. Therefore, MNEs' demand depends on productivity, and the most productive firms face the highest demand, selling more goods in the host country. Subsequently, the size of the

[1] Both exporting firms and MNEs also produce in the source country for the domestic market.

facilities that multinationals construct in the host country is proportional to their productivity level, with the most productive firms building the largest facilities.

Therefore, the cost of investment in new facilities is assumed to be a function of expected profits in the host market[2]. For simplicity, the investment cost function is assumed to be monotone and linear. The cost for firms of country i of opening a subsidiary in country j is $w_j \theta \pi_{ij}(\varphi)$, where the parameter $\theta$ is positive and strictly less than one, and $\pi_{ij}$ is defined as in Equation 3. Thus, the fixed cost of investing in new facilities depends on firm productivity.

The second fixed FDI cost is the adaptation investment in the new institutional environment. To produce in the host country, firms must adapt to its legal system, tax laws, political and governmental framework, conditions of access to credit, and regulations. Such adaptation costs depend on the institutional framework of the host country. Countries with weak institutional environments have high adaptation costs, while improvements in the institutional environment lower these costs (Daude and Stein, 2007). On the other hand, firms are already accustomed to the institutional environments of their domestic markets and have experience in coping with them. Such experience can reduce adaptation costs, especially when the institutional environments of the country-pair are similar (Bénassy-Quéré et al., 2007; Guiso et al., 2009; Habib and Zurawicki, 2002). Thus, institutional proximity between source and host countries reduces adaptation costs and facilitates FDI. A firm accustomed to a weak institutional environment will find it easier to invest in a country with similar characteristics, while the same firm will need to invest more to adapt to a country with an efficient institutional system.

Let us denote by $\lambda_i$ the level of institutional development of country i. This parameter measures the overall institutional quality of a country, including regulations, property

[2] An alternative explanation is that the return on capital is calculated based on the sum of actualised expected profits.

rights, access to information, financial constraints, level of corruption, and political stability, as well as the formalities involved in opening a business, executing a contract, and registering a property. If $\lambda_i$ and $\lambda_j$ represent the overall level of institutional development in the source and host countries, respectively, the cost of institutional adaptation is an increasing function of the distance between $\lambda_i$ and $\lambda_j$. When this distance is large, firms face strong institutional barriers, and adaptation costs are high. However, when institutional environments are similar, that is, when $\lambda_i$ and $\lambda_j$ are close, firms in country i are familiar with the institutional environment in country j and adaptation costs are low.

The adaptation cost associated with the institutional environment of country j for a firm from country i is denoted $w_i c(\lambda_j - \lambda_i)$, where the adaptation cost is measured in labor units of the source-country, as firms pay this cost in their own country before investing in the host country. The adaptation cost function is specific to the country-pair, monotone, strictly positive and increasing in institutional distance, such as $\frac{\delta c(\lambda_j - \lambda_i)}{\delta(\lambda_j - \lambda_i)} > 0$.

The fixed cost of engaging in FDI in country j for firms from country i is

$$F_{ij} = w_j \theta \pi_{ij}(\varphi) + w_i c(\lambda_j - \lambda_i). \quad (5)$$

# I.4. Institutional distance and FDI margins

From Equations 4 and 5, we can rewrite the income threshold above which firms from country i invest in country j as

$$r(\varphi^*_{I\,ij}) = \varepsilon \frac{w_j \theta \pi_{ij}(\varphi) + w_i c(\lambda_j - \lambda_i) - f_{ij}}{1 - \left(\frac{\tau_{ij} w_i}{T_{ij} w_j}\right)^{1-\varepsilon}}. \quad (6)$$

Equation 6 indicates a direct and negative relationship between institutional distance and the marginal variation in the proportion of firms that engage in FDI (extensive margin). On the one hand, an increase in institutional distance raises the income threshold and reduces the set of firms that are able to invest abroad. On the other hand, a decrease in institutional distance reduces adaptation costs and increases the number of firms that engage in FDI. This relationship is shown by

$$\frac{\delta\varphi^{*}_{I\,ij}}{\delta(\lambda_j-\lambda_i)} \approx \frac{\delta r\left(\varphi^{*}_{I\,ij}\right)}{\delta(\lambda_j-\lambda_i)} > 0, \tag{7}$$

where $\delta\varphi^{*}_{I\,ij}/\delta(\lambda_j - \lambda_i)$ is the elasticity of the FDI productivity threshold with respect to institutional distance. This elasticity is positive, and so, a positive change in $(\lambda_j - \lambda_i)$ increases $\varphi^{*}_{I\,ij}$. An increase in the FDI productivity threshold reduces the proportion of MNEs (extensive margin) because $\mu(\varphi)$ is fixed and identical in all countries. This relationship is summarized in the following proposition:

**Proposition 1:** *There is a direct and negative relationship between the institutional distance between countries and the marginal variation in the extensive margin, such as an increase in this distance raises the productivity threshold above which FDI is profitable and reduces the proportion of multinational firms in country i that invest in country j.*

To examine how institutional distance affects the volume of FDI between two countries (intensive margin), we define in the equation below $V_{ij}$ as the average productivity of firms from country i that invest in country j:

$$V_{ij} = \begin{cases} \int_{\varphi^{*}_{I\,ij}}^{\varphi_H} \varphi^{\varepsilon-1} d\mu(\varphi) & \text{if } \varphi^{*}_{I\,ij} \leq \varphi_H \\ 0 & \text{if } \varphi^{*}_{I\,ij} > \varphi_H \end{cases} \tag{8}$$

If $\varphi^{*}_{I\,ij} > \varphi_H$, $V_{ij} = 0$ because the productivity threshold is higher than the productivity of the most productive firm, and no firm from country i is sufficiently

productive to invest in country j. When $\varphi^{*}_{I\,ij} \leq \varphi_{H}$, at least one firm has productivity sufficient to invest abroad, and $V_{ij} > 0$. This variable is country-pair specific, with $V_{ij} \neq V_{ji}$, which allows for asymmetric FDI flows.

The intensive margin is the sum of all investments made by each firm (for which $\varphi \geq \varphi^{*}_{I\,ij}$) in the construction of new facilities[3]. From Equations 5 and 8, total FDI from country i to country j is

$$\begin{aligned} FDI_{ij} &= w_j \theta \pi_{ij}(\varphi) V_{ij} N_i \\ &= \left(\frac{(1-w_j\theta)w_j\theta}{1-(w_j\theta)^2}\right)\left(\psi_j\left(T_{ij}w_j\right)^{1-\varepsilon}\varphi^{\varepsilon-1} - w_i c\left(\lambda_j - \lambda_i\right)\right) V_{ij} N_i \end{aligned} \quad (9)$$

Equation 9 indicates that the cost of institutional adaptation has a negative effect on the value of FDI, and a positive change in the first variable reduces FDI from country i to country j . $c\left(\lambda_j - \lambda_i\right)$ also affects the number of investing firms via the productivity threshold, which is included in $V_{ij}$. Thus, institutional distance affects the intensive margin of FDI through these two distinct channels. Based on these observations, the second theoretical proposition is presented as follows:

**Proposition 2:** *Institutional distance negatively affects the intensive margin of FDI, such as an increase in institutional distance reduces FDI.*

[3] As adaptation cost is incurred in the source country before investments are complete, FDI exclusively concerns investments in new facilities.

# II. Empirical specification

The gravity equation is commonly used to study the determinants of FDI as they can be derived from various theoretical models (Head & Ries, 2008; Kleinert & Toubal, 2010). We develop a gravity equation to test the propositions of our model. First, our model suggests that institutional distance influences decisions to invest abroad (the extensive margin). Second, our model suggests that institutional distance influences the profitability of foreign investment and the volume of investment (the intensive margin). Because the volume of investment depends on the extensive margin, we develop, following Helpman et al. (2008), a two-stage gravity equation to estimate the extensive and intensive margins. In the first stage, or selection equation, firms choose whether to invest (extensive margin); in the second stage, or primary equation, firms that invest decide how much to invest (intensive margin).

## II.1. Empirical specification of the selection equation

From Equation 8, the decision to invest depends on firms' productivity and on the productivity threshold. We define the variable $Z_{ij}$ as the ratio of the productivity of the most productive firm ($\varphi_H$) to the productivity threshold ($\varphi^*_{I\,ij}$). If $Z_{ij} > 1$, then firms from country i invest in country j. We assume that the productivity of the most productive firm ($\varphi_H$) in country i is given; thus, variations in $Z_{ij}$ are caused by changes in the threshold at which FDI is more profitable than exports. Therefore, the estimation of $Z_{ij}$ allows us to estimate the impact of institutional distance on the productivity threshold ($\varphi^*_{I\,ij}$) and the decisions of firms to invest abroad:

$$Z_{ij} = \left(\frac{\varphi_H}{\varphi^*_{I\,ij}}\right)^{\varepsilon-1} = \frac{\left(\frac{(\alpha P_j)^{\varepsilon-1}}{\varepsilon} Y_j\right)\left((T_{ij}w_j)^{1-\varepsilon} - (\tau_{ij}w_i)^{1-\varepsilon}\right)}{F_{ij} - f_{ij}} \varphi_H^{\varepsilon-1} \quad . \qquad (10)$$

We assume that differences in fixed and variable costs between exporting and FDI are stochastic. More precisely, we suppose that $\left(T_{ij}w_j\right)^{1-\varepsilon} - \left(\tau_{ij}w_i\right)^{1-\varepsilon} \equiv \exp(\vartheta_1 w_i + \vartheta_2 w_j + \vartheta_3 X_i + \vartheta_4 M_j + \vartheta_5 \Upsilon_{ij} + \epsilon_{ij})$, where $X_i$ is a measure of the costs of exporting, such as customs procedures and regulations in country i, and is independent from the export destination; $M_j$ is a measure of trade barriers, such as customs procedures and regulations, imposed by the importing country j on all exporters; $\Upsilon_{ij}$ measures country-pair characteristics, such as bilateral distance and ease of communication, that influence both trade costs $\left(\tau_{ij}\right)$ and coordination costs $\left(T_{ij}\right)$; and $\epsilon_{ij} \sim N(0, \sigma_\epsilon^2)$ is an error term. With respect to differences in fixed costs, we assume that $F_{ij} - f_{ij} \equiv \exp(\beta_1 w_i + \beta_2 w_j + \beta_3 c\left(\lambda_j - \lambda_i\right) + \xi_{ij})$, where $\xi_{ij} \sim N(0, \sigma_\xi^2)$ is an error term. We can express Equation 10 in log form as

$$z_{ij} = \gamma_0 + \gamma_i + \gamma_j + \gamma_{ij} + \eta_{ij}, \tag{11}$$

where $z_{ij} = \ln(Z_{ij})$; $\gamma_0 = (\varepsilon - 1)\ln(\alpha) - \ln(\varepsilon)$ is a constant; $\gamma_i = (\varepsilon - 1)\ln(\varphi_H) + (\vartheta_1 + \beta_1)w_i + \vartheta_3 X_i$ represents the characteristics of the source country i; $\gamma_j = \left(\varepsilon - 1\right)\ln(P_j) + \ln(Y_j)\big) + (\vartheta_2 + \beta_2)w_j + \vartheta_4 M_j$ represents the characteristics of the host country j; $\gamma_{ij} = \vartheta_5 \Upsilon_{ij} + \beta_3 c\left(\lambda_j - \lambda_i\right)$ represents the characteristics of the country-pair $i, j$; and $\eta_{ij} = \epsilon_{ij} + \upsilon_{ij} \sim N(0, \sigma_\epsilon^2 + \sigma_\xi^2)$ is an independent and identically distributed (iid) error term.

We cannot measure $z_{ij}$ because neither firms' productivity levels nor the productivity threshold are observable. However, the presence of firms from country i in country j implies that $z_{ij} > 0$. A selection indicator $S_{ij}$ is generated, using a latent variable such as $S_{ij} = 1$ if firms from country i invest in country j and $S_{ij} = 0$ otherwise. Let $\rho_{ij}$ be the probability that country i invests in country j, conditional on the observed variables. Assuming $\sigma_\eta^2 = \sigma_\epsilon^2 + \sigma_\upsilon^2 = 1$, we can specify Equation 11 as a probit equation:

$$\rho_{ij} = \Pr\left(S_{ij} = 1 \middle| \text{Observed variables}\right)$$

$$= \Phi\left(\gamma_0 + \gamma_i + \gamma_j + \gamma_{ij} + \eta_{ij}\right), \quad (12)$$

where $\Phi(\cdot)$ is the cumulative distribution function of the unit-normal distribution. We then estimate the predicted value of $z_{ij}$ as $\hat{z}_{ij} = \Phi^{-1}(\hat{\rho}_{ij})$. It is important to note that the selection equation (Equation 12), is derived from a decision at the firm level. It shows how changes in the characteristics of the countries affect FDI decisions. More specifically, marginal changes in the characteristics of country i or j modify the productivity threshold and affect the choice between exporting or performing FDI. Equation 12 then provides information on the marginal variation in the proportion of firms from country i investing in country j.

# II.2. Empirical specification of the primary equation

FDI flows from country i to country j, given by Equation 9, can be expressed in log form as $\ln\left(FDI_{ij}\right) = \theta + \ln\left(w_j\right) + \ln\left(\pi_{ij}\right) + \ln\left(V_{ij}\right) + \ln(N_i)$. Profits ($\pi_{ij}$) depend on demand as well as on production and implantation costs. Thus, we estimate the following equation

$$\ln\left(FDI_{ij}\right) = \phi + \phi_i + \phi_j + \phi_{ij} + v_{ij} + u_{ij}, \quad (13)$$

where $\phi_i$, $\phi_j$, and $\phi_{ij}$ are the characteristics of country i, country j, and country-pair i, j, respectively; $v_{ij} = \ln(V_{ij})$ is the logarithm of the average productivity level of firms from country i that invest in country j; and $u_{ij} \sim N(0, \sigma_u^2)$ is an error term.

From Equations 4 and 7, following Helpman et al. (2008), we specify $v_{ij} \equiv \upsilon(z_{ij})$ as an arbitrary increasing function of $z_{ij}$. More precisely, we control for $E[V_{ij}|., S_{ij} = 1]$, using $\upsilon(\hat{z}_{ij})$, which we approximate with a cubic polynomial in $\hat{z}_{ij}$.

# II.3. Estimation strategy

Equations 12 and 13 include common exogenous variables specific to the FDI source country i, host country j, and country-pair i, j. GDP per capita proxies for wage levels, geographical and cultural distance proxy for trade and coordination costs, and country size or GDP levels proxy for demand. These proxies enable us to construct a gravity equation for both the selection and primary equations. The literature suggests that under general equilibrium, bilateral FDI depends on the same exogenous determinants as bilateral trade flows (Bergstrand and Egger, 2007; Egger, 2010).

Although the exogenous variables included in the selection and primary equations may be identical, an additional variable not included in the primary equation is also required in the selection equation (Wooldridge, 2002). In addition, incorporating panel data estimates from the selection equation into the primary equation entails potential autocorrelation bias. We follow Wooldridge (2002), who proposes estimating the selection equation for each year t and using the resulting estimates to compute $\hat{z}_{ij}$. This procedure is similar to the two-stage estimators of Heckman (1979); however, we only control for firms' heterogeneity, not for selection bias. To address zero flow observations, we employ the Santos-Silva and Tenreyro (2010) Poisson pseudo-maximum-likelihood (PPML) estimator.

# III. Data

We construct a panel database of the bilateral relationships between 31 OECD countries and 125 countries in different stages of economic development. Data are available for the 2004-2009 period. The dependent variable is the ratio of the bilateral stock of foreign direct investment – inward into and outward from OECD countries – to the GDP of the FDI receiving country[4]. Data come from the International Direct Investment Statistics database, available from the OECD, and from the World Development Indicators (WDI) of the World Bank. WDI also provides data on GDP per capita. Geographic and cultural variables are available from the Center for Studies, Prospective and International Information (CEPII).

## III.1. Institutional distance index

Different institutional frameworks and their impact on economic activity have received substantial attention in the recent literature on FDI (Bénassy-Quéré et al., 2007; Guiso et al., 2009). Generally, the term "institution" refers to structures that affect economic relations. North (1993) defines institutions as the constraints built by men and designed to organise social relations. Formal constraints include regulations, property rights, the financial system and contract enforcement (Levchenko, 2007); while informal constraints include levels of social trust (Algan & Cahuc, 2010) and corruption (Habib & Zurawicki, 2002).

[4] FDI stock data are widely used in the literature. The most frequent arguments used to justify the use of FDI stock data are as follows: (i) FDI is also financed by markets in the host country, and therefore, stock data provide a more accurate measure than flow data; (ii) Stocks are much less volatile than flows; and (iii) Stock data greatly reduce the number of zero observations in the sample.

A measure of the distance between institutional environments must therefore be sensitive to various aspects of the institutional structures of each country. Thus, a wide range of indicators of various formal and informal constraints is used to construct a single composite index for each country in the sample, using principal component analysis (PCA). The institutional indexes of countries i and j are denoted by $\lambda_i$ and $\lambda_j$. The institutional distance between two countries is then calculated from the composite index and equals the absolute value of the difference between two countries' indices:

$$\text{Dist}_{ij} = |\lambda_i - \lambda_j|.$$

# III.2. Principal component analysis

Principal component analysis is used to construct the composite institutional index. This method allows for a set of multivariate observations to be described by a linear combination of these observations so as to maximise the variance explained by the new variable. Specifically, the original variables $x_{1i}, \dots, x_{ni}$ are transformed into a new variable $y$, such that the variance of $y$ in the total sample is maximal. In other words, the weighting coefficients of the first component maximise the variance and minimise the loss of information from the original sample[5].

We estimate the institutional index using the first component of the analysis. This component alone explains approximately 68% of the total variance in the sample

[5] As the growth of these coefficients increases the variance indefinitely, the sum of the squared coefficients is constrained to equal unity. Furthermore, to address the different scales and units of the variables, the initial sample is centred-reduced, such that the mean is equal to zero and the standard deviation is equal to one.

constructed[6], a high level of explanatory power that fully justifies the use of this component to summarise the information contained in the various selected variables.

## IV.3. Institutional data

We use 13 indicators of the efficiency of *structures that affect economic relations* to measure the functioning of the economic and institutional environment. Two different composite indicators are constructed from the combination of these variables, and one distance measure is constructed for each indicator (see Table 1).

The first institutional index we construct is composed of six indicators. Among these, four indicators measure the quality of governments and their policies: corruption index, government effectiveness, political stability, and regulatory quality. The first captures the extent to which public power is exercised for private gain. The second is sensitive to the quality of public services, their independence from political pressure and the credibility of government commitments. Political stability indicates views about the probability that a government could be destabilised or overthrown by unconstitutional or violent means. The final indicator measures the ability of government to formulate and implement policies and regulations that promote development of the private sector. These indicators are made available by the World Governance Indicators project of the World Bank. Two additional variables, which also measure the quality of regulatory policy and the institutional environment faced by firms and their access to information, are employed in the construction of this first index. Credit rights measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus the functioning of the credit market. The Information index measures rules affecting the scope, accessibility, and quality of information available through either public or private credit registries.

[6] For index 1, 68%; 40% in index 2.

These two variables are made available by the Doing Business project of the World Bank.

The second institutional index is composed of the six indicators presented below and seven others[7]. Three of the indicators concern bureaucratic practices and laws imposed on businesses: the costs of executing a contract, of registering a property and of starting a business. Two other indicators measure trade institutions: cost to export and cost to import, both measured as cost per container in U.S. dollars. These five indicators are provided by the World Bank's Doing Business project. An additional indicator is employed to measure governments' protectionist policies: the simple mean applied tariff rate, as a percentage of price, for all traded goods. This indicator is calculated in the Global Development Indicators, using data from the Trade Analysis and Information System of the United Nations and the Integrated Data Base of the World Trade Organization. The seventh measure used is the private credit to GDP ratio, which indicates the financial resources provided to the private sector through loans, purchases of non-equity securities, and trade credits. This variable indicates financial constraints in the economy and is provided by the International Monetary Fund.[8]

[7] The main criterion used in selecting variables and in their division into the two composite indexes is the availability of data.

[8] An increase in all 13 indicators employed in both indexes indicates development of the institutional environment, such that an increase in the two composite indexes proposed in this section indicates an improvement in institutional quality. Nevertheless, this is not the objective of this exercise, which is mainly to measure the difference in institutional environments across countries.

# IV. Results

Our model suggests that institutional distance reduces both the extensive and intensive margins of FDI. This section presents empirical results that verify the propositions of the model, using two alternative datasets. The first uses data on OECD countries' outward FDI, while the second uses data on the OECD countries' inward FDI. We find differences between the determinants of outward and inward FDI, differences that help explain the contrasting patterns of FDI outflows between developing and developed countries.

## IV.1. Determinants of OECD countries' outward FDI

First, we nominated an exogenous variable correlated with the selection indicator $S_{ij}$ but not with FDI stocks. Column 1 of Table 2 shows that the contiguity dummy variable and the colonial tie dummy variable are good candidates for such a variable, as they are not significantly correlated with FDI. The estimates of the probit model indicate that the colonial tie dummy variable is significantly correlated with the selection indicator, but the contiguity dummy is not. Thus, we use the colonial tie dummy variable as an exogenous variable in the selection equation and not in the primary equation.

Column 2 presents the probit estimates of the selection equation, or the extensive margin. The results indicate that GDP per capita in the source country, similarity in size between the countries, common language, and colonial ties increase the number of firms from country i investing in country j, but geographical and institutional distance reduce this number. This result is robust to estimates based on the second index of institutional distance (column 4).

The probit estimates provide information regarding the main determinants of the extensive margin. However, using these estimates can lead to serious bias when estimating the primary equation, or the intensive margin (Wooldridge, 2002). We estimate the parameter for the number of MNEs from country i in country j ($\hat{z}_{ij}$), using different probit estimates for each year t. We then add $\hat{z}_{ij}$ to the primary equation to estimate the determinants of the amount of FDI, or the intensive margin. Column 3 presents the results for the primary equation, using the first index of institutional distance. On the one hand, bilateral FDI increases in the number of investing firms ($\hat{z}_{ij}$), GDP per capita of both the source and host countries, similarity in size and common language. On the other hand, bilateral FDI declines with both geographical and institutional distance. Like the probit estimates, the PPML estimates are quite similar for the second index of institutional distance presented in column 5.

The results show similar determinants of the intensive margin (selection equation) and the extensive margin (primary equation). However, the extensive margin is more sensitive to similarities in GDP level, common language, and institutional distance, but less sensitive to geographical distance. GDP per capita of the host country is not significant for the intensive margin but is significant for the extensive margin. However, similar GDP levels are more important than the host country's GDP per capita.

# IV.2. Determinants of OECD countries' inward FDI

We proceed to estimate the results using inward FDI instead of outward FDI. The results are presented in Table 3. First, we identify an exogenous variable correlated with $S_{ij}$ and not with $FDI_{ij}$. Column 1 indicates that the colonial ties dummy is not correlated with FDI. Thus, we use the colonial ties variable as an exogenous variable in the selection equation, but we exclude it from the primary equation.

Columns 2 and 4 present the probit estimates of the selection equation. The likelihood that a firm from country i invests in country j increases with similarities in size and culture, but this likelihood decreases with geographical and institutional distance. The results are robust to changing the institutional index. Institutional distance reduces the number of firms that engage in FDI, as suggested by the model.

We estimate $\hat{z}_{ij}$ using different probit estimates for each year t; we then add $\hat{z}_{ij}$ to the primary equation to estimate the determinants of FDI volume. Columns 3 and 5 indicate that FDI volume also increases in the number of MNEs, GDP per capita of the host country, similarities in size between the source and host countries and common language but declines in geographical and institutional distance. Among these variables, only GDP per capita is not correlated with the selection indicator. More importantly, the extensive margin is more sensitive than the intensive margin to GDP and language similarities but less sensitive to geographical distance. The difference in sensitivity to institutional distance between the two margins is, however, small.

## IV.3. Institutional distance and FDI patterns

The results, presented in Tables 2 and 3, highlight similarities and differences in the patterns of outward and inward FDI. GDP per capita of the host economy increases the volume of FDI but does not affect the likelihood that new firms will engage in both outward and inward FDI. Average income in the host economy appears to increase the profitability of investment, which encourages firms to undertake the largest investments in the most developed countries.

GDP per capita of the source country is very important in outward FDI of OECD countries but insignificant in inward FDI. The wealthiest OECD countries are present in more countries and invest larger amounts than less developed OECD countries.

OECD countries also attract FDI from various locations but not necessarily from the most developed countries.

Similarities in economic size and culture increase both the number of investing firms and the volume of FDI. Similarity of GDP levels is, however, a stronger determinant of inward FDI than of outward FDI. As OECD countries are among the largest economies in the world, this result suggests that among non-OECD countries, differences in the investment capacities between small and large countries are larger than differences in the abilities of small and large countries to attract FDI from OECD countries.

As our model suggests, institutional distance influences which firms will engage in FDI, or the extensive margin. However, the costs of institutional distance for developed and developing countries are asymmetric. OECD inward FDI is more sensitive to institutional distance than OECD outward FDI. According to our model, institutional distance is a cost that increases the productivity threshold above which FDI is profitable. As firms from non-OECD countries are on average less productive than firms from OECD countries, the probability that the productivity of such firms will exceed the productivity threshold is lower than for firms from OECD countries.

The theoretical model proposes that institutional distance also reduces the profitability of investment and the volume of FDI undertaken. The empirical results validate this proposition. In addition, our results show that the sensitivity of FDI volume to institutional distance is similar for OECD and non-OECD firms. The effect of institutional distance on the profitability of investment is thus similar for OECD and non-OECD countries.

# Conclusion

We propose a theoretical model to explain the impact of institutional distance on FDI. We assume that institutional distance imposes a cost on investors. Precisely, investors must interact with foreign institutions to obtain credit and complete administrative, bureaucratic, and legal procedures when investing abroad; institutional proximity increases the expertise available to cope with these procedures. The model suggests that institutional distance influences both the decision to invest abroad (extensive margin) and the volume of investment a firm undertakes (intensive margin). As adaptation costs increase with institutional distance between source and host countries, institutional distance determines the productivity threshold at which FDI is more profitable than exporting as a means of entering a foreign market. Increases in institutional distance raise this threshold and the number of firms that undertake FDI decreases. In addition, institutional distance also affects the total volume of FDI undertaken by the source country in the host economy by affecting the extensive margin and firms' profitability.

We conduct an empirical investigation to validate our model, using data on FDI of OECD countries. Using alternative indicators of institutional distance, the results suggest that both the extensive and intensive margins of FDI decrease as institutional distance increases. Institutional distance plays an important role in FDI. First, institutional distance reduces the number of firms for which FDI is sufficiently profitable that they prefer exporting over this mode of implantation. Second, institutional distance reduces the profitability of FDI such as the amount of firms' FDI decreases with this distance.

Institutional distance has differing effects on OECD countries' outward and inward FDI. In particular, institutional distance is more important for OECD countries' inward FDI than for their outward FDI. This indicates that there is an asymmetry in bilateral FDI flows between developed and developing countries. Perceived

institutional distance from a developed country to a developing country and from the same developing to the developed country are not equal. Firms from developed countries can more easily cope with the costs of institutional distance, which explains why FDI flows from developed countries are larger than FDI flows from developing countries.

In addition to institutional distance, differences in economic size and in geographical and cultural distance discourage FDI. So, to date, proximity has been a major determinant of bilateral FDI. As cultural and economic proximity cannot be modified in the short run, authorities in developing countries should focus on improving institutions to improve FDI performance.

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# Appendix

**Figure 1. Productivity thresholds and profits from exporting and FDI.**

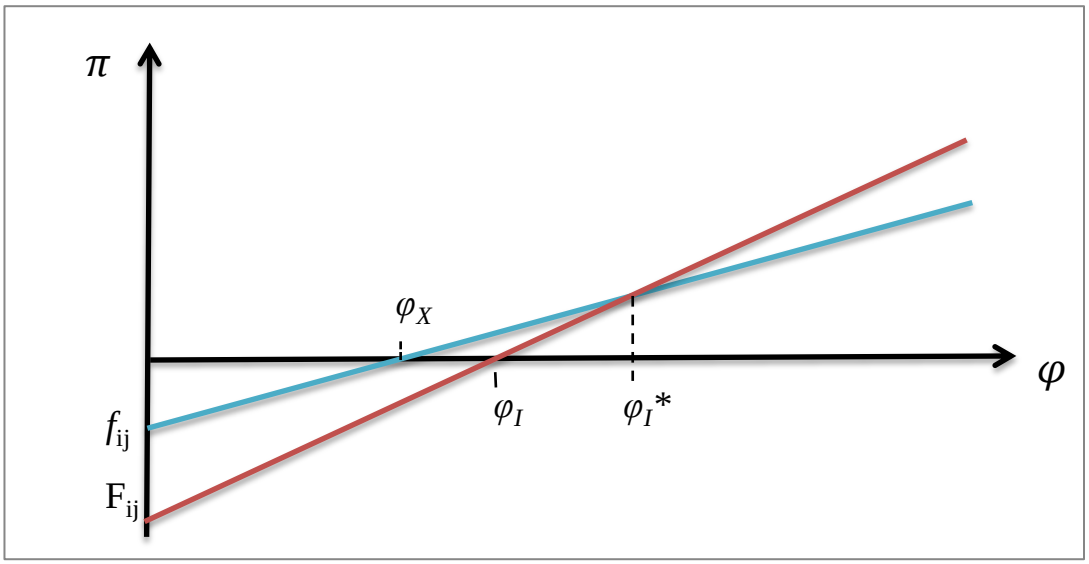



**Table 1. Institutional indexes**

| Variables | Index 1 | Index 2 |
|---|---|---|
| Corruption | Yes | Yes |
| Government effectiveness | Yes | Yes |
| Political stability | Yes | Yes |
| Regulatory quality | Yes | Yes |
| Credit rights | Yes | Yes |
| Information index | Yes | Yes |
| Cost to execute a contract | | Yes |
| Cost to register a property | | Yes |
| Cost to start a business | | Yes |
| Cost to export | | Yes |
| Cost to import | | Yes |
| Protectionist policy | | Yes |
| Private credit | | Yes |

## Table 2. Extensive and intensive margins of outward FDI

| *Estimation method* | *PPML* | | *Probit* | | *PPML* | | *Probit* | | *PPML* | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Dependent variable* | $FDI_{ij}$ | | $S_{ij}$ | | $FDI_{ij}$ | | $S_{ij}$ | | $FDI_{ij}$ | |
| | (1) | | (2) | | (3) | | (4) | | (5) | |
| Source GDP per capita | 2.283 | ** | 2.347 | ** | 2.662 | ** | 2.347 | ** | 2.608 | ** |
| | (0.867) | | (0.493) | | (0.983) | | (0.498) | | (0.962) | |
| Host GDP per capita | 1.145 | ** | -0.131 | | 1.173 | ** | -0.069 | | 1.118 | ** |
| | (0.245) | | (0.253) | | (0.264) | | (0.258) | | (0.255) | |
| GDP Similarity | 0.172 | ** | 0.152 | ** | 0.215 | ** | 0.151 | ** | 0.234 | ** |
| | (0.055) | | (0.037) | | (0.051) | | (0.037) | | (0.049) | |
| Geographical distance | -0.479 | ** | -0.717 | ** | -0.394 | ** | -0.718 | ** | -0.402 | ** |
| | (0.063) | | (0.045) | | (0.052) | | (0.046) | | (0.053) | |
| Contiguity dummy | -0.022 | | -0.157 | | 0.039 | | -0.142 | | 0.027 | |
| | (0.151) | | (0.239) | | (0.132) | | (0.242) | | (0.129) | |
| Common language | 0.676 | ** | 0.387 | ** | 0.716 | ** | 0.383 | ** | 0.667 | ** |
| | (0.133) | | (0.096) | | (0.115) | | (0.096) | | (0.110) | |
| Colonial tie dummy | 0.239 | | 1.161 | ** | | | 1.164 | ** | | |
| | (0.138) | | (0.148) | | | | (0.149) | | | |
| Institutional distance Index 1 | | | -0.053 | * | -0.099 | ** | | | | |
| | | | (0.025) | | (0.027) | | | | | |
| Institutional distance Index 2 | | | | | | | -0.056 | * | -0.093 | ** |
| | | | | | | | (0.027) | | (0.026) | |
| $\hat{z}_{ij}$ | | | | | 1.144 | ** | | | 1.148 | ** |
| | | | | | (0.147) | | | | (0.151) | |
| $\hat{z}_{ij}^2$ | | | | | -0.432 | ** | | | -0.435 | ** |
| | | | | | (0.102) | | | | (0.104) | |
| $\hat{z}_{ij}^3$ | | | | | 0.056 | ** | | | 0.057 | ** |
| | | | | | (0.019) | | | | (0.019) | |
| Observations | 23064 | | 22755 | | 22755 | | 22476 | | 22476 | |
| $R^2$ | 0.87 | | 0.54 | | 0.89 | | 0.54 | | 0.89 | |

Notes: * Significant at 5%, ** significant at 1%. Standard errors robust to country-pair clustering recorded in parentheses. Each regression includes a constant. Time, source-country and host-country dummies not reported. Reported R-squared values for probit regressions correspond to pseudo R-squared values.

## Table 3. Extensive and intensive margins of inward FDI

| *Estimation method* | *PPML* | | *Probit* | | *PPML* | | *Probit* | | *PPML* | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Dependent variable* | $FDI_{ij}$ | | $S_{ij}$ | | $FDI_{ij}$ | | $S_{ij}$ | | $FDI_{ij}$ | |
| | (1) | | (2) | | (3) | | (4) | | (5) | |
| Source GDP per capita | 0.775 | | -0.346 | | 0.907 | | -0.341 | | 0.942 | |
| | (0.726) | | (0.259) | | (0.734) | | (0.263) | | (0.712) | |
| Host GDP per capita | 2.288 | ** | 0.641 | | 2.256 | ** | 0.744 | | 2.201 | ** |
| | (0.575) | | (0.494) | | (0.603) | | (0.498) | | (0.571) | |
| GDP Similarity | 0.332 | ** | 0.241 | ** | 0.366 | ** | 0.242 | ** | 0.382 | ** |
| | (0.064) | | (0.039) | | (0.067) | | (0.039) | | (0.064) | |
| Geographical distance | -0.473 | ** | -0.616 | ** | -0.440 | ** | -0.615 | ** | -0.464 | ** |
| | (0.057) | | (0.044) | | (0.046) | | (0.044) | | (0.047) | |
| Contiguity dummy | 0.222 | | -0.079 | | 0.234 | | -0.088 | | 0.172 | |
| | (0.129) | | (0.200) | | (0.121) | | (0.202) | | (0.123) | |
| Common language | 0.525 | ** | 0.476 | ** | 0.564 | ** | 0.475 | ** | 0.537 | ** |
| | (0.131) | | (0.103) | | (0.128) | | (0.103) | | (0.108) | |
| Colonial tie dummy | 0.159 | | 0.723 | ** | | | 0.733 | ** | | |
| | (0.116) | | (0.146) | | | | (0.146) | | | |
| Institutional distance Index 1 | | | -0.080 | ** | -0.075 | * | | | | |
| | | | (0.025) | | (0.029) | | | | | |
| Institutional distance Index 2 | | | | | | | -0.106 | ** | -0.109 | ** |
| | | | | | | | (0.027) | | (0.028) | |
| $\hat{z}_{ij}$ | | | | | 1.153 | ** | | | 1.136 | ** |
| | | | | | (0.207) | | | | (0.211) | |
| $\hat{z}_{ij}^2$ | | | | | -0.605 | ** | | | -0.597 | ** |
| | | | | | (0.134) | | | | (0.134) | |
| $\hat{z}_{ij}^3$ | | | | | 0.091 | ** | | | 0.089 | ** |
| | | | | | (0.024) | | | | (0.024) | |
| Observations | 23064 | | 22755 | | 22755 | | 22476 | | 22476 | |
| $R^2$ | 0.90 | | 0.57 | | 0.90 | | 0.57 | | 0.91 | |

Notes: * Significant at 5%, ** significant at 1%. Standard errors robust to country-pair clustering recorded in parentheses. Each regression includes a constant. Time, source-country and host-country dummies not reported. Reported R-squared values for probit regressions correspond to pseudo R-squared values.

# Conclusion Générale

Cette thèse étudie l'impact des institutions, notamment les institutions financières, sur le commerce et les investissements internationaux. Les quatre premiers chapitres de la thèse étudient les institutions financières et leur impact sur le commerce et la spécialisation internationale. Précisément, le premier chapitre étudie ces institutions et les déterminants de leur niveau de développement. Le deuxième chapitre analyse la façon dont la finance intervient sur le commerce bilatéral. Le troisième chapitre construit un modèle théorique qui vise à expliquer l'impact de la finance sur le commerce sectoriel en fonction du degré d'intensité financière de chaque secteur. Le quatrième chapitre analyse l'impact hétérogène de la finance sur les différents secteurs manufacturiers. Le dernier chapitre de la thèse utilise le terme "institution" dans un sens plus large et étudie théoriquement et empiriquement si les similitudes et différences dans les environnements institutionnels à travers des pays explique la distribution internationale des investissements directs étrangers (IDE).

Le développement financier reflète l'équilibre entre les épargnants et les emprunteurs, et la maximisation de leur intérêt. Pour favoriser cet équilibre de manière efficace, les systèmes financiers doivent correctement remplir les principales fonctions financières et réduire les frictions entre les agents économiques. Les six principales fonctions des systèmes financiers sont: (i) la mobilisation et l'allocation du capital ; (ii) la production et diffusion d'informations sur les agents économiques ; (iii) la maîtrise et le partage des risques ; (iv) le suivi des investissements et la gouvernance des entreprises ; (v) la réduction des coûts de transaction ; et (vi) la liquidité des marchés. Une mesure idéale du niveau de développement financier devrait être sensible à l'efficacité des intermédiaires financiers à remplir ces fonctions. Cette mesure n'est, malheureusement, pas disponible ni pour un nombre suffisant de pays ni d'années. Le premier chapitre de la thèse propose ainsi un nouvel indice financier composite construit à partir de l'analyse en composante principale de six indicateurs financiers et institutionnels. L'indice proposé possède trois avantages par rapport aux indicateurs financiers déjà utilisés : (1) l'indice présente une mesure plus complète du développement financier, (2) l'indice est moins dépendant des changements dans un

seul aspect des systèmes financiers, et (3) il est moins sensible aux effets conjoncturels.

Le deuxième chapitre étudie empiriquement l'impact du développement financier sur la variation marginale de la proportion de firmes exportatrices (marge extensive) et le volume total exporté par les pays (marge intensive). Le chapitre montre que la finance affecte positivement l'accès des firmes aux marchés étrangers et que le développement financier augmente la proportion de firmes en mesure d'accéder à ces marchés. En revanche, les résultats de l'estimation de la deuxième marge indiquent une relation non concluante, étant à la fois positive, négative ou statistiquement nulle. Le lien entre la finance et les flux commerciaux suit deux voies distinctes. En utilisant des données sur les secteurs manufacturiers (qui ne sont pas extensifs), d'autres travaux constatent que le développement financier se traduit par un avantage comparatif dans ces secteurs. D'un autre côté, ce chapitre de la thèse estime la relation à partir de données bilatérales, qui couvrent tous les secteurs économiques, et démontre que l'impact macro du développement financier sur le commerce n'est pas concluant. La spécialisation induite par le développement financier sur certains secteurs manufacturiers provoque également une baisse des exportations dans d'autres secteurs. Ces deux phénomènes opposés s'annulent de sorte que l'effet global de la finance sur les flux commerciaux soit non concluant.

Le chapitre 3 propose un modèle théorique pour expliquer les résultats empiriques du chapitre précédent. Le modèle est basé sur le cadre de firmes hétérogènes et celles-ci sont partagées en plusieurs secteurs différenciés par leur niveau d'intensité financière. L'économie est composée et deux pays spécifiés par leur niveau de développement financier et leurs coûts relatifs. Il est montré que le pays le plus développé financièrement dispose d'un avantage commercial dans les secteurs intensifs en finance tandis que l'avantage du pays offrant des coûts de production les plus faibles est dans les secteurs peu intensifs. En plus, les résultats théoriques indiquent que le développement financier affecte la structure des échanges uniquement dans les

secteurs les plus utilisateurs des systèmes financiers, en augmentant le nombre d'entreprises exportatrices et le volume exporté par ces secteurs.

Le chapitre 4 de la thèse teste et confirme empiriquement l'hypothèse que l'effet du développement financier sur le commerce manufacturier est hétérogène et varie selon le niveau sectoriel d'intensité financière. Plus précisément, il est montré que l'effet de la finance sur le commerce manufacturier varie selon les secteurs et leur dégrée d'intensité financière, étant négatif dans la plupart des secteurs peu intensifs et positif dans la plupart des secteurs les plus intensifs dans l'utilisation des systèmes financiers pour le financement des dépenses en capital. Par conséquent, le développement financier réduit les flux d'exportation dans le premier groupe de secteurs et augmente ceux du deuxième groupe, confirmant le modèle théorique développé dans le chapitre 3 et l'explication avancée dans le chapitre 2 pour expliquer les résultats sur l'effet des systèmes financiers sur le commerce global de tous les secteurs confondus.

Le dernier chapitre de la thèse étudie l'impact des similitudes et des différences dans les environnements institutionnels sur les investissements directs étrangers (IDE). Le modèle théorique suppose que les firmes multinationales supportent un coût important pour s'adapter aux nouvelles institutions des pays d'accueil des IDE et ce coût est moindre lorsque cet environnement institutionnel est semblable à celui du pays d'origine. Par conséquent, l'augmentation de la distance institutionnelle augmente les coûts d'implémentation et réduit à la fois le nombre de firmes multinationales et le montant investi par ces firmes. Les résultats des estimations empiriques confirment la proposition théorique et indiquent que la réduction de cette distance augmente à la fois le nombre de firmes qui effectuent les IDE (la marge extensive) et le montant engagé dans ces investissements (marge intensive).

Cette thèse contribue à la littérature par plusieurs apports importants. D'abord, le nouvel indice financier composite offre une nouvelle mesure du degré de développement financier, qui est plus complète et moins sensible aux modifications conjoncturelles de l'économie. Ensuite, l'analyse du chapitre 2 apporte une vision

globale de l'effet des systèmes financiers sur le commerce international. Le chapitre 3 démontre théoriquement que l'impact de la finance sur la spécialisation internationale ne s'applique pas uniquement à la dichotomie « commerce manufacturier – commerce de biens primaires » mais également à l'intérieur des secteurs manufacturiers. Le chapitre 4 démontre empiriquement que les effets de la finance sur le commerce manufacturier sont hétérogènes et que la finance impacte différemment les échanges des différents secteurs manufacturiers, en augmentant ou en diminuant les exportations en fonction du degré d'intensité financière de chaque secteur. Le dernier chapitre de la thèse apporte un nouvel indicateur de la proximité (ou distance) institutionnelle entre les pays et montre que celle-ci explique le mode d'insertion internationale des firmes multinationales.

Une limite de ces résultats est l'utilisation de données macroéconomiques pour l'analyse des décisions au niveau des firmes. Cette méthodologie est basée sur la proposition que la distribution de la productivité des firmes est fixe et, surtout, que celle-ci est exogène et n'est pas affectée par les variables macroéconomiques utilisées dans le modèle. Ces variables sont ainsi supposées affecter le seuil de productivité à partir duquel les firmes exportent mais pas la productivité elle-même. Une solution serait d'utiliser directement les données sur la productivité des firmes. Ces données n'étant pas disponibles dans une échelle globale, une piste future de recherche serait de les constituer. L'utilisation des données de firmes serait également une piste de recherche future. Cette analyse doit néanmoins porter sur une base de données constituée d'un nombre important de pays pour qu'une comparaison internationale soit effectuée et pour que cette méthodologie puisse répondre aux questions macroéconomiques posées par cette thèse. Une dernière piste de poursuite de ces études serait la réfection des données d'intensité financière mises à disposition par Rajan & Zingales (1998). Cet indicateur porte sur un nombre limité de secteurs et date des années 1980. Une mise à jour de ces données et l'augmentation de leur extension à un éventail plus large de secteurs pourraient améliorer la précision des résultats et élargir les possibilités de recherche sur les effets du développement

financier sur plusieurs variables macroéconomiques, notamment sur le commerce et la spécialisation internationale et les investissements directs étrangers.

# Résumé

Cette thèse étudie l'impact des institutions, notamment les institutions financières, sur le commerce et les investissements internationaux. Les quatre premiers chapitres étudient les institutions financières et leur impact sur le commerce et la spécialisation internationale. Précisément, le premier chapitre étudie ces institutions et les déterminants de leur niveau de développement. Le deuxième chapitre analyse la façon dont la finance intervient sur le commerce bilatéral. Le troisième chapitre construit un modèle théorique qui vise à expliquer l'impact de la finance sur le commerce sectoriel en fonction du degré d'intensité financière de chaque secteur. Le quatrième chapitre analyse l'impact hétérogène de la finance sur les différents secteurs manufacturiers. Le dernier chapitre de la thèse utilise le terme "institution" dans un sens plus large et étudie théoriquement et empiriquement si les similitudes et différences dans les environnements institutionnels à travers les pays explique la distribution internationale des investissements directs étrangers (IDE).

**Mots-clés :** Systèmes financiers ; Commerce international ; Spécialisation internationale ; Investissement direct étranger ; Firmes hétérogènes, Modèle de gravité.

# Abstract

This thesis examines the impact of institutions, especially the financial institutions, on international trade and foreign direct investments. The first four chapters study the financial institutions and their impact on trade and international specialization. Specifically, the first chapter examines these financial institutions and the determinants of their level of development. The second chapter examines how finance impacts bilateral trade. The third chapter builds a theoretical model and aims to explain the impact of finance on the sectoral trade as a function of the degree of financial intensity of each sector. The fourth chapter analyzes the heterogeneous impact of finance on the different manufacturing sectors. The last chapter of the thesis uses the term "institution" in a broader sense and studies theoretically and empirically whether the similarities and differences in institutional environments across countries explain the international patterns of foreign direct investment (FDI).

**Keywords:** Financial development; International trade; International specialization; Foreign direct investment; Heterogeneous firms; Gravity model.