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# Determinants of the causality between financial development and international trade

Minh Hong Phi

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Normandie Université

## THÈSE

**Pour obtenir le diplôme de doctorat  
Spécialité Sciences Économiques  
Préparée au sein de l'Université de Rouen Normandie**

### **Déterminants de la causalité entre le développement financier et le commerce international**

Présentée et soutenue par  
**Madame Minh Hong PHI**

Thèse soutenue publiquement le 2 décembre 2019 devant le jury composé de

Mme Sophie BRANA	Professeur des Universités, LAREFI, Université de Bordeaux	Rapporteur
Mr Francisco SERRANITO	Professeur des Universités, CEPN-UMR 7234, Université Paris Nord	Rapporteur
Mr Jean-Pierre ALLÉGRET	Professeur des Universités, GREDEG-UMR 7321, Université de Nice Sophia Antipolis	Suffragant
Mr Marc LAUTIER	Professeur des Universités, LIRIS, Université Rennes 2	Président de jury
Mme Cécile COUHARDE	Professeur des Universités, EconomiX-UMR 7235, Université Paris Nanterre	Co-directrice de thèse
Mme Thi Anh-Dao TRAN	Maître de conférences HDR, IRASEC-USR 3142 et Université de Rouen Normandie	Co-directrice de thèse

**Thèse dirigée par Thi Anh-Dao TRAN (MCF HDR, IRASEC-USR 3142 et Université de Rouen Normandie) et Cécile COUHARDE (PU, EconomiX-UMR 7235, Université Paris Nanterre)**



**A Thesis submitted for the Degree of  
*Doctor of Philosophy*  
in Economics  
at University of Rouen Normandy**

# **Determinants of the causality between financial development and international trade**

Presented and defended by  
**Minh Hong PHI**

**Public thesis defence on the 2nd December 2019 before the jury composed of**

Mrs Sophie BRANA	Professor, LAREFI, University of Bordeaux	Reviewer
Mr Francisco SERRANITO	Professor, CEPN-UMR 7234, University of Paris Nord	Reviewer
Mr Jean-Pierre ALLÉGRET	Professor, GREDEG-UMR 7321, Nice Sophia Antipolis University	Examiner
Mr Marc LAUTIER	Professor, LIRIS, Université Rennes 2	President of the jury
Mrs Cécile COUHARDE	Professor, EconomiX-UMR 7235, Paris Nanterre University	Co-supervisor
Mrs Thi Anh-Dao TRAN	Associate Professor, IRASEC-USR 3142 and University of Rouen Normandie	Supervisor

**Thesis co-supervised by Thi Anh-Dao TRAN (Associate Professor, IRASEC-USR 3142 and University of Rouen Normandie) and Cécile COUHARDE (Professor, EconomiX-UMR 7235, Paris Nanterre University)**

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*In loving memory of my Dad...*

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# Résumé

Les changements majeurs intervenus dans le commerce international correspondant à la participation importante des pays émergents au marché mondial remettent en cause la perception traditionnelle du commerce. Au lieu de se spécialiser dans la production pour laquelle ils disposent d'un avantage comparatif, les pays en développement considèrent la diversification des exportations comme un moyen alternatif d'améliorer la croissance économique et de réduire les chocs négatifs externes. Par ailleurs, la crise financière mondiale de 2008 soulève l'examen de la relation entre le taux de change réel (TCR) et le commerce international.

Dans une telle perspective, cette thèse tente d'étudier dans un premier temps le lien de causalité entre la diversification des exportations et le TCR dans les pays à revenu intermédiaire. Tout d'abord, nous trouvons une causalité bidirectionnelle entre nos deux variables d'intérêt. En décomposant leurs exportations par destination, le même lien bidirectionnel est enregistré dans le cas du commerce Sud-Nord, tandis que la causalité unidirectionnelle allant du TCR vers la diversification des exportations est marquée dans le commerce Sud-Sud.

Deuxièmement, nous comparons cette relation entre deux groupes de pays, l'Asie vs. l'Amérique latine et l'effet de deux crises financières (en 1997 et 2008) sur ce lien. Nous montrons que, sans considération des crises financières, il existe une causalité bidirectionnelle pour les pays d'Amérique latine et la relation conventionnelle allant du TCR vers la diversification des exportations pour les pays asiatiques. Toutefois, en tenant en compte des crises financières, la causalité bidirectionnelle est fondée dans les deux sous-groupes.

Troisièmement, nous abordons la question de l'effet de la diversification des exportations sur l'élasticité-prix des importations en comparant deux modèles d'intégration dans la région de l'Asie-Pacifique: les États-Unis avec le modèle d'intégration traditionnel, la Chine avec un modèle singulier d'intégration Sud-Sud. De manière générale, nous trouvons que l'élasticité-prix est négative pour les importations en provenance de la Chine et positive dans le cas des États-Unis. Lorsque leurs partenaires commerciaux réussissent à diversifier leurs destinations à l'exportation, les élasticités-prix des importations s'affaiblissent. Ces résultats questionnent la condition de Marshall-Lerner.

Quatrièmement, pour étudier comment un pays pourrait diversifier ses exportations, nous examinons si un choc de change peut être un facteur promouvant la productivité des entreprises. En utilisant la méthode des différences de différences sur les données au niveau des firmes pour les secteurs industriels vietnamiens, nous avons découvert un effet positif d'une appréciation persistante du dong vietnamien sur la productivité des entreprises. Nous confirmons que la recherche et le développement (R&D) pourrait expliquer le mécanisme par lequel une appréciation améliore la productivité des entreprises.

Mots-clefs: diversification des exportations, taux de change réel, chaînes de valeur mondiale,



intégration régionale, pays émergents asiatiques et latino-américains, productivité

Codes JEL: F14, F15, F41, F63, O11, O24, O53, O57

# Abstract

Major changes in international trade related to the crucial participation of emerging countries in world markets have been challenging the traditional perception of trade. Instead of only specializing in the products in which they have a comparative advantage, developing countries consider export diversification as an alternative way to improve economic growth and reduce external adverse shocks. Besides, the global financial crisis in 2008 raised the need for an examination of the relationship between real exchange rate (RER) and trade.

In this line, this thesis attempts to investigate the causal link between export diversification and RER in the middle-income countries. Firstly, we find a bidirectional causality between our two variables of interest. By differentiating the countries' exports by destination, the same bidirectional link is recorded in the case of South-North trade, while a unidirectional causality running from RER to export diversification is recorded in the South-South trade.

Secondly, we compare this relationship between two groups of countries, Asia *versus* Latin America, and the effect of the two financial crises (in 1997 and 2008) on this link. We show that, regardless of the financial crises, the bidirectional causality exists for the Latin American countries and the conventional link from RER to export diversification for Asian countries. However, when accounted for financial crises, the bidirectional causality is found in both subgroups.

Thirdly, we address the question of the effect of export diversification on price elasticity of imports in two models of integration in the Pacific-Rim, that is: the traditional model (the US) and a new model of integration (China). We find consistent negative price elasticity of imports for China and a positive one in the case of the US. When their trading partners are successful in diversifying their export destinations, import price elasticity of either China or the US becomes very low. This result challenges our awareness of the Marshall-Lerner condition.

Fourthly, to investigate how a country could diversify her exports, we look at real exchange rate shocks as a factor that may promote firm productivity. Using the difference-in-differences methodology on firm-level data for Vietnamese manufacturing, we find a positive effect of a persistent real appreciation in the Vietnamese dong on firm productivity. We note that research and development (R&D) could explain the mechanism by which real appreciation improves firm productivity.

Key words: export diversification, real exchange rate, global value chains, regional integration, emerging Asia and Latin America, productivity

JEL Codes: F14, F15, F41, F63, O11, O24, O53, O57

# Long résumé

Au cours des dernières décennies, l'un des changements les plus importants du commerce international a été la participation large et profonde des pays en développement au commerce international. Parmi eux, l'Asie est la région qui connaît la plus forte expansion en termes de parts des exportations et des importations.

Parallèlement à la montée d'un certain nombre de pays en développement asiatiques dans les années 80, le changement des exportations mondiales des marchandises inter- et intra-régionales est une raison importante de l'augmentation rapide de leur part dans le commerce mondial. Traditionnellement, les pays en développement exportent principalement des produits primaires et des produits dérivés des ressources pour importer des produits à plus haute intensité de main-d'œuvre et de technologie, généralement en provenance de pays avancés du Nord. Cependant, face à la baisse de la demande d'importation de produits de base dans les pays développés, les économies émergentes s'orientent vers les échanges entre eux, formant ainsi le modèle de commerce Sud-Sud, afin d'atténuer le choc de la demande d'importation du Nord. Selon le rapport de WTO (2013), durant la période 1990-2011, alors que la part des exportations Nord-Sud est restée stable, la hausse de celle dans les économies émergentes (Sud-Sud) a compensé la baisse de celle dans les pays développés (Nord-Nord).

Considéré comme une alternative au commerce traditionnel Nord-Sud, le commerce Sud-Sud permet aux pays émergents de diversifier leurs exportations (UNCTAD, 2006). D'une part, il est évident qu'en augmentant leurs exportations vers d'autres pays émergents, ils pourraient être moins influencés par le choc de la demande émanant de leurs partenaires développés et modérer la transmission des chocs internationaux défavorables (Newfarmer, Shaw, and Walkenhorst, 2009). D'autre part, ils pourraient réduire leur dépendance aux produits primaires en passant d'une exportation de produits à faible valeur ajoutée aux produits à plus forte valeur ajoutée. En effet, le secteur industriel est dominant dans le commerce Sud-Sud, avec la part des exportations industrielles représentant les deux tiers des exportations totales Sud-Sud en 2003 (Shirotori and Molina, 2009; WTO, 2003). Cependant, la composition des produits d'exportation diffère au niveau régional. Alors que les exportations des pays émergents asiatiques vers le Sud sont principalement liées aux secteurs industriels, les produits primaires et les produits provenant des ressources naturelles sont les principaux secteurs d'exportation en Amérique latine et en Afrique (Shirotori and Molina, 2009). Cette différence est importante pour mieux comprendre l'hétérogénéité des pays en développement. Par exemple, dans le contexte de la crise financière mondiale de 2008, Coud-

ert, Couharde, and Mignon (2011) montrent que la monnaie des pays producteurs de produits primaires comme l'Argentine, le Brésil et le Pérou, ou encore l'Afrique du Sud, semble être plus exposée aux tensions sur les marchés des produits de base. Dans le même temps, l'effet de la volatilité de l'indice des marchés boursiers développés sur la flexibilité des devises est signalée dans les pays asiatiques (Chine, Inde, Philippines).

La différence dans la composition des marchandises d'exportation pourrait s'expliquer par la décomposition de la production en Asie de l'Est, qui donne lieu à un schéma de commerce "triangulaire", surtout pour le secteur industriel. Dans ce type de commerce, les intrants de biens intermédiaires sont exportés vers les pays les plus industrialisés, tels que la Chine, par exemple, où ils sont utilisés pour produire des biens destinés à être exportés vers les pays développés. Dans ce cas, le commerce triangulaire entraîne une augmentation simultanée des exportations Sud-Sud et Sud-Nord; cependant, si l'on regarde du côté des importations, seules celles relatives au commerce Sud-Sud s'accroissent (UNCTAD, 2006). Ce schéma de commerce pourrait expliquer la part croissante du commerce Sud-Sud dans les exportations mondiales mentionnées au-dessus.

Parmi les moteurs de la performance à l'exportation, la littérature sur la croissance tirée par les exportations montre qu'il est avantageux de maintenir les prix des produits exportables à des niveaux compétitifs afin de les rendre attractifs via la ré-allocation des ressources productives. Le taux de change réel (TCR), qui reflète le mouvement relatif sous-jacent des prix dans le pays et à l'étranger, s'avère avoir un effet significatif sur les résultats à l'exportation. L'utilisation du TCR pour allouer des ressources au secteur manufacturier peut favoriser les exportations sans faire baisser les prix car la demande extérieure est élastique, contrairement à la situation des produits de base. Lorsque le TCR et la diversification des exportations sont corrélés, la plupart des études se concentrent sur le TCR en tant que déterminant de la diversification des exportations: la sous-évaluation et la stabilité des TCR favorisent la diversification des exportations en augmentant la rentabilité du secteur des exportations. Toutefois, les expériences des premiers Nouveaux Pays Industrialisés (NPI) d'Asie, et plus récemment de la Chine, pourraient indiquer un lien de causalité inverse: la structure du commerce et les facteurs structurels peuvent avoir une incidence sur les résultats liés au commerce, tels que les prix relatifs. En fait, la composition des exportations de la Chine est bien plus variée que les modèles économiques ne le prédisent. Il se peut qu'en diversifiant les échanges dans le cadre de leur participation aux chaînes de valeur mondiales (CVM), ces pays aient réussi à faire baisser leurs prix de fourniture en augmentant leurs capacités de production pour l'exportation et en renforçant leurs secteurs marchands. Malgré les risques d'inégalité de pouvoirs et de répartition des marges entre les fournisseurs, l'échelle compte, ce qui permet de maintenir des coûts de production peu élevés. Dans ce cas, la diversification des échanges peut affecter le TCR via le changement de prix relatif.

En outre, la croissance rapide de la part de la Chine dans le commerce international pourrait inquiéter d'autres pays en développement quant à leur compétitivité. Cependant, la puissance croissante de la Chine laisse également espérer de meilleurs résultats à l'exportation des pays en développement

grâce aux processus d'amélioration de la qualité et de diversification des produits. En tant que région la plus dynamique, la région Asie-Pacifique attire l'attention de la Chine et des États-Unis, se traduisant par deux grands accords régionaux de libre-échange (ALE), le Partenariat transpacifique dirigé par les États-Unis (remis en cause par l'actuel président Donald Trump) et le Partenariat économique global, impliquant la Chine. Ces deux ALE cachent deux types d'intégration régionale Nord-Sud: (i) le schéma traditionnel Nord-Sud dirigé par un pays avancé, où les marchandises sont exportées directement des économies émergentes vers les économies avancées, (ii) un "nouveau" schéma d'intégration Nord-Sud où la Chine joue un rôle central, dont les exportations vers le Nord reposent sur le commerce Sud-Sud. Cette structure triangulaire des échanges implique que tout effet de changement de la monnaie chinoise (RMB) est répercuté sur les fournisseurs tiers. Par conséquent, alors que l'effet négatif de l'appréciation réelle du RMB sur les exportations chinoises est confirmé, l'impact sur les importations est devenu moins évident.

Jusqu'à présent, comment un pays pourrait-il accroître ses exportations et diversifier ses exportations? Pour répondre à cette question, sur la base de Melitz (2003), nous examinons la productivité et la décision des entreprises d'exporter. Pour exporter, les entreprises sont confrontées à des coûts nouveaux et importants liés à leur entrée sur les marchés étrangers. Par conséquent, une entreprise représentative doit atteindre et maintenir un niveau de productivité minimal pour être suffisamment rentable afin de devenir un exportateur tout en faisant face à de nouveaux concurrents disposant de nouvelles parts de marché et d'une nouvelle variété de produits. Confirmant cette idée, une conclusion empirique importante de la littérature est que les exportateurs ont tendance à être plus productifs que les non-exportateurs. Un certain nombre de facteurs peuvent affecter la productivité des entreprises. Dans cette thèse, nous examinons un facteur possible qui est le TCR et tentons de déterminer son lien avec la productivité des entreprises dans un pays en développement. Dans cette optique, le TCR pourrait influencer la productivité de l'entreprise, donc sa décision d'entrer ou de sortir du marché d'exportation. Cet impact pourrait également renforcer ou atténuer la capacité des entreprises exportatrices à étendre la gamme de produits.

Motivée par les observations ci-dessus, cette thèse a pour objectif d'explorer le lien de causalité entre la diversification des exportations et le taux de change réel dans les pays en développement. En nous intéressant uniquement aux dynamiques de court et de moyen terme, nous ne traitons ni du mésalignement du taux de change ni de la volatilité du taux de change, mais nous concentrons plutôt sur la relation entre le commerce international et le taux de change réel. De cette façon, nous essayons d'examiner non seulement les facteurs de la demande, mais également ceux de l'offre.

En particulier, la thèse tente de répondre aux quatre questions principales suivantes:

- Premièrement, existe-t-il un lien de causalité univoque entre la diversification des exportations et le taux de change réel?
- Deuxièmement, les deux crises financières affectent-elles le lien entre la diversification des exportations et le TCR?

- Troisièmement, comment la diversification des exportations influence-t-elle l'élasticité des prix à l'importation?
- Quatrièmement, comment le taux de change réel affecte-t-il la productivité des entreprises?

Après un premier chapitre revoyant la littérature sur le sujet, le chapitre 2 aborde la première question en examinant le lien de causalité entre la diversification des exportations et le taux de change réel des pays à revenu intermédiaire d'Asie et d'Amérique latine. Nous comparons cette direction causale en distinguant un partenariat Nord-Sud *versus* Sud-Sud. Pour approximer la diversification des exportations, nous utilisons l'indice de Herfindhal-Hirschman (IHH), d'où plus IHH est faible, plus les exportations sont diversifiées. En utilisant le test de causalité de Granger complété par Dumitrescu and Hurlin (2012) pour les données de panel, nous trouvons une causalité bidirectionnelle entre nos deux variables d'intérêt lorsque nous prenons l'échantillon de pays dans son ensemble. Cela implique que ni la diversification des exportations ni le TCR ne peuvent être considérés comme exogènes. En divisant leurs exportations par destination, le même lien bidirectionnel est enregistré dans le cas du commerce Sud-Nord. Ce résultat conteste l'argument standard sur la détermination du taux de change. Cependant, dans le commerce Sud-Sud, nous obtenons la causalité unidirectionnelle allant du TCR vers la diversification des exportations, ce qui est cohérent avec la littérature standard. Au niveau des pays individuels, nous trouvons cinq pays avec une causalité bidirectionnelle dans leurs exportations destinées aux marchés du Nord, seulement trois pays pour lesquels le lien conventionnel du TCR à la diversification des exportations est validé. Pour les autres pays, la causalité est hétérogène.

La deuxième question est traitée dans le chapitre 3. En raison de la différence entre les échanges Sud-Sud au niveau régional évoquée ci-dessus, nous comparons le lien diversification des exportations-TCR entre deux groupes de pays émergents, l'Asie *versus* l'Amérique latine. En outre, nous examinons également deux crises financières susceptibles d'affecter nos résultats: la crise financière asiatique de 1997 et la crise financière mondiale de 2008. En utilisant le même échantillon et la même méthodologie que le chapitre précédent, nous montrons que, quelle que soit la crise financière, une causalité bidirectionnelle existe pour les pays d'Amérique latine. Dans le cas de l'Asie, seule la liaison conventionnelle reliant le TCR à l'IHH est confirmée. Lorsqu'on examine deux crises financières, les résultats du sous-échantillon latino-américain restent robustes. Pour le sous-groupe asiatique, nous obtenons la même causalité bidirectionnelle avec un lien clairement négatif, ce qui signifie que la diversification des exportations aide à maintenir des niveaux de TCR compétitifs. Ces résultats semblent révéler des effets divergents des crises financières d'un pays à l'autre dans les deux régions.

Dans le chapitre 4, nous abordons la troisième question concernant l'effet de la diversification des exportations sur l'élasticité-prix des importations de la Chine et des États-Unis, représentatifs de deux modèles d'intégration, respectivement le nouveau modèle Sud-Sud et le modèle traditionnel Nord-Sud. Nous considérons leurs partenaires commerciaux dans la région d'Asie Pacifique, qui participent à deux accords régionaux de libre-échange (ALE), soit l'accord de partenariat transpacifique (TPP) soit

le partenariat économique régional global (RCEP). Nous effectuons les analyses d'une part, au niveau des importations globales, où nous ne parlons pas de diversification des exportations, d'autre part au niveau bilatéral, où nous incluons différents types de diversification des exportations. Les deux méthodes confirment un résultat contrasté entre deux intégrations régionales: une élasticité-prix négative des importations chinoises et positive dans le cas des États-Unis. De plus, lorsque les partenaires commerciaux réussissent à diversifier leurs destinations d'exportation, l'élasticité-prix des importations de la Chine et des États-Unis (en termes absolus) s'affaiblit. Dans ce cas, la condition de Marshall-Lerner peut ne pas être vérifiée. En particulier, dans le cas de la Chine, une appréciation réelle peut réduire les exportations et les importations du fait de la diversification des échanges. Par conséquent, il n'est pas évident que l'excédent initial sera réduit si la baisse de ses exportations reste inférieure à celle des importations.

Le chapitre 5 tente de répondre à la dernière question. Dans ce chapitre, nous examinons l'effet d'un mouvement persistant du taux de change réel sur la productivité des entreprises dans le secteur industriel vietnamien. Pendant la période 2000-2015, nous observons une appréciation réelle persistante du dong vietnamien depuis 2004. En utilisant la méthode de la différence des différences, nous définissons la période 2000-2004 comme la période avant le choc du TCR et 2004-2015 la période de ce choc. Nous appliquons cette méthodologie aux entreprises survivantes tout au long de la période car, en décomposant la croissance de la productivité globale, nous observons une contribution importante de ce groupe d'entreprises par rapport aux entreprises entrantes et sortantes. Nous obtenons des résultats cohérents selon lesquels une appréciation réelle persistante pourrait améliorer la productivité des entreprises dans le cas du Vietnam.

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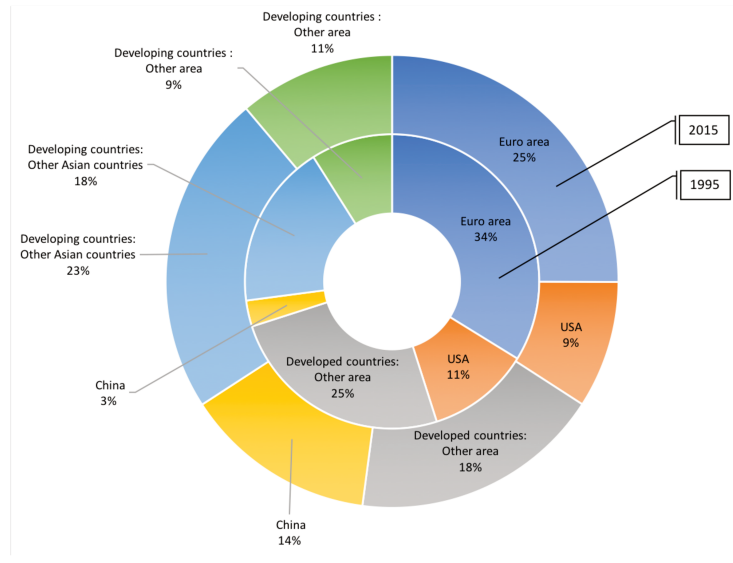
# General Introduction

## Context

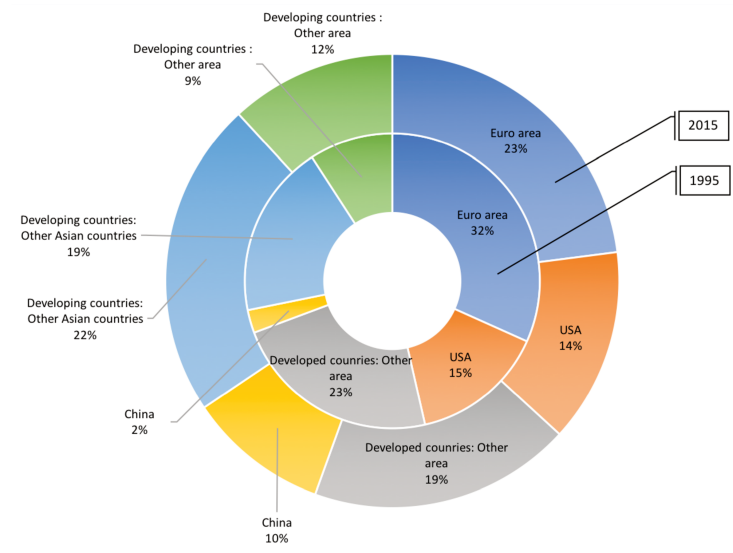
Over the last few decades, one of the most important changes in international trade is the larger and deeper participation of developing countries. As shown in Figure 1, their share of exports and imports grew by 50 percent in the period 1995-2015, representing nearly a half of the total in 2015. Among them, Asia is the region with the largest expansion in either export and import share.

Together with the rise of a number of Asian developing countries in the 1980s, the changing nature of trade in world exports within and between advanced and emerging countries was an important factor behind the fast-growing share in world trade of those countries. Traditionally, developing countries mainly exported their primary products and resource-based goods, they often traded to import more skill-intensive and technology-based products, usually from advanced countries in the North. However, facing the decline in import demand for primary commodities in developed countries, emerging economies orientated towards trading between themselves, forming the model South-South trade, to mitigate the shock of lower import demand from the North. In fact, as shown in the report of WTO (2013), during 1990-2011, while the share of North-South trade remained stable, the rise in the share of exports between emerging economies (South-South) offset the drop in the share of world merchandise exports between developed countries (North-North).

Considered as an alternative to the traditional North-South pattern of trade, South-South trade provides emerging countries with an opportunity for export diversification (UNCTAD, 2006). On the one hand, it is obvious that by expanding exports to other emerging countries, they could be less influenced by the demand shock from their developed partners and could moderate the transmission of adverse international shocks (Newfarmer et al., 2009). On the other hand, they could reduce their narrow dependence on primary commodities. Moreover, this could change the export category from low value-added to higher value-added products. Indeed, manufacturing is the dominant sector in South-South trade with the share of manufacturing exports accounting for two-thirds of total South-South exports by 2003 (Shirotori and Molina, 2009; WTO, 2003). However, there is still a difference in composition of export merchandise at the regional level. While exports from Asia to the South are mostly related to manufactured goods, primary commodities and natural resource-based products are leading export sectors in Latin America



(a) Export share



(b) Import share

Figure 1: Share in world merchandise exports and imports by level of development (percentage), 1995-2015 (Source: UNCTADstat)

and Africa (Shirotori and Molina, 2009). This difference is crucial for a better understanding of the heterogeneity among developing countries. For example, in the context of the global financial crisis in 2008, Coudert et al. (2011) show that the currencies of primary commodity producers such as Argentina, Brazil, Peru and South Africa seem to have been more exposed to stress in the commodity markets. Meanwhile, the effect of volatility from the developed stock market indexes on currency flexibility is reported in Asian countries (China, India, the Philippines).

The difference in composition of export merchandise could be explained by the growing importance of production sharing within East Asia which gives rise to a “triangular trade” pattern. In this pattern of trade, intermediate production inputs are exported from the more industrially advanced countries such as the Republic of Korea to China, for example, where these inputs are used to produce goods for exports



to developed countries. In this case, triangular trade makes both South-South and South-North exports experience a similar increase. However, from the point of view of imports, there is an increase only in South-South trade, and not in developing-country imports from developed countries (UNCTAD, 2006). This mechanism could also explain the growing share of South-South trade in world merchandise exports mentioned above.

## **Motivation and research questions**

Among the drivers of export performance, the literature on export-led growth points to the benefits of keeping the prices of exportable products at competitive levels in order to make it attractive for resources to flow into their production. The real exchange rate (RER) which reflects the underlying relative movement of prices at home and abroad, proves to have a significant effect on export performance. Using the RER to allocate resources into manufacturing can promote exports without driving down prices as external demand is elastic, unlike the situation with primary commodities. When the RER and export diversification are correlated, most studies focus on the RER as a determinant of export diversification: RER undervaluation and stability promote export diversification by increasing the profitability of the export sector. However, the early experience of the Asian NICs and more recently, of China, might show a reverse causation: the competitiveness of trade structure and the structural factors can have an impact on trade-related outcomes, such as relative prices. In fact, there is much more product variety in China's export mix than economic models would predict. It might be the case that by diversifying trade under their participation in GVCs, those countries have succeeded in lowering their supply prices through expanding export production capacities and enhanced tradable sectors. Despite the risks of unequal powers and distribution of rents between the suppliers, scale matters and this helps keeping low production costs. In that case, trade diversification may affect RER through the change in relative price.

Furthermore, the rapid growth of China's share of international trade could raise a concern in other developing countries about their competitive ability. However, China's increasing power also gives hope to promote the export performance of other developing countries through the processes of quality improvement and product diversification. As the most dynamic region, the Asia-Pacific Rim attracts the attention of both China and the US, represented by two major regional free trade agreements (FTAs), the Trans-Pacific Partnership, led by the US, and the Regional Comprehensive Economic Partnership, involving China. These two FTAs hide two kinds of North-South regional integration: (i) the traditional North-South pattern led by an advanced country, where goods are exported directly from emerging to advanced economies, (ii) a "new" North-South integration scheme with China playing the central role, whose exports to the North are based on South-South trade. This triangular pattern of trade implies that any effect of change in the Chinese currency (RMB) is passed through third-party suppliers. Therefore, while the negative effect of real appreciation of RMB on China's exports is confirmed, the impact on the import side is still in a black box.

At this stage, how can a country expand her exports and diversify exports over products and destinations? To answer this question, based on Melitz (2003), we look into the productivity and the decision of firms to export. In order to export, firms face new and significant costs associated with the entry into foreign markets. Therefore, a representative firm has to attain and maintain a cutoff level of productivity in order to be profitable enough to become an exporter while facing new competitors with new market shares and product variety. Confirming this idea, an important empirical finding of the literature is that exporters tend to be more productive than non-exporters. There might be a number of factors that can affect firm productivity. In this thesis, we look into one possible factor namely RER and try to find the linkage between RER and firm productivity in a developing country. In this line of thought, RER can have impact on firm productivity, therefore making firms entering or exiting the export market, stimulating or dampening their capability of extending the product range and scope.

Motivated by the above observations, this thesis aims to explore the connection between export diversification and the real exchange rate in developing countries in Asia and Latin America. Only interested in the dynamic in the short- and medium-term, we address neither exchange rate misalignment nor exchange rate volatility but rather concentrate on the relationship between international trade and real exchange rate. In this way, we attempt to look not only at demand factors but also consider the supply side.

Specifically, the thesis attempts to answer the following four main questions:

- Firstly, is there a causal link between export diversification and real exchange rate?
- Secondly, did the two financial crises affect the link between diversification through GVC-related exports and RER?
- Thirdly, how does export diversification influence the import price elasticities in regional integration?
- Fourthly, how does real exchange rate affects firm productivity?

Chapter 2 addresses the first question by examining the bidirectional causality between export diversification and the RER across destinations, meaning South-North trade *versus* South-South trade. The second question is worked out in Chapter 3. Because of the difference in South-South trade at regional level as mentioned above, we address our investigation in a comparative analysis between Asian and Latin American emerging countries and check whether the financial crises in 1997 and 2008 affected this causal link. The third question is examined in Chapter 4 by measuring China's price elasticities of imports in the presence of either bilateral export diversification or global export diversification of her partners. We also consider the case of the US for comparison. Chapter 5 attempts to deal with the last question. We use a rich firm-level data for Vietnamese manufacturing sector to explore the effect of real exchange rate shock on firm productivity.

## Empirical results and contributions

In Chapter 2, we examine the directional causality between export diversification and real exchange rate for Middle-Income Countries (MICs) of Asia and Latin America. We examine this direction across trading partners, that means, North-South *versus* South-South partnership. To proxy for export diversification, we use the Herfindhal-Hirschman Index (HHI), hence, the lower HHI, the more diversified are the exports. Using the Granger causality test augmented by Dumitrescu and Hurlin (2012) for panel data, we find a bidirectional causality between two variables of interests while accounting for all trading partners. This implies that neither export diversification nor RER can be considered exogenous. By splitting their exports by destinations, the same bidirectional link is recorded in the case of South-North trade. These results challenge the standard argument on exchange rate determination. However, in the South-South trade, we obtain the unidirectional causality running from RER to export diversification, which is consistent with standard literature. At individual country-level, we find five countries with bidirectional causality in their exports destined for the Northern markets, but only three countries for which the conventional link from RER to export diversification is validated. For the remaining countries, the causality is heterogeneous.

In Chapter 3, we compare the export diversification-RER nexus between two groups of emerging countries, Asia *versus* Latin America. Moreover, we also consider two financial crises that may affect our results: the East Asian financial crisis in 1997 and the Global financial crisis in 2008. Using the same sample and methodology as in the previous chapter, we show that regardless of the financial crisis, the bidirectional causality exists for the Latin American countries. In the case of Asia, only the conventional link running from RER to HHI is confirmed. When considering the two financial crises, the results for the Latin American sub-sample are still robust. For the Asia sub-group however, we obtain the same bidirectional causality with a clear negative link, meaning export diversification helps to maintain competitive RER levels. These findings seem to reveal divergent effects of financial crises across countries in the two regions.

In Chapter 4, we address the question about the effect of export diversification on price elasticity of imports of China and the US, representative for two models of integration, the new South-South pattern and the traditional North-South one, respectively. We consider their trading partners in the Pacific-Rim, who are involved in two regional free trade agreements (FTA), the Trans-Pacific Partnership (TPP) and the Regional Comprehensive Economics Partnership (RCEP). We perform the analyses in both aggregate import level, where we are silent in export diversification, and bilateral level, where we include different kinds of export diversification. Both methodologies confirm the contrasting figure of two regional integrations: negative price elasticity of Chinese imports and positive price elasticity in the case of the US. Moreover, when trading partners are successful in diversifying their export destinations, the import price elasticity of China and the US (in absolute terms) become too low. In that case, the Marshall-Lerner condition may not be verified. Particularly, in the case of China, a real appreciation can reduce exports

and imports as a result of trade diversification, therefore, it is not evident that an initial current surplus will be reduced if the decline in its exports remains lower than the decline in imports.

In Chapter 5, we investigate the effect of a persistent real exchange rate movement on firm productivity in the Vietnamese manufacturing sector. Over the period 2000-2015, we observe a persistent real appreciation in the Vietnamese dong since 2004. Using the difference-in-differences methodology, we define the period 2000-2004 as the pre-RER shock and 2004-2015 as the RER shock period. We apply this methodology for surviving firms throughout the period because, by decomposing aggregate productivity growth, we observe an important contribution of this group of firms relative to the entrants and exiters. We obtain consistent results that a persistent and sharp real appreciation may improve firm productivity in Vietnam's case.

## **Outline**

This thesis is structured as follows. Chapter 1 delivers the literature review on the relationship between real exchange rate and trade. Chapters from 2 to 5 embody the four central chapters of the thesis. Each of these chapters stands as an independent essay with the corresponding titles as following:

- Chapter 2: Export diversification and real exchange rate in emerging Latin America and Asia: A South–North vs. South-South decomposition
- Chapter 3: Global value chains and the missing link between exchange rates and export diversification
- Chapter 4: Should I stay or should I go? The role of Renminbi on trade partnerships in Asia
- Chapter 5: Real exchange rate and firm productivity in an emerging country

Finally, a last section summarizes our results and provides some concluding remarks.

# Chapter 1

## Literature review

Exchange rate and trade have had a tight relationship since early times when countries became involved in international markets to expand their prosperity. Understanding the complex relationship between exchange rate and trade is crucial, especially for developing countries where trade flows account for a significant component of their balance of payments due to less developed capital markets. The perception of this relationship has been changing throughout a long history of evolving exchange rate and trade policies.

The Bretton Woods Agreement, which established the rules for commercial and financial relations among major trading countries in 1944, put an end to the era of the gold standard and opened the new period of globalization. The objective of this agreement was to eliminate harmful forms of international restriction on trade and finance. Within the circumstance of extending international economic cooperation and rising integration following the agreement, one of the major concerns was related to the impact of devaluation on current account. A series of theoretical studies, such as elasticity approach, absorption approach and monetary approach, were developed as the basis for gaining insight of the relationship between exchange rate and trade. Accordingly, a currency devaluation would increase exports while decreasing imports, hence improving the current account. This relationship has been largely supported by a number of empirical studies. After the end of the Bretton Woods system, one strand of literature focused on the effect of exchange rate volatility on trade, however, this relationship is still unclear and controversial. Another line of studies which also received attention is the effect of misalignment currency on international trade. Nevertheless, the misalignment measurement is unclear, so the effect of misalignment currency on trade seems less robust.

In recent decades, there have been major changes in the pattern of international trade: the gradual integration of developing countries contributed to the strong performance of international trade since the 1990s; the financial crisis in 2008 after that one observed an important decrease in trade flows (according to the IMF statistics, exports decreased 11% for developed countries and 7.6% for developing countries), which is called the Great Trade Collapse (R. E. Baldwin, 2009); the growing regional agreements, es-

pecially in the Pacific Rim. In this context, many studies in the last decade detected that the exchange rate and trade flows do not follow the conventional rules. This leads to the necessity of reconsidering the relationship between exchange rate and trade.

To this end, this chapter attempts to review the literature on the relationship between exchange rate level and trade. Before doing so, it is worth making a brief history of exchange rate regimes - the context for the evolution of the studied relationship - and the traditional theories which explored the effect of currency devaluation on trade. This chapter is therefore structured as following: Section 1.1 covers the history of exchange rate regimes, Section 1.2 describes three major traditional approaches such as elasticity approach, absorption approach and monetary approach, Section 1.3 reviews different perspectives about the impact of exchange rate on trade, including the relationship between exchange rate and export diversification.

## **1.1 A brief history of the exchange rate regimes**

The history of exchange rate and international trade is crucial for a better understanding of how these two variables are related. This section attempts to outline the awareness about the historical relationship between exchange rate and international trade in the context of different international monetary systems.

International trade rose gradually in the 19th century due mainly to the industrial revolution in the late 18th century. The expansion of international trade helped countries to specialize in the products in which they had a comparative advantage. By specializing, countries could offset disadvantages due to limited natural resources. It broadened, however, the income gap between industrializing countries in the North and raw material producing countries in the South, a phenomenon which was referred as “the great divergence” (Pomeranz, 2009). From 1870 until 1914, one of the policies that affected international trade was the classic gold standard system, in which countries allowed the flow of gold across their territories, and with an agreement on price, they converted their currencies at the agreed rate. In turn, currency exchange rate changed according to the variation of market demand but not outside the so-called “gold-export points”. The classical gold standard was proved to be significantly associated with bilateral trade, and more specifically, increased international trade flows (Estevadeordal, Frantz, and Taylor, 2003; Meissner et al., 2003). This could be explained by the fact that the system ensured long-run price stability, so individual country had only to maintain a fixed price of gold (Bordo et al., 1981). However, the balance of payments and other transmission channels could make the country in question suffer from monetary and real shocks from other countries (Bordo, Schwartz, and Darby, 1989).

In World War I, the classical gold standard was broken because each country individually pursued its own interest and took disordered steps. In the early years of the interwar period, countries turned from

the fixed exchange-rate mechanism to the floating regime<sup>1</sup>. Advocates for fixed exchange rates criticised the floating exchange rate for deteriorating the balance of trade following an exchange rate depreciation. Nurkse (1944) argued that imports would increase since importers expect a further devaluation and thus an increase in import price, while exporters postponed their sales to get improved revenue in expectation of an increase in the price of exports. This argument is based on the French experience during 1922-1926 when the country underwent a speculative capital flight due to an anticipation of further decline by speculators following the franc depreciation. With regard to the “golden age” of trade and financial stability in the 19th century, and because of a gold shortage mainly due to wartime inflation, most countries held both gold and foreign exchange as international reserves. This monetary system was called “gold spread exchange standard”. The re-establishment of the gold standard led to a reduction of exchange rate volatility and less uncertainty in transnational transactions for all parties involved. However, unlike the pre-war gold standard, the gold exchange rate was not long lasting since the Great Depression in 1929-1932 brought it to an end. The sharp fall in international trade was likely a consequence of the tariffs increased by trading countries in response to the tightening of US monetary policy and the US tariff rises. Besides, deflation and depression which spread over the world during the Great Depression had one important cause in the commitment to gold convertibility (Eichengreen, 1992). A country might increase its trade deficit since its currency was overvalued if they stuck with the gold system while the others devalued. All things being equal, indeed, countries with stronger exchange rates usually tried to impose higher increases in their tariffs Eichengreen and Irwin (2010). Therefore, countries with the economies and banking systems adhered to the gold standard usually performed worse than the countries which left this system (Eichengreen and Sachs, 1985). In that case, greater devaluation had benefit in increasing export volume, more incentive to invest and lower probability of a banking crisis (Grossman, 1994). The demise of the international gold standard raised exchange-rate volatility and increased uncertainty in international transactions.

In order to outline a new international monetary and exchange rate system, representatives from 44 countries met in July 1944 at Bretton Woods, New Hampshire and subsequently adopted a system mainly based on fixed exchange rates, in which all members countries, except for the United States, fixed the price of their currency in terms of dollars. The Bretton Woods agreement was designed to provide enough flexibility to re-establish equilibrium in an attempt to prevent a recurrence of the interwar agonizing circumstance with floating exchange rates. Between 1948 and 1968, the total volume of merchandise exports from non-communist countries increased 290 percent, representing the highest growth rate of the twentieth century for international trade (Ashworth, 1987). Beside commercial policies and technological factors, the Bretton Woods international monetary system was considered as factor facilitating the growth of world trade because it helped trade development with a favourable and stable setting for multiparty payments. Indeed, Terborgh (2003) finds that as an important feature of participating in the

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<sup>1</sup>There were three international monetary system in the interwar period: general floating (1919-1925), the gold exchange standard (1926-1931) and managed float to 1939, see Bordo (1993) for further discussion on interwar experiences.

Bretton Woods System, the volatility limitation of the nominal exchange rate helped increasing bilateral trade in 1950s and 1960s. However, in the early 1970s, the system was revealed to be unstable and collapsed in 1973. An earlier acceleration in the US resulted in a speed-up of world inflation which, in turn, started the breakdown of the system of the gold exchange standard and adjustable peg with several serious shortcomings. The Bretton Woods system collapsed for three basic reasons: two major flaws undermined the system (gold exchange standard and the adjustable peg), the inappropriateness of US monetary policy affecting the key currency and the unwillingness of surplus countries to make adjustments (Bordo, 1993). Since then, the exchange rates of major industrial countries floated against the dollar.

In the first 20 years of floating exchange rates, although both nominal and real exchange rates had been highly volatile, export growth was still robust. However, compared to the Bretton Woods time, output growth was halved with substantially higher inflation rates. In this period, there was a series of “capital account crises” in emerging markets<sup>2</sup>. Early in the 2000s, emerging countries recovered from these financial crises. Having learned their lessons from the crises, the Asian economies tried not to make their currencies overvalued and to hold enough international reserves to fight capital account shocks. Since the mid-2000s, many countries have undergone large current account imbalances with the US as the major deficit economy, while China and other Asian emerging economies have grown largest surplus. To support their export-led growth strategies, they purposefully maintained undervalued currencies for competitive advantage. The financial crisis at the end of 2007 made us know a broad recession of the world economy like the Great Depression of 1929. This recession recorded a sharp decline in exports of 11% for developed countries and 7.6% for emerging countries. This “Great Collapse of Trade” (R. E. Baldwin, 2009) continues to animate the relationship between finance and trade. In recent years, there have been unusually large exchange rate movements in both developed and developing countries.

## 1.2 Traditional theories of the relationship between exchange rate and trade

The effects of exchange rates on trade flows are clearly perceived through three prominent theories of trade, which surged chronologically after the collapse of the gold standard system in 1931: the elasticities theory, the Keynesian absorption theory and the monetary theory. For a long time, the studies in international trade were dominated by the so-called elasticity theory, with the focus on the effect of exchange-rate changes and the elasticity of demand for exports and imports in international trade. Bickerdike (1920); Metzler (1948); Robinson (1947) developed the elasticity theory, also known as BRM condition, which clarifies the adjustment of trade flows following a devaluation of the home currency.

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<sup>2</sup>Those are: Mexico in 1994, the east Asian economies in 1996/97, Russia in 1998, Brazil in 1999, Turkey in 2001, Argentina in 2002, and Uruguay in 2003.



The theory separately considers markets for imports and exports and assumes no cross-price effects between markets. In the export market, a country's supply of exports is assumed to depend only on the nominal price in terms of domestic currency. Following a devaluation by the home country, the supply of exports remains unchanged since it is priced in their domestic currency. In order to keep the foreign currency price of goods, domestic currency price of exports would have to rise in the same proportion as the exchange rate. That leads the foreign demand of imports to shift upward and hence exports increase. The same logic is applied for the import market: the devaluation of the home currency increases the domestic currency price of imports, making the foreign supply of exports shift upward, resulting in a decline of imports. Further, the responsiveness of imports and exports to the exchange rate movement is proved to affect the change of the trade balance. The condition in which a devaluation of currency can improve the trade balance is clarified by Lerner (1944) and becomes the very well-known Marshall-Lerner condition. Accordingly, in order to improve the trade balance after devaluing a currency, the sum of price elasticities of imports and exports (in absolute terms) must be higher than unity. The analysis, like the BRM condition, is based on the partial equilibrium by holding everything else constant and studying only the impact of exchange rate fluctuations in the export and import markets. In other word, it incorporates both the price and income effect of change in exchange rate (Thirlwall, 1986). Different from the previous elasticity theory, the Marshall-Lerner condition is constructed under various other restrictions: all elasticities of supply of outputs are assumed to be infinite, there is no monetary effect of exchange rate change, trade is initially balanced, and the exchange rate change is small. The elasticity approach is mostly criticised for the basis of partial-equilibrium analysis; it does not take into account the supply condition and cost changes in consequence of devaluation and overlooks the income and expenditure effects of exchanges rate fluctuation. More precisely, this approach takes a microeconomic consideration with close attention to the changes along given supply and demand curves in a specific market, while a study with a macroeconomic viewpoint on the whole economy spending and production would be more appropriate (Vines, 2008).

Dissatisfied with the partial equilibrium framework of the elasticity theory, the absorption approach was developed, and it merged the elasticities approach with the Keynesian theory. Modelled in early 1950s by Alexander (1952); Meade (1951), the approach considers how the whole economy is influenced by the policies, particularly the impact on expenditure in comparison with output. According to the Keynesian income-expenditure identity, the balance of trade is the difference between national output (income) and the absorption - expenditure by domestic residents on goods and services. Thus, the trade balance is improved with either an increase in income or a decline of total expenditure (absorption). In this approach, devaluation has a direct effect on income, a direct effect on absorption and an indirect one through income.

Different from previous theories, the monetary approach shows the impact of devaluation on the balance of payments as a whole (current and capital account). Originated in the 18th century by David Hume or Richard Cantillon, the modern revival of the monetary approach appeared in the writings of

James Meade in early 1950s followed by Harry G. Johnson and Robert A. Mundell in the 1960s and under the leadership of Jacques J. Polak at the International Monetary Fund (Blejer and Frenkel, 2008). A subsequent collection of studies in Frenkel and Johnson (1976); Mundell (1968, 1971) gave more incentive for its swift theoretical development and a number of empirical studies based on the monetary approach. In the subsequent extensions of the basic framework, researchers tried to incorporate the impact of exchange rate on prices and on the balance of payments. Different from the elasticities approach in particular and from other balance of payment approaches in general, the monetary approach emphasises the transitory effect of exchange rate adjustments in a small economy. When the currency devaluates, the international price of tradable goods increases, this in turn leads to a decrease in real money stock. To re-equilibrate the money market, foreign exchange reserves run into the domestic market and create a surplus in balance of payments until the equilibrium is re-established.

## **1.3 On the relationship between exchange rate and trade**

### **1.3.1 Exchange rate level and trade**

In the traditional theory of international trade, a depreciation in domestic currency reduces export prices in foreign currency, and then increases exports. On the import side, this depreciation makes import goods in domestic currency more expensive and thus decreases imports. However, this prediction might no longer hold true in circumstances of increasingly complex trade patterns, for example, global value chains.

In recent decades, the question about the impact of exchange rate on trade was raised again following the unfamiliar movements of exchange rate and the development of global value chains. Some studies predict the strong effect of recent exchange rate movements on trade (Krugman, 2015, 2016). Bussière, Gaulier, and Steingress (2016) estimate trade elasticities for important economies and claim the important role of the exchange rate to deal with global trade imbalances. IMF (2016b) shows a strong response of trade to exchange rate movements. This response depends, however, on the situation of the economy. Indeed, the increase in exports related to currency depreciation is lower when the country's financial system has problems, such as a banking crisis, but higher when the domestic economy is in a favourable condition.

Other studies point out instead the disconnection between exchange rate change and trade. Kang and Dagli (2018) clarify the shrinking role of real exchange rate depreciation in improving real exports over time, especially after the global financial crisis. Leigh et al. (2017) show that there is no obvious connection between large changes in trade volumes with hefty changes in exchange rate, such as in the case of Japan for the period 2012-2014 and the UK for the period 2007-2009.

Another strand of literature tries to figure out the reason behind the disconnection between ex-

change rate and trade, *i.e.*, the large change in real exchange rate and the slow reaction of trade. One of the proposed arguments is the presence of global value chains (GVCs). Ahmed, Appendino, and Ruta (2016); Ollivaud, Rusticelli, and Schwellnus (2015) suggest that the rise of GVCs could weaken the impact of exchange rate on trade. IMF (2016b) shows that there is little evidence to say that the global value chains lead to a disconnection between exchange rate and trade, although it undermines this relation for some products or even some economies. Specifically, trade in intermediate products, in a country heavily engaged to global value chains, used as input for other countries' exports reacts sluggishly to variations in exchange rate. Nevertheless, international trade recently still consisted of conventional trade as the speed of trade involving global value chains reduced in recent years. However, Kang and Dagli (2018) find evidence of the weakened effect of exchange rate depreciation on export volume, due to the progress of deepening GVCs.

Another argument for the disconnection is about structural factors, such as import composition and the short-term external debt exposure of economies (Campa and Goldberg, 2005; Kearns and Patel, 2016). Kang and Dagli (2018) show that there is, especially after the global financial crisis, a weaker relationship between real exchange rate and the ratio between primary goods to processed or manufactured goods, and between real exchange rate and the stock of short-term external debt from both export and import countries.

Parallel with the growing importance of global value chains, the most recent studies argue that the sluggish response of exports to exchange rate depreciation is due to the invoicing of trade in a dominant currency (Boz, Gopinath, and Plagborg-Møller, 2017; Gopinath, 2015; Gopinath et al., 2018).

While the nominal prices are sticky, the currency used for pricing has an important part in exchange rate pass-through to the changes in prices in domestic currency and hence in the trade volumes afterward. This research challenges the standard Mundell-Fleming framework that if prices are set in the currency of the producer, exchange rate depreciation of domestic currency induces lower demand for imports and higher demand for exports. However, in the case of invoicing in a third country's currency, the response of trade volume to the exchange rate movement could be different. Casas, Díez, Gopinath, and Gourinchas (2017) develop a dominant currency paradigm for small open economies to figure out the outcomes following variations in the exchange rate from different shocks in those economies. According to the new paradigm, imports in all countries decrease after a depreciation of the exchange rate. However, the impact of exports to a non-dominant currency depends on the co-movement of the exchange rate between the destination country and the dominant currency, while there is no relation between export to dominant-currency countries and the currency movements. In other words, trading partners experience a stable local currency price since their exchange rates with regard to the dominant currency are unchanged. Therefore, exports of the reporter country do not respond in the traditional way to the currency depreciation. The empirical analysis applied for Colombia supports this new model of dominant currency invoicing. Using panel data of bilateral manufacturing trade among 37 developed and emerging countries, IMF (2019) points out the effect of invoicing in US dollars on the relationship between exchange rate and trade vol-

umes in both short-term and medium-term. In the short-term, there is a positive response of bilateral exports to bilateral exchange rate depreciation (or an appreciation of trading partners' currency). However, there is a negative response to a depreciation only with respect to the US dollar (or trading partners also have a depreciation with respect to the US dollar) as the import prices in terms of domestic currency increase in the non-US trading partner, therefore its import demand declines. On the import side, there is a small response of imports to bilateral depreciation (or an appreciation of the trading partner) since import prices do not largely fluctuate. However, import volumes react noticeably to a depreciation with regard to the US dollar, since the prices of imports rise in terms of importer's currency. In the medium term, the effect of the US dollar exchange rate reduces and can be insignificant in both economical and statistical terms. The reason is that prices in the currency of invoicing have time to adjust, there is an increased sensitivity to bilateral exchange rate movement for both export and import quantity.

### **1.3.2 Exchange rate and export diversification**

#### **Determinants of export diversification**

Diversification in export also has many dimensions and can occur either vertically (a shift in exports from primary products to the manufacturing and tertiary sectors) or horizontally (an increase in the number of exported products within the existing export basket). However, much attention has been paid to its underlying determinants. There are many studies exploring the factors that affect export diversification in developing countries. They can be reduced to three kinds of factors:

#### **Structural determinants**

- GDP, which is a measure of a country's size. Larger countries have potential for diversifying productive capacity through scale effects.
- GDP per capita, which measures the level of development. The degree of diversification may grow with the level of development up to a threshold income level (Imbs and Wacziarg, 2003).
- Factor endowments. An abundance of natural resources and/or a high reliance on primary goods is an obstacle to export diversification. In contrast, the availability of physical and human capital favors diversification: in particular, stocks of knowledge enable countries to change their specialization patterns through the externalities of learning-by-doing and R&D tasks that support innovation.
- The technology gap or asymmetry. When faced with a wide technological gap, a developing country can diversify its export structure only by imitating, thereby doing little to narrow the technological gap separating it from its trading partners.

- Geographical distance to main trading partners. Increasing remoteness or higher transport costs tend to reduce export diversification (Regolo, 2013).

### **Policy and reform measures**

- Tariff rates. Trade liberalization is expected to improve access to foreign markets, which will eventually lead to export diversification. However, some studies taking a Structuralist approach have found that lower tariff rates induce specialization rather than diversification (Agosin, Alvarez, and Bravo-Ortega, 2012; Cimoli, Fleitas, and Porcile, 2011).
- Market access through bilateral or multilateral trade arrangements. As countries become increasingly integrated, their trade tends to diversify more because countries can exploit economies of scale and spillover effects.
- Investment in infrastructure (highways, ports, telephone, electricity, water). Improving infrastructure and trade networks is among the main determinants of successful attempts at diversification (IMF, 2014).
- Regional integration as measured by the trade intensity index is also a key factor. Most recent studies show that country pairs with low trade costs (because of geographic proximity and involvement in trade agreements) have more diversified bilateral exports (Regolo, 2013).
- Financial development. Access to credit helps countries diversify their exports (Agosin et al., 2012).

### **Macroeconomic factors**

- Foreign Direct Investment (FDI), and more generally, physical capital accumulation. FDI can promote diversification and upgrading of the host country's export basket through spillover benefits (Iwamoto, Nabeshima, et al., 2012). But Hausmann, Hwang, and Rodrik (2007) stress that, although FDI has a generally positive effect on export diversification, it has a greater impact on vertical diversification than on horizontal.
- Terms of trade shocks. Improvements in terms of trade (with an increase in the price of the main exported products) tend to concentrate exports as fewer inputs are available for new export activities. Agosin et al. (2012) suggest an interesting interaction between this variable and human capital: countries with higher levels of education take advantage of positive terms of trade variations to increase export diversification
- The level of the RER and its volatility. Real depreciation may improve competitiveness, while removing RER misalignment can favor the extent of export diversification. By increasing uncer-

tainty and reducing the profitability of the exportable sector, real overvaluation or exchange rate fluctuations discourage investment and the emergence of new tradable activities (IMF, 2014).

### **1.3.3 Relationship between exchange rate and export diversification**

The discussion on relationship between exchange rate and export diversification has been raised in recent years, especially for developing countries which consider exporting as the main engine of economic growth. However, the literature on this issue is still limited. An undervalued currency can foster export diversification when the country has a weak institutional framework (Rodrik, 2008). de Piñeres and Ferrantino (1997) analyse the successful Chilean experience since the mid- 1970s and find a positive effect of real exchange depreciation and trade reforms on export diversification. Fonchamnyo and Akame (2017) find that official exchange rate promoted export diversification in selected countries in Sub Sahara Africa. Using a large sample of countries over a long period of time, Agosin et al. (2012) finds the evidence that exchange rate volatility now appears to be a factor leading to more concentrated exports. Wondemu and Potts (2016) show that undervaluation of the real exchange rate boosts export supply as well as export diversification in African economies.

Another strand of literature investigates the role of export diversification in the choice of exchange rate regimes. The results are mixed. Indeed, some papers show that a more diversified economy is more likely to adopt a peg exchange rate regime (Frieden, Leblang, and Valev, 2010; Markiewicz, 2006; Méon and Rizzo, 2002; Rizzo, 1998), while others show that a more diversified economy is more likely to adopt a flexible exchange rate regime (Chowdhury, Bhattacharya, Mallick, and Ulubaşoğlu, 2014; Heller, 1978; Holden, Holden, and Suss, 1979; Jin, 2009).

## Chapter 2

# Export diversification and real exchange rate in emerging Latin America and Asia: A South-North *versus* South-South decomposition

### Abstract

The present chapter examines the directional causality between export diversification and real exchange rate in the middle-income countries of Asia and Latin America over the period from 1995 to 2013. Additionally, we investigate asymmetries in the causality issue by examining the direction across trading partners. Our empirical results show that there is a two-way causality between the two variables when we look at the sample as a whole. A causal link running from the real exchange rate to export diversification is consistent with the standard literature but it is not systematic at all. The reverse causation is very appealing and challenges the standard argument on exchange rate determination. When the causality issue is investigated by treating export markets differently, our findings at the aggregate level are confirmed in exports destined for the advanced countries. The analysis for ‘South-South’ trade only shows a unidirectional link from the real exchange rate to changes in export diversification. The same tests performed at the individual countries level reveal a heterogeneous causality across trading partners.

Key words: Export diversification; real exchange rate; Asia and Latin America; panel Granger causality

JEL codes: F14, F41, O11, O24, O53, O57

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## **2.1 Introduction**

Recent decades have seen major changes in the pattern of international trade: on the one hand, the shift towards more outward-oriented policies has pushed an ever growing number of developing countries into the international markets. On the other hand, much of the increase in exports provided by those developing countries has occurred in manufactures. From 10% in 1980, the share of developing countries in world exports of manufactures reached 40% after three decades, while the share of manufactures in total exports for all developing countries grew from 30% to 42% in the same period (UNCTAD, 2011).

However, the export-oriented development strategy has been increasingly opened to question. First, to the extent that a growing number of developing countries are exporting a similar range of products and becoming close substitutes for each other, there is a risk that an intensification of price-based competition among them will increase potential "crowding-out": that is, developing countries will compete and crowd out one another's exports (Athukorala, 2009; Ghani, 2006; Razmi, 2007). Second, even though it has contributed to rapid growth in the East Asian countries, there is a danger that external trade driven by participation in global production networks organized around FDI will lock developing countries into a narrow pattern of international specialization with limited growth prospects (UNCTAD, 2011).

In the light of this, export diversification and the modernization of export products have become of growing interest in recent years. On the one hand, they are perceived as a way for developing countries to mitigate adverse external shocks. The objective is to benefit from increased diversification and reduced dependency on a few products and markets, the higher income elasticity of world demand and less intense price competition. Failure to address such issues may leave countries in a "middle-income trap" which prevents them from economic development and from climbing up successive rungs of the technological ladder. On the other hand, the growing involvement of developing countries in trade integration processes at bilateral, regional and multilateral levels has developed new opportunities for product diversification. For example, the recent development of economic relations between Asia and Africa aptly illustrates a geographical restructuring of global trade around a "South-South" pattern (Bagnai, Rieber, and Tran, 2015). Internationalization of production with the so-called "global value chains" is driven by the rapid growth of some Asian countries and in an earlier study, we showed that access to their markets has a multiplier effect on the development of Sub-Saharan countries' supply capacities (Diaw, Rieber, and Tran, 2012). Additionally, a "vertical" specialization is increasing at the various stages of production and is placing Asian countries (and, consequently, the dynamic of their demand for imports) at the heart of a cumulative process that is contributing to the growth of exports from the other developing countries (Diaw, Rieber, and Tran, 2014).

These observations suggest that developing export capacity outside the resource-based sector should be a central focus of economic policy. Among the drivers of export performance, the literature on export-led growth points to the benefits of keeping the prices of exportable products at competitive levels in order to make it attractive to shift resources into their production. The real exchange rate (RER), which



reflects the underlying relative movement of prices at home and abroad, proves to have a significant effect on export performance. Using the RER to shift resources into manufacturing can promote exports without driving down prices as external demand is elastic, unlike the situation with primary commodities. The early experiences of the Newly Industrializing Countries (NICs) of East Asia have directed attention to the RER as a development- relevant policy tool.

Although there is an extensive literature about export diversification and the RER, respectively, few studies, if any, have combined the two strands of the literature. When both variables are correlated, most studies focus on a unidirectional causality running from the RER to export diversification. However, export diversification may, in turn, determine the RER by affecting the relative price of traded goods or the relative movement of prices. Surprisingly, this causal direction is usually ignored in earlier studies.

Against this background, one important purpose here is to fill the gap. Our study examines export diversification performance among the Middle-Income Countries (MICs) of Asia and Latin America from a comparative perspective. This comes from Imbs and Wacziarg (2003), who showed a non-linear relationship between per capita income and product diversification. Globally, inter or intra-sectoral diversification is relatively more important at the middle stage of development. This investigation will enable us to develop comparative descriptive statistics; notably, how different export diversification patterns are when countries trade with developed (the "North") and the growing share of developing countries (the "South"). In other words, we will explore the relative importance of trading partners in the causal link between export diversification and relative prices.

To explore the causality issue, we then employ Granger causality techniques on panel data covering the entire sample of MICs over the period 1995–2013. The standard causality test defined by Granger (1969) has been widely applied in the empirical literature. However, because the question of causality between export diversification and the RER may exist in panels, we use the Granger non-causality test for panel data models extended by Dumitrescu and Hurlin (2012). This method requires stationary data and can be used in case of cross-sectional dependency.

Our empirical results show a two-way causality between the two variables when we look at the sample as a whole, and they are confirmed when the causal issue is investigated in the specific case of exports destined for the Northern partners. In contrast, the analysis for the South shows a unidirectional link from the RER to changes in export diversification. When Granger causality tests are conducted on individual countries, the role of the RER as a conventional determinant of export diversification dynamics, whatever the destination country, is only validated for three countries. The remaining ones seem to reveal a heterogeneous causality across trading partners. Among them, five countries show a bidirectional causality, and four countries show a univocal link running from export diversification to RER when they export to the North. Such causal link has crucial implications in terms of economic policy.

The rest of the chapter is organized as follows. Section 2.2 provides an overview of the literature. Section 2.3 briefly describes our statistics and develops a comparative analysis for the Asian countries.

Section 2.4 presents the general options of our econometric approach before reporting our empirical findings. Section 2.5 summarizes the results and concludes.

## **2.2 Literature review**

The relationship between exports and economic performance is among the most interesting and richest debates in the economic literature. Among the wide number of theoretical and empirical issues related to the topic, a theoretical issue of the greatest importance then emerged in the development field, namely, how export diversification might contribute to economic growth in developing countries.

There are old and new explanations for this relationship. Without going back to the pioneers, it is commonly argued in development economics that production diversification is *beneficial to growth* as a result either of economic externalities or an enlarged matrix of input–output trade. The benefits from diversification are viewed in dynamic terms through the growth spillovers and cumulative improvements in the economy linked to additional products: higher rates of return on fixed investment, inter-sectoral or forward and backward linkages, increased sources of technology upgrading and productivity growth. As a result, having a more complex and diversified industrial structure is especially important for developing countries in search of balanced growth (Agosin, 2007). It is worth noting that the hypothesis of encouraging product diversification was not initially associated with outward-orientation recommendations. From the 1980s onwards, the analysis of contrasting country experiences in the developing world brought about a dramatic change in the debate. It came with the adoption of export-promotion policies by the NICs of East Asia in the early 1970s, where diversification and trade expansion were successfully combined with growth in manufacturing value-added and gross domestic product (GDP). A large number of countries then took comprehensive measures to open up and integrate their economies into global and regional markets. With the outward-oriented consensus, relatively new studies of endogenous growth suggested that structural changes in exports would lead to faster growth through the availability of a wider variety of imported inputs (Romer, 1990), augmented and diversified investments in new activities and reduced investor risks (Acemoglu and Zilibotti, 1997).

In international trade, *export diversification* seems to contradict traditional theories, which require specialization when a country integrates the world economy. According to comparative advantage theories, a country's involvement in international trade leads to the concentration of resources in the few sectors in which the country produces more efficiently than other countries. However, a dramatic change occurred in the debate with the successful experiences of the East Asian NICs. Some authors revived the 'infant industry' argument, which notably advocates temporary protection for some domestic industries as a means of developing a more diversified economic structure before entering international markets (Stiglitz and Yusuf, 2001; Weiss, 2003). In this line of argument, governments are required to be proactive in supporting exporters and alleviating the high 'death rate' for new exports that low-income countries usually experience (Hausmann and Rodrik, 2003). In sum, contrary to the teachings of traditional theo-

ries, expanding the production and trade of a variety of commodities plays an important role in promoting export performance.

Another strand of the literature considers export diversification from the perspective of a portfolio approach. In line with the "trade pessimism" which conducted import-substitution strategies in the 1960s, export diversification would provide a hedge against price variations, volatile export revenues and income instability when the export pattern is over-concentrated in one or a limited number of products and geographical destinations (Stanley and Bunnag, 2001). In addition, concentration may be dangerous if asymmetric shocks hit the core sectors of the economy in which its activity is most intense. These critiques are summarized in the literature on the "resource curse", that is: a negative relationship between an abundance of natural resources and growth.

Against this background, two policy questions arise. First, given the potential benefits of export diversification, what can a developing country do to diversify its exports? Second, how should the country set about the task of diversifying? Is there a trade-off between an increase in the quantity of goods that are already being exported and the number of goods exported?

While many theoretical and empirical studies have revealed the contributions of diversification to the development process, a recent strand of the literature has focused more on *the determinants of export diversification*. Among the factors needed for diversification to be successful, the level of per capita income in an economy has been widely analysed, reversing the relationship from economic development towards diversification. A seminal contribution has been made by (Imbs and Wacziarg, 2003), who showed that export diversification can be an outcome of the development process. The authors present evidence from a wide set of countries that shows an inverted U-shaped pattern of export concentration in relation to development level, with diversification followed by re-concentration.

Different approaches to the determinants of export diversification can be found in the recent literature on international trade. One argument that features in the debate on specialization versus diversification is the concept of "product proximity" (Hausmann and Klinger, 2006; Hidalgo, Klinger, Barabasi, and Hausmann, 2007). Countries that develop products that are close to those products in which they have comparative advantage can diversify more easily than by developing products that are on the periphery of the product space. Another similar argument is that developing countries should change and diversify their exports to match those of richer countries because these goods are characterized by higher productivity and hence growth potential (Hausmann et al., 2007; Hummels and Klenow, 2005). Beyond specializing in the sectors with comparative advantage, "export sophistication" (reflected in the higher value-added and productivity content of the export goods) may enable more benefits to be derived from international trade. In sum, countries that succeed in acquiring the capability to export more sophisticated manufactures will grow faster.

Depending on where a country stands in terms of its level of economic development, diversification has been addressed by the endogenous growth literature (Mejía, 2011). It appears that the underlying

determinants of export diversification encompass structural variables (factor endowments, country size, the level of human capital or technology gap) as well as policy and macroeconomic variables (trade reforms, macroeconomic management, quality of infrastructure and institutions, FDI inflows and capital accumulation, elasticity to terms of trade shocks and the level of RER as well as its volatility).

Recent theoretical and empirical contributions to the trade literature have offered new tools to address the second question, namely how to diversify? Within new trade theory as well as "new" new trade theory, a common idea is that the degree of diversification varies depending on trade costs, product type and market size (representing both the productive capacity and market potential). However, Melitz (2003)'s novel contribution was to identify the microeconomic determinants of export diversification. Drawing on a dynamic model of industry equilibrium with heterogeneous firms, one of the predictions of the model is that opening up to trade will increase aggregate productivity in the economy and will eventually lead to export diversification as the set of exporters is endogenous. Chaney (2008) extends Melitz's model by assuming countries with asymmetric size and trade barriers. His theoretical model with heterogeneous firms helped to disentangle the effects of trade costs (*i.e.*, the trade-cost elasticity of trade flows) at the intensive and extensive margins. The Intensive Margin (IM) of trade refers to the growth of exports in goods that are already being exported. The Extensive Margin (EM) is defined as the growth of exports in new categories; it refers to the increased number of active export lines via new products and new markets.

The IM characterized by increased exports of the same products to the same markets has been questioned by various scholars. A key concern is the risk that increasing exports will depress the terms of trade, leading the developing countries to an 'immiserizing' form of growth: that is, an export-biased growth that makes a country worse off along the lines formulated by Bhagwati (1958). In sum, countries which only expand their exports by driving down their prices relative to other countries (*i.e.*, export growth which takes the form of IM growth) will not escape from the trade pessimism noted by the pioneers. Only export growth which comes in large measure through expansion in the number of products exported (*i.e.*, EM growth) will help developing countries to offset the deterioration in the terms of trade associated with traditional IM growth. In other words, increasing levels of export do not guarantee, by themselves, higher levels of growth: the most important issue is to find the "right export mix" that ensures low instability in export earnings through a broader export base combined with positive price trends.

On the other hand, some authors have pointed to differences in export diversification patterns between high- and low-income countries (Amurgo-Pacheco and Pierola, 2008; Lee and Kim, 2012). Although both IM and EM are much more important in developed countries, trade growth at the EM is predominant for developing countries with income levels below the turning point in the diversification curve. In other words, countries at earlier stages of development trade more at the EM, whereas high-income countries develop exports along the IM with a re-concentration of their exports towards fewer products. These various forms of export diversification are driven by forces of globalization of both trade and capital flows which are now much stronger than in the previous century. Moreover, transnational

rms have established elaborate production networks, both globally and within regions. To get a sense of perspective, the textile sector was the main driver of the Asian NICs' export strategy, but it is now one of the most globalized industries in the world.

Product diversification and product quality upgrade are well-documented explanations of high export performance, especially in the NICs of East Asia. Their early experiences have also directed attention to the RER as a development-relevant policy tool. Export diversification will take place if factors are reallocated to exportable goods, if more resources are made available or freed up in, thereby facilitating inter-sectoral reallocations. A range of economic measures can be adopted to smooth the way for this structural change. One important variable in this regard is the RER. A stable and competitive RER should be thought of as a facilitating condition for exploiting a country's capacity for growth and development (Eichengreen, 2008).

The point is that all the literature on export diversification takes the RER as strictly exogenous: however, what happens if causation runs the other way around? No study addresses export diversification as a determinant of the RER. The literature has invested more in documenting the impact of RER misalignment on export diversification than in identifying any feedback or bidirectional causality in the relationship. As aforementioned, product diversification introduces changes in the relative prices and hence in future competitiveness of the goods produced. Moreover, there is no evidence on a homogenous relationship between the RER and export diversification. Especially, are developing countries better able to diversify their exports by stimulating exchange rate pass-through when they trade with developed countries (the North), or with other developing countries (the South)? In the light of the growing emphasis on export performance through diversification, a focus on the RER and export diversification in developing countries has been recent in nature and evidence of the link is not definitive. Few, if any, studies have examined the mechanisms through which export diversification may affect the RER. So, many aspects are still in need of clarification, implying that the relationship is of particular relevance.

Along with the increasing emphasis on export performance, we then focus on the link between export diversification and the RER which is of great concerns in developing countries. In this purpose, the present research addresses the issue by reference to the group of MICs. First, the idea is that the MICs, with their intermediate income level, have less clear comparative advantages and are therefore assumed to have a more diversified product supply. Second, by controlling for the per capita income level of the exporting country, we aim to examine how diversification patterns may interact with the RER and the importing country.

## 2.3 Data description

### 2.3.1 Measures of export diversification

Export diversification can take different forms and consequently can be analysed at different levels. A country can diversify its exports by changing the shares of produced goods in the existing export mix (‘intensive’ diversification) and by including either new products or new trading partners in the export portfolio (‘extensive’ diversification). Similarly, we talk about ‘horizontal’ diversification when shifts into new export industries take place within the same sector; ‘vertical diversification’, conversely, entails a shift from primary goods to manufactures or higher value-added products.

Several ways of measuring export concentration (diversification being the complement to 1 of concentration) have been developed in the empirical literature: the Herfindhal-Hirschman concentration index, the Ogive index, Theil’s entropy index and the Gini coefficient, which measure inequality in export shares (Cadot and Strauss-Kahn, 2007). On the whole, the concentration indices provide quite similar rankings of export concentration and thus may be used interchangeably.

The Herfindahl-Hirschman Index (HHI) for country  $i$ , normalized to range from 0 to 1 (so that the information about the number of export products is lost), is

$$HHI_i = \frac{\sum_{k=1}^N p_{ik}^2 - \frac{1}{N}}{1 - \frac{1}{N}} \text{ with } p_{ik} = \frac{x_{ik}}{X_i} \text{ and } X_i = \sum_k x_{ik} \quad (2.1)$$

where  $p_k$  is the share of export line  $k$  (with  $x_k$  denoting the amount exported) in total exports of country  $i$  ( $X_i$ ) and  $N$  is the total number of export lines. The share of each product in a country’s total exports is weighted, to make sure that a small export value has a minor influence on the outcome of the index. Contrary to the usual index, which ranges from  $1/N$  to 1, the normalized HHI is more suitable as a measure for equality of distribution. This is especially the case here if we consider export diversification in a portfolio approach: the lower the HHI, the less concentrated or more diversified exports are. The shares of each product  $k$  are used in whole percentages, so that the index for country  $i$  can range from 0 to 10,000 (Phi, Thai, and Tran, 2015).

Recent theoretical and empirical contributions to the trade literature have offered new tools to address the IM and EM of trade (IMF, 2014). Many of the empirical studies on export diversification have measured the EM by counting the number of product lines in which a given country exports. Having ascertained the number of ‘zero-trade flows’, they then interpret the evolution of such flows as export diversification by focusing on the bilateral trade flows that switch from zero to a positive value for each possible destination. Similarly, a new export product is defined as the one that has been exported in a recent period (for instance, at least five times after a reference date according to Amurgo-Pacheco and Pierola (2008)), or that remains active for two years but had been inactive during the two previous years (Cadot and Strauss-Kahn, 2007). The EM then measures diversification by adding new product

lines to the number of active product lines (lines with non-zero exports). However, many of the studies have focused excessively on simply adding new products to export portfolios (Newfarmer et al., 2009). First, the number of active product lines (and the number of zeros) may be sensitive to the level of disaggregation at which exports are measured. By the same token, the counting may be biased by the quality of the customs administration, especially in developing countries. Second, this kind of measure favours big-sized countries, since the larger the country is, the more product lines it has. Third, in focusing on the number of relationships, earlier studies have overlooked the role of survival; the vast majority of developing country export relationships fail almost immediately after commencing – about 7 of 10 new export relationships fail within two years (Besedeš and Prusa, 2011). Finally, although it deals with the volume on existing export lines, the IM also contributes to diversification through changes in the distribution of the individual proportions.

Hummels and Klenow (2005) develop a useful method of decomposing a country's exports into the contribution from IM and that from EM. To measure the EM, the authors appropriately weight categories of goods by their overall importance in exports to a given country, so that it prevents a category from appearing important solely because an exporter exports a large quantity in a certain category. However, as with the Gini indices, the above calculation of the EM may be sensitive to the level of aggregation at which exports are measured: that is, the EM is smaller as data become more aggregated, with most variety differences relegated to the IM. In addition, the country should not only diversify its export portfolio towards important categories relative to the reference country, but such diversification should also be more broadly based. Therefore, the degree of diversification must reflect both the number of products in a country's export portfolio as well as the distribution of their individual proportions.

In this context, we choose to use the Herfindhal-Hirschman concentration Index (HHI) – namely, changes in the shares of commodities in the existing export mix – which is the most commonly used statistic for measuring export concentration. We use country-level data from the Basis for the Analysis of International Trade (BACI) data-set which is compiled by the CEPII at the HS 6-digit product level <sup>1</sup>. Original data are taken from countries' bilateral exports in value to all regions from 1995 to 2013. The sample is limited to a set of lower middle income (LMI) and upper middle income (UMI) in a comparative perspective, that is: 21 Asian countries and 21 Latin American countries <sup>2</sup>. The main reason that we choose to consider the MICs separately stems from the general view that diversification is especially important in the early stages of economic development. Finally, to explore differences in export behaviors depending on destination countries, we separate patterns of export diversification in the Northern (developed) countries from those in the Southern (developing) countries, the former being high-income countries as defined by the World Bank.

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<sup>1</sup>See <http://www.cepii.fr/anglaisgraph/bdd/baci.htm> for further details.

<sup>2</sup>According to the World Bank classification, there are 28 LMI and UMI countries in South Asia, East Asia and Pacific and 25 LMI and UMI countries in Latin America and the Caribbean. However, because data are not available for all countries, our balanced sample has been reduced to 42 countries over a 19-year period. The countries in our sample are listed in Appendix 1.

In our study, we choose the most frequent definition of the RER, which is

$$RER = \frac{EP^*}{P} \quad (2.2)$$

where  $E$  is the official nominal exchange rate (the number of local currency units per unit of foreign currency) and  $P^*$  and  $P$  are the foreign and domestic prices, respectively. To calculate RER, it is usually preferable to deflate the nominal exchange rate with producer prices or costs and weight bilateral exchange rates by the share of the main trading partners. Unfortunately, it is not possible to compute real effective exchange rates, as there are no available data on trade structure for all the LMI and UMI countries under consideration. Moreover, it is crucial to choose a composite price index that takes account of all destination prices and their mutual dependence. Therefore, we decided to compute the RER for our sample by using the consumer price indices. The United States will be defined as foreign and the nominal exchange rates are the number of local currency units per US dollar. Annual data are extracted from the World Bank's World Development Indicators database with base 2010 = 100.

### **2.3.2 A comparative analysis for Developing Asia**

Using the available data, descriptive statistics are displayed in Table 2.1. In accordance with the literature linking the evolution of export diversification with development, our statistics provide evidence that export diversification is more prevalent in the MICs, although it is less pronounced in small countries. Figure 2.1 shows the evolution of HHI and RER by region over the period considered. The remarkable point is that mean HHI in both regions is relatively low, even if it kept on fluctuating in Asia while it increased steadily in Latin America from the 2000s onwards. Starting from a huge gap at the beginning of the period, the two indices which are split by destination country experienced an opposite change: export concentration tended to decline in Developing Asia when South-South trade is considered.

On the other hand, RER has a mean value of 116.2 in Asia and 113.5 in Latin America, which is quite low compared to previous decades. In addition, standard deviation in both regions is 24 and 20, respectively, suggesting that the panel data-sets are not so spread. An interesting point is that, on average, exports tended to become less diversified while the RER was declining from the early 2000s onwards. This last trend may be explained by growing exports of raw commodities from some Latin American countries, such as Venezuela.

To get a sense of perspective, we develop a descriptive analysis in the specific case of Developing Asia. This investigation enables us to produce some stylized facts; notably, how different export diversification patterns are when countries trade with developed (Northern) and the growing share of developing (Southern) countries.

Using the HHI, Table 2.2 presents the top ranking for export diversification performance among Asian MICs in 1995 and 2010. As expected, we observe that big-sized countries register the highest



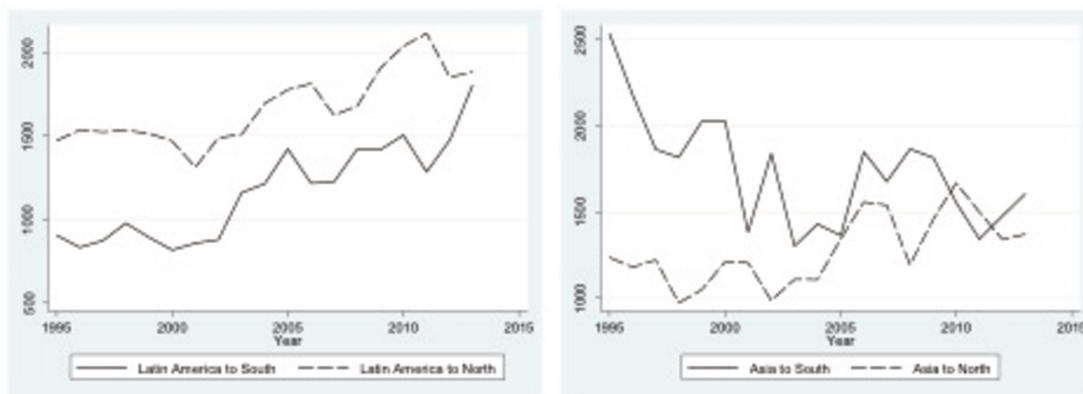
Table 2.1: Descriptive statistics of HHI and RER (1995-2013)

Variable	Obs	Mean	Std. Dev.	Min	Max
Whole					
Aggregate HHI	798	1221.67	1266.53	29.45	6837.97
HHI to the North	798	1472.32	1460.14	33.14	8869.27
HHI to the South	798	1449.87	1626.98	21.23	9141.55
RER	798	114.90	22.18	59.22	233.78
Asia					
Aggregate HHI	399	1199.64	1374.19	29.45	6837.97
HHI to the North	399	1275.30	1552.96	33.14	8869.27
HHI to the South	399	1733.56	1915.32	21.23	9141.55
RER	399	116.25	24.24	59.22	233.78
Latin America					
Aggregate HHI	399	1243.68	1150.15	109.38	6206.39
HHI to the North	399	1669.33	1334.12	143.57	6394.40
HHI to the South	399	1166.19	1212.84	80.52	7885.94
RER	399	113.55	19.86	84.34	224.93

number of export lines to all destinations (the upper level of the table). Notably, China’s exports span a widening spectrum of sectors. According to Wang and Wei (2008), of a total of 4212 HS6 digit product lines exported to the US, Japan and the EU in 2005, China failed to participate in only 83 lines. It means that the country will display a lower reduction in the number of zeros since few 6-digit categories are being exported yet. Interestingly, the HHI increases dramatically in India so that the country ranks at the bottom of the top 10 by the end of the period.

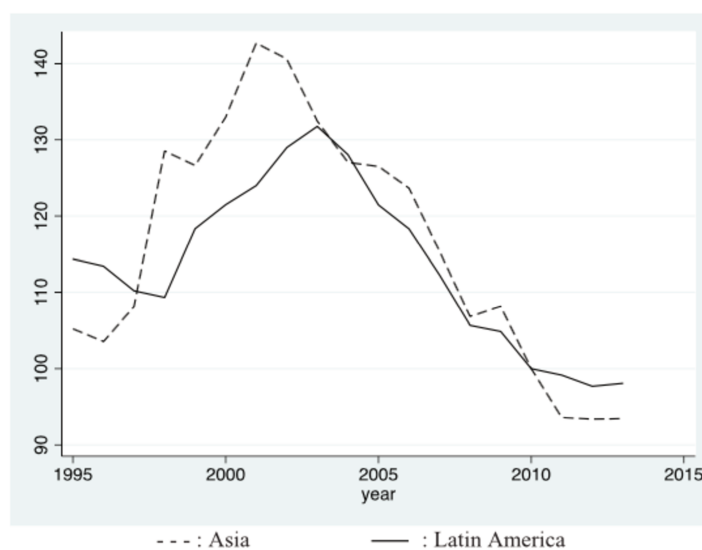
Figure 2.2 shows the same trends in the evolution of export diversification over time for China, India and Vietnam compared with the region as a whole (the Asian figures are taken as simple averages of the individual country results). A contrasting picture emerges when looking at the HHI, with India raising its concentration index to a greater extent (from 54 to 358 as shown in Table 2.2). In other words, the country’s integration into global and regional markets led to less export diversification, notably since 2000. Similarly, China follows the same trend, with continuing industrialization enabling the country to re-concentrate in existing categories since 2007. Broadly speaking, Developing Asia tended to re-concentrate its export portfolio, even if it still remains more diversified than that of other developing regions in the world. On average, the HHI for the whole area increased from 1162 in the first sub-period 1995-99 to 1336 in the last sub-period 2006-10, with the largest increase stemming from Pacific islands like Western Samoa or the Solomon Islands. In comparison, the same average rose from 1044 to 1367 in the MICs of Latin America and reached 1536 in 2013 (1319 in Developing Asia, respectively).

The regional picture shows that Vietnam has successfully diversified its export base both by changing the shares of commodities in the export mix and by including new export lines (Figure 2.2). The decrease in the concentration index (from 590 in 1995 to 133 in 2010) is due to diversification in particular areas of comparative advantage, while the increase in the number of export lines (which doubled over the



(a) Mean of HHI: Latin America

(b) Mean of HHI: Asia



(c) Mean of RER

Figure 2.1: HHI and RER in the MICs of Asia and Latin America (1995-2013)

period considered) consists of new commodities and new destinations, especially following the bilateral trade agreement signed in 2000 with the United States. Our result is in line with those of Amurgo-Pacheco and Pierola (2008), who found that within the EM, geographical diversification seems to matter for developing countries. Vietnam’s successful performance enabled the country to climb up the ranking of Asian countries between 1995 and 2010: as shown in Table 2.2, the country strikingly outperformed second-tier NICs and in 2010 registered the lowest concentration index after China.

To include a geographical dimension in our discussion, we break down the export flows into products destined for the Northern (advanced) and Southern (developing) markets. This decomposition shows the extent to which the development level of the destination countries matters in export diversification. Table 2.2 and Figure 2.2 show a contrasting picture of export diversification when we compare the HHI among the countries. While the concentration index for the whole of Asia rose by 28.7% between 1995 and 2010 to all destinations, the same HHI for exports to the South decreased by 23.5%. This index increased dramatically in China (+121.5%) and India (+135.6%). In contrast, it decreased in Vietnam

Table 2.2: Diversification ranking in Developing Asia (top 10)

	Number of export lines		HHI	
	1995	2010	1995	2010
All destinations (World)	China (4915)	China (4794)	China (29.5)	China (84)
	India (4673)	India (4650)	India (53.8)	Viêt-Nam (133)
	Malaysia	Thailand	Thailand	Thailand
	Thailand	Malaysia	Sri Lanka	Sri Lanka
	Indonesia	Indonesia	Malaysia	Pakistan
	Philippines	Viêt-Nam (3619)	Pakistan	Indonesia
	Pakistan	Philippines	Indonesia	Malaysia
	Sri Lanka	Pakistan	Philippines	India (358)
	Viêt-Nam (1807)	Sri Lanka	Laos	Fiji
	Fiji	Fiji	Viêt-Nam (590)	Philippines
To the North	China (4900)	China (4614)	China (33)	China (99)
	India (4482)	India (4477)	Sri Lanka	Viêt-Nam (142)
	Malaysia	Malaysia	Thailand	Thailand
	Thailand	Thailand	Malaysia	Sri Lanka
	Indonesia	Indonesia	Pakistan	Pakistan
	Philippines	Viêt-Nam (3091)	India (244)	Indonesia
	Pakistan	Philippines	Indonesia	Malaysia
	Viêt-Nam (1599)	Pakistan	Philippines	Laos
	Sri Lanka	Sri Lanka	Laos	India (572)
	Fiji	Fiji	Viêt-Nam (633)	Fiji
To the South	China (4638)	China (4775)	China (24)	China (53)
	India (4226)	India (4572)	India (108)	Thailand
	Thailand	Malaysia	Indonesia	Viêt-Nam (246)
	Malaysia	Thailand	Thailand	India (254)
	Indonesia	Indonesia	Pakistan	Indonesia
	Philippines	Viêt-nam (3135)	Malaysia	Malaysia
	Pakistan	Philippines	Sri Lanka	Pakistan
	Sri Lanka	Pakistan	Philippines	Sri Lanka
	Viêt-nam (795)	Sri Lanka	Bhutan	Fiji
	Fiji	Fiji	Mongolia*	Samoa

Source: Author's calculations based on BACI.

\*Viêt-Nam at the 11th rank (1506)

(−83.6%), Malaysia (−41%), Thailand (−30.8%) and the Philippines (−21.7%). In other words, trade with Southern partners becomes less concentrated and this emerging South-South trade diversification is largely a reflection of China's dominant role in the new regional division of labour (Diaw et al., 2012).

## 2.4 Empirical Investigation

### 2.4.1 Methodology

#### Granger causality on panel data

The Granger causality test, which is commonly used on time series data, has been recently applied to panel data. Such application to macroeconomic studies has substantial benefits because it allows inves-

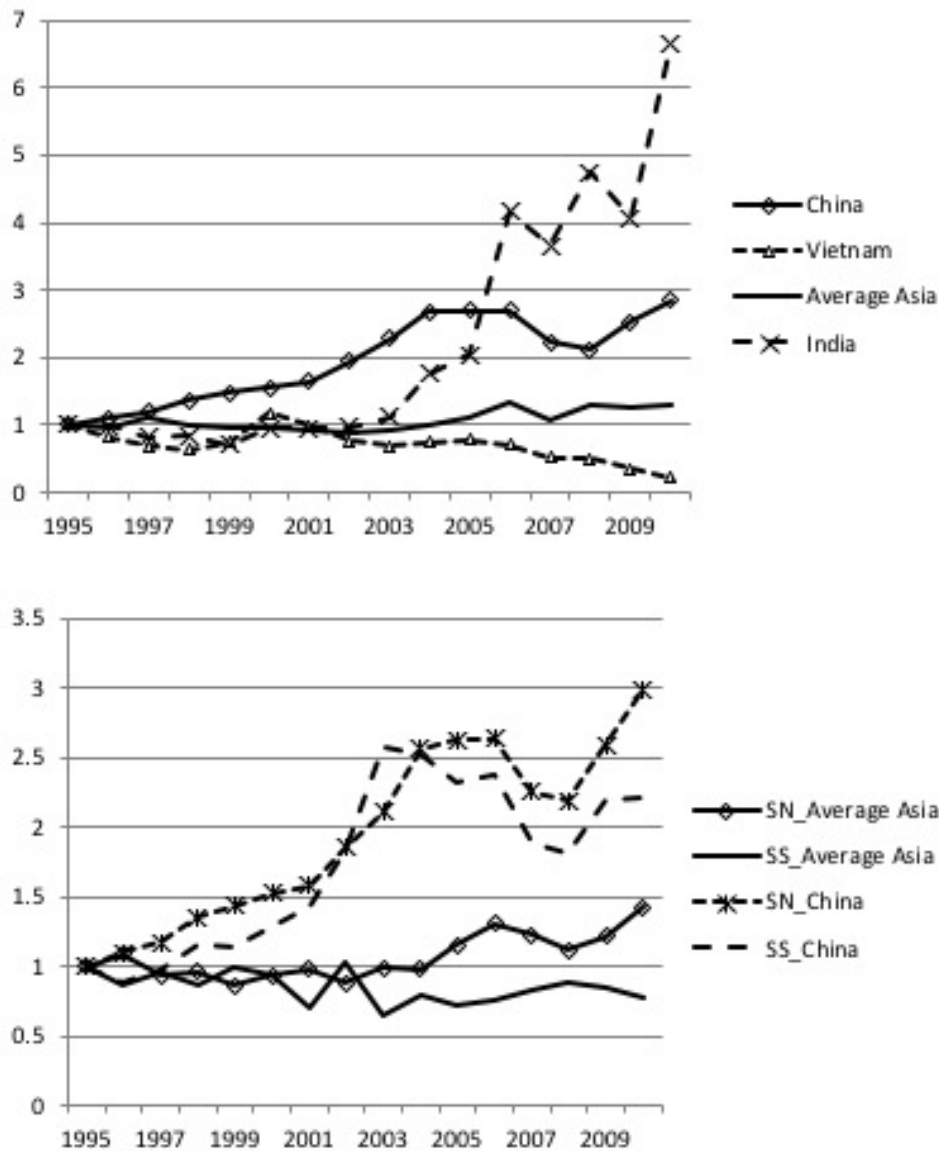


Figure 2.2: Evolution in the HHI in Developing Asia (base year=1995)

tigation with more valuable information. Although different approaches exploring causal links in panels are available in the literature, a relevant one should enable us to account for both cross-country dependence and heterogeneity across countries, *i.e.*, a causal link may exist for one country but may not exist for others. Taking these considerations into account, we use the test of Granger non-causality developed by Dumitrescu and Hurlin (2012). First, their approach allows not only heterogeneity in the regression model used for Granger causality analysis, but also heterogeneity in the causality across countries. Second, the authors show that the panel-based tests have very good properties even when we consider very small time span  $T$  and number of individuals  $N$ . Finally, this test works well in the presence of cross-sectional dependence between individuals, which is a rapidly growing field of study in panel data analysis.

The test is based on heterogeneous panel data models with fixed coefficients and stationary variables:

$$y_{i,t} = \alpha_i + \sum_{k=1}^K \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^K \beta_i^{(k)} x_{i,t-k} + \epsilon_{i,t} \quad (2.3)$$

We assume that the lag orders  $K$  are identical for all cross-section units of the panel ( $i = 1, \dots, N$ ) observed at time period  $t$  ( $t = 1, \dots, T$ ), while the autoregressive parameters  $\gamma_i^{(k)}$  and the regression slopes  $\beta_i^{(k)}$  differ across countries. Similarly,  $\alpha_i$  denotes the individual effects and all those coefficients are constant in time.

A variable  $x$  causes another variable  $y$  if the coefficients of its past values are statistically significant and help to explain and predict  $y$  on its own past values and other relevant information. The authors propose to test the homogeneous non-causality (HNC) hypothesis, which means that there is no causal relationship from  $x$  to  $y$  for all countries in the panel:

$$H_0 : \beta_i = 0 \quad \forall i = 1, \dots, N \quad (2.4)$$

A rejection of the null hypothesis suggests the existence of causality from  $x$  to  $y$  for at least one individual.

Associated with the null HNC hypothesis, the authors define the average of individual Wald statistics for each unit  $i$  as

$$W_{N,T}^{HNC} = \frac{1}{N} \sum_{i=1}^N W_{i,T} \quad (2.5)$$

where  $W_{i,T}$  denotes the individual Wald statistics for the  $i$ th-cross-sectional unit corresponding to the individual test  $H_0 : \beta_i = 0$ . Each individual Wald statistic has a chi-squared distribution with  $K$  degrees of freedom. For large  $N$  and  $T$  samples, the standardized statistic is defined by

$$Z_{N,T}^{HNC} = \sqrt{\frac{N}{2K}} (W_{N,T}^{HNC} - K) \quad (2.6)$$

For finite  $T$  samples, the approximated moment  $\tilde{Z}_N^{HNC}$  is used to test the null HNC hypothesis:

$$\tilde{Z}_N^{HNC} = \sqrt{\frac{N}{2K} \times \frac{(T - 2K - 5)}{(T - K - 3)}} \times \left[ \frac{(T - 2K - 3)}{(T - 2K - 1)} W_{N,T}^{HNC} - K \right] \quad (2.7)$$

For large  $N$  samples, if  $\tilde{Z}_N^{HNC}$  are superior to the corresponding normal critical value for a given level of risk, the HNC hypothesis is rejected.

## Preliminary tests

To determine the appropriate method, Dumitrescu and Hurlin (2012)’s causality test with panel data requires some preliminary tests that involve cross-sectional dependence, stationarity of the variables and selection of optimal lag length. Our two variables are expressed in logarithms in order to include the proliferative effect of time series.

In the first step, we determine whether our panel data is cross-sectionally independent. Cross-sectional dependence is a rapidly growing field of study in panel data analysis. This is restrictive, as macro time series exhibit significant cross-sectional correlation among countries in the panel. Phillips and Sul (2003) argue that it is important to take this feature into account in panel analysis because cross-sectional dependence increases the variation of the pooled (panel) least-squared estimators. Their results indicate that cross-sectional dependence must be considered if we want to gain from panel estimation by pooling cross section and time series information.

The methodology proposed by Breusch and Pagan (1980) has been widely applied in empirical studies to test cross-sectional dependence. The test is based on the following panel data model:

$$y_{it} = \alpha_{it} + \beta_i' x_{it} + u_{it} \quad (2.8)$$

where  $i$  is the cross-sectional dimension,  $t$  is the time dimension and  $x_{it}$  is a vector of explanatory variables. To test the null hypothesis of cross-sectional independence,  $H_0 : Cov(u_{it}, u_{jt}) = 0$  for all  $t$  and  $i \neq j$ , they propose the Lagrange Multiplier (LM) test as:

$$LM = T \sum_{i=1}^N \sum_{j=i+1}^N \hat{\rho}_{ij}^2 \quad (2.9)$$

where  $\rho$  is the estimated pairwise correlation of the residuals from ordinary least squares (OLS) estimation of the panel data equation above for each unit  $i$ . Under the null hypothesis, the statistic has asymptotic chi-square with  $N(N-1)/2$  degree of freedom.

For large  $N$  samples, Pesaran (2004) extends Breuch–Pagan methodology by defining a scaled version of the LM statistics:

$$LMs = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^N (T \hat{\rho}_{ij}^2 - 1) \quad (2.10)$$

The author shows that under the null hypothesis with  $T \rightarrow \infty$  and then  $N \rightarrow \infty$ ,  $LMs \sim N(0, 1)$ .

Pesaran (2004) also proposes another test based on an average of pairwise correlation coefficients of OLS residuals from the individual regressions in the panel:

Table 2.3: Cross-sectional dependence test

Null hypothesis: cross-sectional independence		F-statistics		
		Breusch-Pagan LM	Perasan scaled LM	Pesaran CD
World	HHI	3098.238***	52.901***	5.705***
	RER	6200.284***	127.655***	62.618***
North	HHI	2709.599***	43.536***	7.364***
	RER	6310.335***	130.307***	62.893***
South	HHI	2338.450***	34.592***	0.902
	RER	6231.173***	128.399***	62.945***

Note: The cross-sectional dependence test is performed following Pesaran (2004) approach. \*, \*\* and \*\*\* indicate the rejection of the null hypothesis at 10%, 5% and 1% level of significance, respectively.

$$CD = \sqrt{\frac{2NT}{N(N-1)}} \left( \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij} \right) \quad (2.11)$$

Under the null hypothesis of no cross-sectional dependence,  $CD \rightarrow N(0, 1)$  for  $N \rightarrow \infty$  and  $T$  sufficiently large. The CD statistic has exactly mean at zero for fixed values of  $N$  and  $T$  under a wide range of panel data models, including: heterogeneous models, non-stationary models and dynamic panels.

The statistics in Table 2.3 show clearly that the null hypothesis of no cross-sectional dependence is rejected at the 1% level of significance in both the whole sample and sub-samples. Therefore, cross-sectional dependencies exist in our data and it confirms that the panel causality is appropriate.

In the second step, we need to take into account cross-sectional and slope heterogeneity features when we have to verify the stationarity of our panel data-sets. Panel unit root tests, especially the 'first generation' tests, have been criticized because they assume cross-sectional independence. The Chang (2002); I. Choi (2002) and Pesaran (2007) tests belong to the 'second generation' of panel unit root testing methods which take into account cross-sectional dependence. To eliminate the latter, Chang (2002) proposes to use, for each cross-sectional unit, the instruments generated by an integrable non-linear function of the lagged levels of variables. The test statistic,  $S_N$ , is given by an average IV  $t$ -ratio statistics for testing the unity of the AR coefficient computed from each cross-sectional unit. I. Choi (2002) proposes a panel unit root test for cross-sectional correlation which comes from error components. To test the null hypothesis of unit root test, the author deletes the constant term and the non-stochastic components from the observed panel data by time series and cross-sectional de-meanings. The combination test statistics proposed include: the  $P_m$  test, which comes from Fisher (1932) Fisher (1932); the  $Z$  test proposed by Stouffer, Suchman, Devinney, Star, and Williams (1949) and the  $L^*$  test, which relies on George (1977). These tests have a standard normal distribution. To deal with the presence of cross-sectional dependence in an alternative way, Pesaran (2007) augments the Dickey-Fuller (ADF) regression with cross-sectional

Table 2.4: Unit root test

Partner	Variable	Pesaran (2007)	Chang (2002)	Choi (2002)		
		CIPS	$S_n$	$P_m$	$Z$	$L^*$
World	HHI	-2.163***	-1.769***	9.283***	-6.160***	-6.840***
	RER	-5.426***	1.547	2.049**	-1.314*	-1.190
North	HHI	-1.989***	-1.613***	10.059***	-7.082***	-7.758***
	RER	-5.426***	1.547***	2.049***	-1.314*	-1.190
South	HHI	0.759	-1.151	16.314***	-9.040***	-10.500***
	$\Delta$ HHI	-2.497***	-7.360***	46.536***	-21.789***	-29.124***
	RER	-5.426***	1.547	2.049**	-1.314*	-1.190

Note: Pesaran (2007), Chang (2002) and I. Choi (2002) test the null hypothesis of unit root test. \*, \*\* and \*\*\* indicate the rejection of the null hypothesis at 10%, 5% and 1% level of significance, respectively.

averages of lagged levels and first-differences of the individual series, and then obtains the augmented model CADF (cross-sectionally augmented Dickey-Fuller). From the individual CADF statistics, Author suggests the CIPS (cross-sectionally augmented IPS) statistics and their truncated version CIPS\*.

The results of the unit root tests are reported in Table 2.4. Taking the country sample as a whole, the statistics indicate a rejection of the null hypothesis and suggest stationarity at the level of both variables. We also obtain the same results when we split our panel by export markets: the South-North trade sub-panel has stationary variables at the level. In the case of the South-South trade, the three alternative tests provide evidence that RER is  $I(0)$ . However, the null hypothesis of the unit root test for HHI is not rejected in most cases, implying that HHI is stationary at first difference while RER is stationary at level.

Choosing an appropriate lag length is important in the Granger causality test because its results are sensitive to the number of lags. The omission of lags leads to a bias inference, while selecting more lags than the true lag length in the equation may cause the estimates to be inefficient. Because the results from the causality test may be sensitive to the lag structure, we test the robustness of our findings by following two alternative approaches. On the one hand, we compute the statistics for various lags without choosing a common lag order; on the other hand, we select the optimal lag length to be set before testing our Granger causality. According to Hsiao (1981), the number of lags can be chosen by Akaike information and Bayesian information criteria (BIC). However, these criteria information are incompatible with dynamic panel models (Moon, Perron, and Phillips, 2007). Han, Phillips, and Sul (2016) demonstrate also the inconsistency of BIC in panel data. We use, therefore, BIC modified proposed by Han et al. (2016) to select the optimal lag length for the Granger causality test. This modified BIC is calculated from the following simple panel  $AR(k)$  process:

$$y_{it} = \sum_{s=1}^k \rho_s^* y_{it-s} + \epsilon_{it} \quad (2.12)$$



Table 2.5: Optimal lag length selection

Variables	Lags	Modified BIC		
		World	North	South
HHI	<b>1</b>	1.592	1.595	
	2	1.620	1.674	
	3	1.672	1.730	
$\Delta$ HHI	1			2.172
	2			2.057
	3			1.967
RER	1	-1.026	-1.026	-1.026
	2	-0.882	-0.882	-0.882
	3	-0.706	0.706	0.706

Note: In bold are optimal lag length, by country group.

where  $k$  is the lag length,  $i = 1, \dots, N$ ,  $t = 1, \dots, T$  and  $\epsilon_{it} \sim iidN(0, \sigma^2)$ . By defining  $X_{k,it} = (y_{it-1}, \dots, y_{it-k})'$ ,  $\lambda_k = (\rho_1^*, \dots, \rho_k^*)'$ , the modified BIC is express as follows:

$$IC(k) = \ln \hat{\sigma}_k^2 + k \times \frac{\ln(\sqrt{NT}_k)}{\sqrt{NT}_k} \quad (2.13)$$

where  $\hat{\sigma}_k^2 = \frac{1}{NT_k} \sum_{i=1}^N \sum_{t=k+1}^T \epsilon_{k,it}^2$ , where  $\epsilon_{k,it}^2 = y_{it} - X'_{k,it} \hat{\lambda}_k$

Table 2.5 shows that the optimal lag length selected under the modified BIC is 1 for HHI and RER for the whole sample as well as for the South–North trade sub-case. Alternatively, it is 1 for RER and 3 for HHI in the case of South–South trade.

## 2.4.2 Results

The preliminary analysis having been completed, we now turn to the Granger causality test. The appropriate model will vary according to our previous tests.

For the whole sample and for the South–North trade sub-sample, the Granger causality test is based on the following model with fixed coefficients and stationary variables:

$$\begin{cases} HHI_{it} = \alpha_{HHI,i} + \gamma_{HHI,i} HHI_{i,t-1} + \beta_{HHI,i} RER_{i,t-1} + \epsilon_{it} \\ RER_{it} = \alpha_{RER,i} + \gamma_{RER,i} HHI_{i,t-1} + \beta_{RER,i} RER_{i,t-1} + \epsilon_{it} \end{cases} \quad (2.14)$$

For South–South trade, the alternative model for the causality analysis will be

$$\begin{cases} \Delta HHI_{it} = \alpha_{\Delta HHI,i} + \sum_{k=1}^3 \gamma_{\Delta HHI,i}^{(k)} HHI_{i,t-1} + \sum_{k=1}^3 \beta_{\Delta HHI,i} RER_{i,t-1} + \epsilon_{it} \\ RER_{it} = \alpha_{RER,i} + \gamma_{RER,i} HHI_{i,t-1} + \beta_{RER,i} RER_{i,t-1} + \epsilon_{it} \end{cases} \quad (2.15)$$

Table 2.6: Granger causality test for panel data with optimal lags.

	Statistics					
	$\bar{W}_{HNC}$	$\bar{Z}_{HNC}$	$\bar{\tilde{W}}_{HNC}$	$\bar{W}_{HNC}$	$\bar{Z}_{HNC}$	$\bar{\tilde{W}}_{HNC}$
Whole	$H_0$ : RER does not cause HHI ( $K = 1$ )			$H_0$ : HHI does not cause RER $K = 1$		
	2.851	8.481***	6.125***	1.981	9.740***	7.110***
North	$H_0$ : RER does not cause HHI ( $K = 1$ )			$H_0$ : HHI does not cause RER $K = 1$		
	3.334	10.696***	7.859***	2.288	5.901***	4.106***
South	$H_0$ : RER does not cause $\Delta$ HHI ( $K = 3$ )			$H_0$ : $\Delta$ HHI does not cause RER $K = 1$		
	7.832	38.355***	6.887***	1.182	0.833	0.099

Note: The Granger causality test for panel data follows Dumitrescu and Hurlin (2012) methodology with various lags. The null hypothesis is the homogeneous non-causality (HNC) from X to Y. \*, \*\* and \*\*\* indicate the rejection of the null hypothesis at 10%, 5% and 1% level of significance, respectively. In bold are optimal lag length, by country group.

For the former cases, the null hypothesis of HNC  $H_0 : \beta_{HHI,i} = 0$  with  $\forall i = 1, 2, \dots, N$  means that the RER does not Granger cause HHI and  $H_0 : \gamma_{RER,i} = 0, \forall i = 1, 2, \dots, N$  means that HHI does not Granger cause the RER. The rejection of the null hypothesis implies the existence of causality in at least one country.

Table 2.6 provides the Granger causality results following Dumitrescu and Hurlin (2012) methodology with an optimal lag length selected. First, the null hypothesis is rejected at 1% level of significance in both directions taking the whole sample. A bidirectional causality indicates that neither export diversification nor the RER can be considered exogenous here because feedback may occur. To get a deeper understanding, the same Granger causality analysis was conducted by splitting our exports by destination. The results reported here provide strong evidence that the same bidirectional relationship exists for the *South-North* trade sub-panel, which implies that there is a two-way causality between the RER and HHI in at least one country in the middle-income group. More importantly, the fact that there is a causal link running from diversification to the RER in exports destined for the advanced countries challenges the standard argument on exchange rate determination. In the case of *South-South* trade sub-panel, the null hypothesis that  $\Delta$ HHI does not homogeneously cause RER is not rejected with the selected optimal lag length ( $K = 1$ ). It means that movements in export concentration do not explain the RER when the MICs export to other developing countries. We find however a reverse causation from RER to  $\Delta$ HHI, that is: the null hypothesis that RER does not homogeneously cause  $\Delta$ HHI is rejected at a level of significance with the optimal lag length chosen ( $K = 3$ ). A causal link running from the RER to export diversification dynamics is consistent with the standard literature.

Because the results may be influenced by lag-order misspecification, the same causality tests were

Table 2.7: Granger causality test for panel data: individual statistics with optimal lags

Country	RER does not cause HHI	RER does not cause $\Delta$ HHI	HHI does not cause RER
	To the North ( $K=1$ ) W-stat	To the South ( $K=3$ ) W-stat	To the North ( $K=1$ ) W-stat
Bangladesh	3.8398*	4.9633	5.2395**
Belize	0.0017	0.2187	0.1023
Bhutan	8.4133***	1.7524	0.7807
Bolivia	0.0349	35.7128***	5.0392**
Brazil	3.6636*	3.4019	0.2990
China	1.6684	0.1817	2.8160*
Colombia	14.6473***	4.6280	1.5509
Costa Rica	6.4606**	0.6118	3.1482*
Dominica	4.1978*	4.5417	6.8110***
Dominican Rep.	0.4464	2.8406	1.9451
Ecuador	0.5084	5.0264	3.4471*
El Salvador	0.0791	1.0365	0.4796
Fiji	0.4607	14.0999***	0.1595
Grenada	7.9168***	0.6215	0.0132
Guatemala	0.2021	6.8452*	2.7638*
Guyana	2.4261	20.3266***	0.5871
Honduras	8.1362***	0.5894	11.7101***
India	1.6920	13.3099***	0.7503
Indonesia	2.7638*	13.2601***	0.0780
Jamaica	2.7952*	1.5770	2.5557
Kiribati	2.6118	2.1352	0.4299
Lao PDR	7.1256***	3.4598	0.4972
Malaysia	6.5542**	3.7418	4.4367**
Maldives	10.8873***	3.0535	0.0241
Mongolia	1.2330	8.1752**	3.5335*
Pakistan	3.9980**	5.7840	0.0005
Panama	0.2178	63.0809***	4.7851**
Papua New Guinea	0.9190	5.2797	1.3048
Paraguay	0.8023	3.7775	0.0382
Peru	0.0001	3.3025	6.6184**
Philippines	3.5668*	4.0964	0.0054
Samoa	0.0947	2.5606	2.1280
Sri Lanka	0.1577	1.6416	10.6387***
St Lucia	0.1331	0.2989	0.0079
St. Vincent and Grenadines	3.2473*	0.7619	2.3086
Solomon Islands	1.8958	4.0469	0.0752
Suriname	8.0402***	8.0428**	1.2951
Thailand	15.3941***	31.7079***	0.2763
Tonga	0.5686	14.1715***	3.6768*
Vanuatu	1.3690	3.5351	1.1231
Venezuela, RB	0.6857	3.3607	0.0403
Vietnam	0.1751	17.3980***	2.5600

Note: \*, \*\* and \*\*\* indicate the rejection of the null hypothesis at 10%, 5% and 1% level of significance, respectively.

performed with various lags ranging from 1 to 3. We found results which are similar to the ones obtained with an optimal lag length selected.

The fact that there is at least one country where HHI causes the RER calls for deeper investigation. Therefore, Granger causality tests were conducted on individual countries and the results are displayed in Table 2.7. We find that 11 countries show no causal relationship between RER and export diversification in either direction. For these countries, the dynamics of the RER does not affect movements in export diversification and vice versa. On the opposite, five countries show a bidirectional causality but specifically in their exports destined for the Northern markets, namely: Bangladesh, Costa Rica, Dominica, Honduras and Malaysia. Interestingly, a same direction from RER to HHI or  $\Delta$ HHI for both Northern and Southern sub-panels is only found in Indonesia, Suriname and Thailand. In other words, the role of the RER as a conventional determinant of export diversification dynamics, whatever the destination country, is not systematic at all.

Finally, our remaining countries seem to reveal a heterogeneous causality between export diversification and the RER across destinations. First, 10 (respectively four) countries show a univocal causation from RER to HHI in specifically Northern markets (from RER to  $\Delta$ HHI in specifically Southern markets). On the contrary, four countries show a univocal link running from HHI to RER when they export to the North, namely: China, Ecuador, Sri Lanka and Peru. Second, five countries show opposite causations depending on destinations: RER causes  $\Delta$ HHI in exports to the South while HHI causes RER in exports to the North.

### **2.4.3 Implication of the results**

To allow an extensive discussion on the meaning of the results, let split the country sample on the basis of our Granger causality tests at the individual countries level (Table 2.8). The first evidence from our results indicates that there is neither uniform nor homogeneous causality from RER to HHI. At the individual level, only countries in *Group 3* give evidence on this unidirection and among them, only three countries confirm this standard link in exports destined for all trading partners. Even though empirical evidence suggests a correlation between our two variables, it does not underpin necessarily a causal link running from the RER to export diversification. Moreover, the fact that these countries have divergent exchange rate regimes suggests that one size does not fit all: rather, exchange rate arrangements are mainly dedicated to monetary policy frameworks and broad macroeconomic policy in the face of capital flow volatility<sup>3</sup>.

The second idea behind our findings is that we have a significant heterogeneity both across and within regions, even after controlling for income per capita. The causal relationship displays much heterogeneity among across countries, so do their structural characteristics too (Table 2.9). For example, Caribbean small states in *Group 3* (e.g. Grenada, Guyana, Jamaica, St. Vincent and the Grenadines or Suriname) suggest that an exchange rate policy would facilitate diversification. However, the same pol-

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<sup>3</sup>In Appendix 2.B, we provide the classification of our countries according to IMF methodology: the system classifies exchange rate arrangements on the basis of the degree to which the exchange rate is determined by the market.

Table 2.8: Granger causality results

None	Bi-directional (only to the North)	Uni-directional		Opposite direction
Group 1	Group 2	Group 3	Group 4	Group 5
Belize (UMI)	Bangladesh (LMI)	$RER \rightarrow HHI$ or $\Delta HHI$	$HHI \rightarrow RER$	$RER \rightarrow \Delta HHI$
Dominican Republic (UMI)	Costa Rica (UMI)	(Both destinations)	China (UMI)	(to the South)
El Salvador (LMI)	Dominica (UMI)	Indonesia (LMI)	Ecuador (UMI)	$HHI \rightarrow RER$
Kiribati (LMI)	Honduras (LMI)	Suriname (UMI)	Peru (UMI)	(to the North)
Papua New Guinea (LMI)	Malaysia (UMI)	Thailand (UMI)	Sri Lanka (LMI)	Bolivia (LMI)
Paraguay (LMI)		To the North		Guatemala (LMI)
Samoa (LMI)		Bhutan		Mongolia (LMI)
Solomon Islands		Brazil (UMI)		Panama (UMI)
St. Lucia (UMI)		Colombia (UMI)		Tonga (UMI)
Vanuatu (LMI)		Grenada (UMI)		
Venezuela (UMI)		Jamaica (UMI)		
		Laos (LMI)		
		Maldives (UMI)		
		Pakistan (LMI)		
		Philippines (LMI)		
		St. Vincent and the Grenadines (UMI)		
		To the South		
		Fiji (UMI)		
		Guyana (LMI)		
		India (LMI)		
		Vietnam (LMI)		

icity would be irrelevant in similar Caribbean small states belonging to *Group 1* (e.g. Belize, Dominican Republic or St. Lucia). More globally, the majority of small islands in Asia and Latin America are highly opened to trade due to small domestic markets and limited opportunities to exploit economies of scale<sup>4</sup>. But they are also remote in nature: therefore, diversification took another pattern than the one followed by the other MICs.

Interestingly, resource-based exports continue to contribute significantly to total exports in some major countries. Malaysia and Vietnam in the Asian area are two cases where the diversification experience began at different times but where it has been successful both in primary-products (foodstuffs, agriculture) and manufactured exports (IMF, 2014). By the emergence of new agricultural products, Chile has been invoked as an example of an export diversification based on natural resources since the 1970s (de Pineres and Ferrantino, 1997; Kaulich, 2012). Brazil and Colombia have experienced the same success in an agricultural-based pattern since the mid-1990s. Mining plays also an important role in these countries: Medellin (in Colombia) and Sao Paulo (in Brazil) are presented as dynamic centres based on mining. For commodity exporters in both regions, the solid causal link from the RER to export diversification is partly attributed to favourable commodity prices in the 2000s. Driven by high oil prices for example, the share of fuel exports (in percentage of merchandise exports) grew in Colombia (*Group 3*) and Ecuador (*Group 4*) from, respectively, 27.7% and 35.9% to 69.4% and 57% between 1995 and 2013. However, Ecuador also sustained export growth by resource exploitation in recent years (flowers, crus-

<sup>4</sup>The highest ratio was recorded by Guyana with 213.3% of GDP in 1995.

taceans, canned fish, food processing) while industrial is directed primarily to the domestic market. Also abundant in natural resources, Central American countries such as Bolivia, Costa Rica or Peru applied the same pattern of diversification with prudent macroeconomic policies, structural reforms and large public investment projects (Bebczuk and Berrettoni, 2006).

Finally, all developing regions participate to international trade. However, some MICs participate more significantly to regional or global production and distribution chains, and this has enabled them to succeed in their export diversification across partners and across products. China and Malaysia aptly illustrate such successful experiences in East Asia, where a dynamic process of structural change has accompanied output and export diversification. Against this background, causality between the RER and export diversification is in question. For example, China experienced a dramatic rise of productivity in the manufacturing sector due to the benefits of mass production with product diversification, and this helped export competitiveness (as unit costs fall with increasing output). Similarly, Bangladesh recorded rapid export development in ready-made garments, electronics thanks to large investments in export processing zones. The standard approach argues that the RER explains or 'causes' export diversification; on the contrary, our reverse causation highlights the importance of economies of scale (and the tradable sector in which the country exports) in maintaining a competitive exchange rate.

As far as developmental strategies are concerned, the diversity of experiences and constraints recorded at the individual countries level calls for specific policy measures.

First, manufactured exports have gained importance: but export diversification does not necessarily mean manufactured goods. For example, export diversification in some Latin American and Asian MICs since the mid-1990s has been possible by the emergence of new primary-products (Agosin, 2007; de Pineres and Ferrantino, 1997). In terms of development policies, such finding implies that export diversification should not discriminate between different types of products. Reforms dedicated to resource-based activities or commodity processing may imply considerable potential for developing new products. In the same idea, small islands in Asia and Latin America could develop their capacity to diversify through tourism services (IMF, 2014; Newfarmer et al., 2009). In this perspective, a competitive exchange rate policy can support such pattern of diversification.

Second, the RER does not determine export diversification in *Group 4*, and this is a prominent result. Rather, diversification leads to changes in the relative prices thanks to productivity gains, larger export production capacities and enhanced tradable sectors. It points out some policy measures that should be oriented towards economies of scale. Improving infrastructure and trade networks is among the main channels of successful attempts at diversification (IMF, 2014). Several countries in the sample have used state support to develop specific industries through interventionist policies (Rodrick, 2007). However, because product diversification is not decided directly by the government but by individual firms, policy measures are an important ingredient for diversification provided that it enhances the profitability of (heterogeneous) firms producing tradable products (Bebczuk and Berrettoni, 2006). For example, state policies aimed at facilitating agglomeration or clustering proved to be effective in encouraging economies

Table 2.9: Descriptive statistics by group

		1995			2013		
		Mean	Min	Max	Mean	Min	Max
Merchandise trade (% of GDP)	G1	59.89	41.53 (Venezuela)	88.57 (Papua New Guinea)	64.04	37.04 (Venezuela)	91.43 (Solomon Islands)
	G2	85.45	26.87 (Bangladesh)	170.91 (Malaysia)	77.41	44.14 (Bangladesh)	134.29 (Malaysia)
	G3	65.55	12.81 (Brazil)	157.97 (Guyana)	66.57	19.98 (Brazil)	154.22 (Vietnam)
	G4	42.09	25.31 (Peru)	70.06 (Sri Lanka)	44.87	37.97 (Sri Lanka)	54.86 (Ecuador)
	G5	43.66	37.16 (Guatemala)	61.15 (Mongolia)	67.07	49.76 (Tonga)	84.46 (Mongolia)
Merchandise exports to high-income economies (% of total merchandise exports)	G1	70.25	17.86 (Dominican)	94.74 (Belize)	44.89	13.32 (Kiribati)	73.39 (Belize)
	G2	75.85	67.22 (Dominica)	85.74 (Bangladesh)	68.62	61.72 (Malaysia)	77.57 (Dominica)
	G3	75	16.1 (Lao PDR)	88.72 (Philippines)	61.44	13.86 (Lao PDR)	92.22 (Suriname)
	G4	81.15	75.2 (Peru)	88.05 (China)	70.76	64.46 (Peru)	76.74 (Ecuador)
	G5	71.4	57.12 (Guatemala)	87.11 (Tonga)	50.09	9.05 (Mongolia)	71.35 (Tonga)
Manufactures exports (% of merchandise exports)	G1	27.66	0.0014 (Kiribati)	77.71 (Dominican)	27.6	0.29 (Solomon Islands)	73.36 (El Salvador)
	G2	48.17	9.14 (Honduras)	85.15 (Bangladesh)	61.32	60.78 (Malaysia)	61.86 (Costa Rica)
	G3	50.22	14.06 (St. Vincent and Grenadines)	82.97 (Pakistan)	41	0.05 (Maldives)	78.6 (Philippines)
	G4	35.58	7.81 (Ecuador)	84.13 (China)	46.26	6.73 (Ecuador)	94.02 (China)
	G5	17.79	4.1 (Tonga)	28.15 (Guatemala)	14.21	3.52 (Mongolia)	41.33 (Guatemala)
Fuel exports (% of merchandise exports)	G1	12.83	0 (Belize, St. Lucia)	76.65 (Venezuela)	22.58	0.007 (Solomon Islands)	97.67 (Venezuela)
	G2	1.65	0.0001 (Dominica)	7 (Malaysia)	11.15	0.05 (Costa Rica)	22.26 (Malaysia)
	G3	5.61	0 (Grenada)	27.71 (Colombia)	13.85	5.01E-06 (Guyana)	69.43 (Colombia)
	G4	14.94	3.58 (China)	35.87 (Ecuador)	18.73	0.32 (Sri Lanka)	57.02 (Ecuador)
	G5	6.59	2.05 (Guatemala)	14.55 (Bolivia)	20.84	0.16 (Tonga)	57.25 (Bolivia)
Agriculture, value-added (% of GDP)	G1	20.48	5.53 (Venezuela)	44.66 (Solomon Islands)	15.86	3.18 (St. Lucia)	44.66 (Solomon Islands)
	G2	18.69	12.95 (Malaysia)	26.38 (Bangladesh)	12.07	5.61 (Costa Rica)	16.28 (Bangladesh)
	G3	20.8	5.77 (Brazil)	55.68 (Lao PDR)	12.7	3.85 (Maldives)	26.38 (Lao PDR)
	G4	18.68	9.28 (Peru)	23.14 (Sri Lanka)	8.45	7.13 (Peru)	9.41 (China)
	G5	20.8	7.11 (Panama)	34.36 (Mongolia)	12.7	3.14 (Panama)	20.66 (Tonga)

Source: World Development Indicators (World Bank).

of scale (industrial zones, export processing zones).

Finally, the choice of trading partner also matters. Recall that South-South trade has a more di-

versified export pattern than South-North trade in the MICs of Asia (see Figure 2.1). IMF (2014) reports that recent increasing trends in South-South trade (or higher export shares to all developing economies) are correlated with increased export diversification. The main factor behind this result is improved physical infrastructures and market access (*i.e.*, decreasing transaction costs) following trading agreements between and within developing regions. In this specific trade however, only a uni-directional causality running from the RER to changes in HHI prevails, which means that export diversification occurs mainly through price effects in Southern destinations. Cheaper imported inputs through better market access have allowed relatively lower output prices and increased diversification towards Southern partners. On the opposite, demand for manufactured exports from the North shows a relatively higher income elasticity, which means that any income growth in developed markets will increase the relative demand for manufactured exports. It suggests that export diversification occurs through income effects in Northern destinations. All in all, our empirical results on individual countries suggest that a 'price-driver-export diversification' prevails in the Asian South-South trade, contrasting with an 'income-driver-export diversification' which may lead the production process in destination to Northern markets (Phi et al., 2015).

## **2.5 Conclusion**

For a long time, developing countries suffered from the widely held view that, since their products were largely similar (mainly raw materials and basic goods), complementary relationships with other developing countries did not exist. This absence of complementarity, combined with a lack of outlets because of limited markets, was supposedly the reason why they tended to favour trade relations with developed countries. Over the last two decades, however, a new geography of international trade has begun to emerge, based on a complementary dynamic between the increased involvement of Southern countries in international trade, on the one hand, and an expansion of South-South trade, on the other.

In this chapter, we have sought to identify the specificities of this dynamic by focusing in particular on export diversification performance. Diversifying the export structure can make a country less prone to negative economic shocks and follow the most sustainable path to economic growth. However, it depends on a broad set of conditions. On the other hand, the RER proves to have a significant effect on export performance. The central question is then: what should be done specifically in relating export diversification to the RER? While the dynamics of the integration process have attracted all the attention of policy-makers, we provide a comparative examination of export diversification performance in Asia and Latin America. The present chapter contributes to the existing literature in three respects. First, we address the issue of causality in the relationship between export diversification and the RER, which has not yet been done. Second, as diversification is more prevalent in the early stages of economic development, we explore the relationship for the MICs of Asia and Latin America. Third, we investigate asymmetries in the causality issue by examining the direction according to trading partners.

To explore the causality issue, we employed Granger causality techniques on panel data covering



the entire sample of MICs over the period 1995-2013. Our investigation has been conducted with a large and disaggregated data-set on world exports and it shows how exports from the selected countries have diversified or concentrated over time. General differences in export diversification patterns appear at the aggregate level, but become particularly interesting when we separate export markets into the North and the South.

Our empirical results show that there is a two-way causality between the level of the RER and export diversification when we look at the sample as a whole. A causal link running from export diversification to the RER is very appealing and has crucial economic policy implications for countries at the middle-income stage. When the causal issue is investigated by treating export markets differently, our findings at the aggregate level are confirmed in exports destined for the Northern countries. In contrast, the analysis for the South shows a unidirectional link from the RER to changes in export diversification. The latter result is consistent with the standard literature but it is not systematic at all.

Because there is at least one country where HHI causes the RER, Granger causality tests were conducted on individual countries. We find that five countries show a bidirectional causality in their exports destined for the Northern markets. Interestingly, the role of the RER as a conventional determinant of export diversification dynamics, whatever the destination country, is only validated for three countries. Our remaining countries seem to reveal a heterogeneous causality between export diversification and the RER across destinations. All in all, the empirical results on individual countries suggest that a 'price-driver-export diversification' prevails in the Asian South-South trade, contrasting with an 'income-driver-export diversification' which may lead the production process in destination to Northern markets. The relevance of heterogeneous causal links between our two variables implies that different policies should be applied to different subgroups of MICs.

# Appendix

## 2.A Country sample

Area	Country	Status	Area	Country	Status
East Asia and Pacific	China	UMI	Latin America and the Caribbean	Belize	UMI
	Fiji	UMI		Bolivia	LMI
	Indonesia	LMI		Brazil	UMI
	Kiribati	LMI		Colombia	UMI
	Lao PDR	LMI		Costa Rica	UMI
	Malaysia	UMI		Dominica	UMI
	Mongolia	LMI		Dominican Republic	UMI
	Papua New Guinea	LMI		Ecuador	UMI
	Philippines	LMI		El Salvador	LMI
	Samoa	LMI		Grenada	UMI
	Solomon Islands	LMI		Guatemala	LMI
	Thailand	UMI		Guyana	LMI
	Tonga	UMI		Honduras	LMI
	Vanuatu	LMI		Jamaica	UMI
South Asia	Viêt-Nam	LMI	Panama	UMI	
	Bangladesh	LMI	Paraguay	LMI	
	Bhutan	LMI	Peru	UMI	
	India	LMI	St. Lucia	UMI	
	Maldives	UMI	St. Vincent and the Grenadines	UMI	
	Pakistan	LMI	Suriname	UMI	
	Sri Lanka	LMI	Venezuela, RB	UMI	

## 2.B Exchange rate arrangements

2013	No separate legal tender (4)	Currency board (5)	Conventional peg (6)	Stabilized arrangement (7)
	Ecuador El Salvador Kiribati Panama	Dominica Grenada St. Lucia St. Vincent and the Grenadines Solomon Island Venezuela	Belize Bhutan Fiji Samoa  Sri Lanka Suriname Vietnam	Bangladesh Bolivia Guyana Maldives
	Crawl-like arrangement (6)	Pegged exchange rate within horizontal bands (1)	Other managed arrangement (4)	Floating (0)
	China Dominican Rep. Guatemala Honduras Jamaica Laos	Tonga	Costa Rica Malaysia Pakistan Vanuatu	Brazil Colombia India Indonesia Mongolia Papua New Guinea Paraguay Peru Philippines Thailand
1995	USD (8)	Other currencies (2)	A composite of currencies (7)	
A peg to (17)	Belize Dominica Grenada Panama St. Lucia St. Vincent and Grenadines Venezuela	Bhutan Kiribati	Bangladesh Fiji Solomon Island Thailand Tonga Vanuatu  Western Samoa	
	More flexible arrangement (25)	Managed floating (14)	Independently floating (11)	
	Brazil China Colombia Costa Rica Dominican Rep. Ecuador El Salvador Honduras Indonesia Malaysia Maldives Sri Lanka Suriname Vietnam	Bolivia Guatemala Guyana India Jamaica Lao Mongolia Papua New Guinea Paraguay Peru Philippines		

Source: Annual Report on Exchange Arrangement and Exchange Restrictions (IMF 2014) <https://www.imf.org/external/pubs/nft/2014/areaers/ar2014.pdf> (Hard pegs: no separate legal tender, currency board; Soft pegs: conventional peg, crawling peg, stabilized arrangement, crawl-like arrangement, pegged exchange rate within horizontal bands; Floating regimes; Residual: other managed arrangement)

## Chapter 3

# Global value chains and the missing link between exchange rates and export diversification<sup>1</sup>

### Abstract

In consequence of an international division of labour that has intensified with globalisation, fragmentation of production is associated with larger participation of developing countries in Global Value Chains (GVCs). Concomitantly, diversification in export has become of growing interest in the recent literature. At a conceptual framework, we link participation in GVCs and export diversification through the real exchange rate. On one hand, the competitiveness of trade structure and the structural factors related to countries affect the performance of GVCs. But on the other hand, increased involvement into GVCs has led to a greater diversification of exports in the newly industrializing countries, and this has affected in turn the real exchange rate. Intuitively, as countries are more integrated in global production processes, the causal relationship between export diversification and the real exchange rate might change because of GVC-related exports. In a previous article, we proposed a panel Granger causality test between real exchange rate and export diversification in the middle-income countries of Asia and Latin America. The present chapter extends the framework by examining the effects of financial crises on the causal relationship (namely the East Asian financial crisis of 1997 and the global crisis of 2008) over the period 1995-2015. Looking at the whole sample, our study finds a bidirectional causality between the two variables. However, our empirical findings show that the financial crises have affected the causation in half of the individual countries in our sample.

Key words: Global value chains, export diversification, real exchange rate, emerging Asia and Latin America, financial crises.

JEL Codes: F14, F41, O11, O24, O53, O57

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### **3.1 Introduction**

For many developing countries, export performance has become crucial in order to make international integration an efficient instrument for development. According to UNCTAD statistics, half of all developing countries depend on non-fuel commodities for more than half of their export earnings, two thirds if fuels are included. However, exporters of primary commodities have faced with additional difficulties arising from their weakening position in world markets. Vertical integration of the different stages in the supply chain has strengthened the bargaining power of a few multinational corporations and large distribution networks in a number of commodity markets. This has led developing countries to target diversification of their export portfolios, especially into manufactured goods. One way to reach this outcome is participation in Global Value Chains (GVCs) or Global Production Networks (GPNs). But the early experiences of the Newly Industrializing Countries (NICs) of East Asia have directed also attention to the Real Exchange Rate (RER) as a development-relevant policy tool. A stable and competitive RER should be thought as a facilitating condition for exploiting a country's capacity for growth (Eichengreen, 2008). This raises the question as how to adopt and maintain a competitive RER level. Building domestic supply capacity and enhancing international competitiveness while managing integration with the global economy are of great concern for most of them, as such performance is likely to be the outcome of a combination of various elements which still have to be clearly identified. Among them, diversification in export has become of growing interest in the recent literature and it is generally viewed as a positive development (IMF, 2014; Newfarmer et al., 2009).

Two important strands of literature are combined in the present study: the first concerns the determinants of export diversification and the related studies on GVCs in international trade theories, and the second the determinants of the RER in international macroeconomics. The literature in both areas is extensive but there is no connection between them. When the RER and export diversification are correlated, most studies focus on the RER as a determinant of export diversification: RER undervaluation and stability promote export diversification by increasing the profitability of the export sector. However, the early experiences of the Asian NICs and more recently, of China, might show a reverse causation: the competitiveness of trade structure and the structural factors can have an impact on trade-related outcomes, such as relative prices. In fact, there is much more product variety in China's export mix than economic models would predict. We argue here that by diversifying trade under their participation in GVCs, those countries have succeeded in lowering their supply prices thanks to larger export production capacities and enhanced tradable sectors. Although there are risks of unequal powers and distribution of rents between the pool of suppliers, scale matters and this helps keeping low production costs.

Diversification through GVC-related exports may therefore determine the RER by affecting the relative price of traded goods or the relative movement of prices. Surprisingly, this causal direction is usually ignored. One important purpose of this study is to bridge the gap. Firstly, the evolution of export diversification indicators for different regions of the world shows that exports have tended to be

more diversified for Asia over time (Amurgo-Pacheco and Pierola, 2008). Secondly, the major players in GVCs are located in Asia (Gill and Kharas, 2007). While part of their success has been attributed to their participation in the most dynamic GVCs, one possible interpretation of their export performance is that it was a combination of exchange rate and active diversification policies that framed firms' production environment and export products' access to international markets (Rodrik, 2005; Stiglitz and Yusuf, 2001).

By exploring the issue in the Middle Income Countries (MICs) of Asia and Latin America over the period 1995-2013, a previous research has contributed to the literature in two respects (Tran, Phi, and Diaw, 2017). Firstly, it examined the directional causality between RER and export diversification, which has not been done yet. Secondly, it investigated asymmetries in the causality issue by examining the direction across trading partners (namely, North-South versus South-South partnerships). As the tests performed at the individual countries level revealed a heterogeneous causality across trading partners, one wonders if external shocks like financial crises would have explained such results. The present chapter addresses the issue by examining the effects of the East Asian financial crisis of 1997 and the global crisis of 2008 on the causal relationship over the period from 1995 to 2015. Accordingly, the Granger causality will be tested in a panel context given cross-sectional dependencies and heterogeneity across countries stemming from their participation in GVCs.

The remainder of this chapter is organized as follows. Section 3.2 provides the conceptual framework underlying the relation between RER and export diversification in a value chain analysis. Section 3.3 presents the general options of our econometric approach before we report our empirical findings in Section 3.4. Section 3.5 summarizes the results and concludes.

## **3.2 GVCs, export diversification and RER: a two-way causation?**

### **3.2.1 On the link between GVCs and export diversification**

In traditional trade theory based on factor endowments, a country should specialize (not diversify) in the products that it produces more efficiently than others. When all countries specialize in accordance with their comparative advantage, the entire world is better off and the consequent gains from trade become an argument for trade liberalization. There are two main points in the critiques of this pattern of trade according to free trade theory (Mejía, 2011). Firstly, export concentration combined with specialization in raw materials or primary commodities is correlated with volatile and adverse terms of trade shocks, rendering free trade less beneficial for developing countries. Secondly, too much reliance on a small set of products results in export revenue instability, with detrimental effects on investment, import capacity, employment, and growth. These critiques are synthesized in the literature on the "natural

resource curse”, *i.e.*, a negative relationship between natural resource abundance and growth (Cadot, Carrere, and Strauss-Kahn, 2013).

The answer to the question of trade diversification was then seen to lie in the development of a portfolio: by diversifying, countries reduce the risk of export instability, their vulnerability to external trade shocks and the dependence on a limited number of commodities. Similarly, if an economy exports to a large number of countries, it will be less sensitive to large fluctuations in the demand from one country or region. Geographic diversification, like product diversification, can moderate the transmission of adverse international shocks (Newfarmer et al., 2009). Additionally, those countries that diversify their exports more tend, by and large, to have higher income elasticity of global demand (Haddad, Lim, and Saborowski, 2010).

The issue of export diversification as a stabilization strategy then became an important economic issue. A large number of countries undertook the usual measures to open up their economies. One of the objectives of the trade liberalization efforts was to benefit from increased diversification and reduced dependence on a few products and markets. However, the recent literature on new growth and trade models has shifted the focus on to the emergence of and trade in new or high-productivity varieties of goods. Countries that produce more diversified and high-productivity goods experience faster export growth than countries with concentrated and lower productivity export baskets (Hausmann et al., 2007; Hummels and Klenow, 2005). Moreover, the choice of trading partners can improve the size of the export basket, the number of differentiated items, and their relative prices (Amurgo-Pacheco and Pierola, 2008; Regolo, 2013).

The above-mentioned points suggest that developing export capacity outside the resource-based sector should be in the center of focus. However, what kind of diversification should be put in place? What are the underlying determinants? There is a large recent literature that has attempted to answer to these questions. Different patterns of diversification exist, varying from country to country and depending on the stage of development (Cadot et al., 2013; IMF, 2014). Among the determinants of export diversification, market access through bilateral or multilateral trade arrangements is a key factor. As countries become increasingly integrated, their trade tends to diversify more because countries can exploit economies of scale and spillover effects (Diaw et al., 2012). Moreover, because of geographic proximity and involvement in regional trade agreements, most recent studies show that country pairs with low trade costs have more diversified bilateral exports (Regolo, 2013). When Foreign Direct Investment (FDI) is involved, it can promote diversification and upgrading of the host country’s export basket through spillover benefits (Iwamoto et al., 2012).

Product and market diversification indicators together provide perspective on the degree to which countries are taking advantage of potential trading relationships. Many economists argue that GVCs have given developing countries new opportunities in this aspect. Accordingly, a value chain analysis is developed to reveal a changing nature of international trade (Gill and Kharas, 2007; WB, 2017). On conceptual grounds, international production sharing has enabled developing countries to move into new activities

or new markets, to diversify their exports because different steps of the production process can be carried out in different countries. Geography clearly matters here as production systems consist of complex networks of “hubs and spokes”, even within a national economy. Because vertical integration implies a multi-country dimension, FDI has become the main driver of supply chains, and this influences the distribution of production stages across national borders. When developing countries are more involved in global and regional production processes, this contributes to diversify their exports. By supporting access to export markets, the formation of supply chains allows them to build supply capacities and upgrade export mix. Accordingly, GVC-related trade allows countries to industrialize by specializing in a fraction of the value of final good exports rather than by building their own (R. Baldwin and Lopez-Gonzalez, 2015). Kowalski, Gonzalez, Ragoussis, and Ugarte (2015) point out that the volume of the activity may matter as much as the domestic value added share or sophistication in exports. Important benefits can derive from specializing in less sophisticated assembly activities and performing them on a large scale.

Product diversification and participation in GVCs are well documented explanations of high export performance in East Asia (Jankowska, Nagengast, and Perea, 2012). In addition, different types of trade linked to GVC activities expanded dramatically in the 2000s. But they went through a pattern of “boom and bust” which seems to be closely linked to financial crises. The point is that all the GVC-related literature takes the RER as strictly exogenous. By increasing uncertainty and reducing the profitability of the exportable sector, financial shocks discourage investment and the emergence of new tradable activities (IMF, 2014). And because it affects the causation between export diversification and the RER, evidence of the link is not definitive. The reverse causality issue is rarely addressed and few, if any, studies have examined the mechanisms through which GVC-related export diversification may affect the RER.

### **3.2.2 On the determinants of the real exchange rate**

Export diversification will take place if factors are reallocated to exportable goods, if more resources are made available or freed up in, thereby facilitating inter-sectoral reallocations. A range of economic measures can be adopted to smooth the way for this structural change. One important variable in this regard is the RER. Results indicate that an overvalued or volatile RER is seriously detrimental to export profitability, and this is of particular importance for commodities and manufactured products that are labor-intensive and highly exposed to price competition. In developing countries, the possibilities for devaluation are limited by the need to maintain macroeconomic and price stability, and frequent use of the exchange rate for macroeconomic adjustments increases uncertainty. Any policy aimed at manipulating the nominal exchange rate would lead to problems in managing the economy. In addition, developing countries usually export goods that are highly dependent on imported raw materials and intermediate inputs, machinery and equipment. Any currency depreciation would increase the cost of imported inputs and tighten the liquidity constraint or the foreign-currency debt servicing faced by exporters, thereby impeding the contribution of exchange rate depreciation to export growth (Taylor, 1991).



A key concern then is whether there are other ways to slow down the real appreciation or to maintain competitive RER levels. Any search for alternatives to competitive devaluations of nominal exchange rates would soon identify the factors influencing the “fundamentals” as having potential. One alternative to devaluation would be to slow down the real appreciation through trade liberalization. Wider private sector participation, market liberalization with exchange rate and price reforms have become policy priorities. An increase in trade liberalization would reduce the relative price of importable products, which in turn diverts spending toward exportable products. In international macroeconomics, the literature examines how trade liberalization (or reductions in trade protection) would help to lower the equilibrium level of RER. It follows that misalignments (that is, any deviation of the observed exchange rate from its equilibrium values) arise from external and internal imbalances (Coudert and Couharde, 2008). The former are captured by the difference between the observed current account and the equilibrium level given by its fundamentals, while the latter refer to output gaps, generally measured as the difference between the observed GDP and its potential level.

A recent and still expanding strand of the literature attempts to examine the transmission mechanisms between external and internal disequilibria and RER misalignments in the context of widespread macroeconomic imbalances (Gnimassoun and Mignon, 2013). However, no study addresses export diversification as a determinant of the RER. The literature has invested more in documenting the impact of RER misalignment on export diversification than in identifying any feedback or bidirectional causality in the relationship. To the best of our knowledge, only two studies addressed the issue. First, Bodart, Candelon, and Carpentier (2011) proposed an interesting study that found that the degree of export diversification, among several structural factors, affects the magnitude of the RER reaction to terms of trade shocks. Increases in the terms of trade (like commodity price shocks) are associated with a rise in the RER. The authors found that a high degree of export diversification decreases the elasticity between the RER and the price of the main exported raw commodity, which is in line with the portfolio approach. Second, in a general equilibrium framework inspired by the “Footlose Capital Model”, Méjean (2008) compares three determinants of the RER. Among them, a structural determinant, the “Variety Supply effect”, explains long-run real exchange rates by the endogenous distribution of firms across countries. It implies that, as long as international trade is costly, location decisions (or the spatial repartition of the traded good production) are important determinants of relative price levels.

This leads us to move towards the role of involvement into GVCs in determining the RER. In a value chain perspective, there are some emerging studies linking GVCs and the RER. Using a panel framework covering 46 countries over the period 1996-2012, Ahmed, Appendino, and Ruta (2015) analyses how the formation of GVCs has affected the exchange rate elasticity of exports over time and across countries. In line with this intuition, they find evidence that GVC participation reduces the RER elasticity of manufacturing exports by 22 percent, on average. Bems and Johnson (2012) present an interesting extension of the trade in value added approach to international macroeconomics by proposing the concept of the “value-added real effective exchange rate”. They use GDP (value added) deflators, instead of con-

sumer price indices, to measure price changes, and bases weights of these price indices on value-added bilateral trade flows, instead of gross trade flows. However, the main challenge to such contribution is data availability on value-added bilateral trade, especially for developing countries. The scarcity of econometric and empirical studies on GVC integration is linked to the lack of inter-country input–output tables of trade, *i.e.*, databases do not still include all countries because of missing information in some sectors.

GVC is an opportunity for developing countries to raise their competitiveness in world trade (IMF, 2016a). But the performance of GVC is closely related to export diversification. To get a better understanding of this shortcoming, the research question to be tackled here is how export diversification affects the RER. *A priori*, it introduces changes in the relative prices of the goods produced and hence in future competitiveness. Several mechanisms through which export diversification affects the RER can be identified:

- Diversification increases domestic production capacities, either by expanding inputs into export production or by enlarging the export basket. In addition, improved production techniques associated with export diversification raise a country’s aggregate productivity level, bringing down costs. Both higher domestic supply and lower producer prices help to consolidate export performance.
- Diversification leads to changes in product composition, implying changes in the composite price index. This product composition effect combined with dynamic economies of scale resulting from the production process belongs to the “price-driver-export diversification”, contrasting with the income-driver-export diversification suggested by the new trade theories. It also contrasts with the “fallacy of composition”, which arises when too many countries rush into the same sectors or products, thereby driving down terms of trade and export earnings (Faini, Clavijo, and Senhadji-Semlali, 1992).
- Diversification is likely to be achieved without substantial growth in domestic wages when the increased demand for labor in the new tradable sectors is absorbed by underemployment and the large number of new entrants in the labor market (countries with relatively large or freed labor forces). Moreover, export diversification may not affect factor remuneration if productivity gains allow them to have lower unit labor costs (which are not similar to low wages) <sup>2</sup>.
- Diversification in the exporting country helps to decrease the consumer price index in the importing countries, elevating the purchasing power of their expenses and their market absorptive capacity. But the lower consumer prices might help to consolidate a competitive exchange rate policy, which in turn stimulates exports in the latter countries.

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<sup>2</sup>Export diversification may however impact on relative labor costs, notably the skilled-unskilled wage differentials. When the exported goods are different varieties of a non-homogenous industry, the reward to human capital will increase.

A better insertion in GVCs may help foster export diversification if local suppliers are competitive enough. In addition, export diversification helps to build domestic supply capacity and simultaneously to increase export competitiveness through cost reduction in the exporting country. By a cumulative process, the higher potential of market absorption capacity in the importer partner helps in turn the exporting country to diversify its own production capacities.

Such theoretical considerations imply that the relationship between export diversification and the RER is of particular relevance. It means that regressions “explaining” export diversification in terms of the RER will be contaminated by reverse causation. Unfortunately, there is no unified theoretical framework explaining these endogenous interactions. Since export diversification affects relative prices in a rather complex way, this phenomenon calls for an empirical approach to the problem. This has led us to investigate the causality issue in a previous study (Tran et al., 2017). We here extend the framework by examining the effects of the East Asian financial crisis of 1997 and the global crisis of 2008 on the causal relationship over the period from 1995 to 2015. The intuition behind the link is that external conditions after financial crises (with tightening global markets) affected not only the size and structure of trade, but also the macroeconomic interactions through FDI, monetary policy conditions and the RER. Accordingly, the Granger causality will be tested in a panel context given cross-sectional dependencies and heterogeneity across countries stemming from their participation in GVCs.

### 3.3 Empirical framework

#### 3.3.1 Data

As in our previous study (Tran et al., 2017), we focus on intensive export diversification (when it results from changes in the relative share of goods in the export basket), which is based on the most commonly used statistic for measuring export concentration, namely the Herfindhal-Hirschman product concentration Index (HHI). The index for country  $i$ , normalized to range from 0 to 1 (so that the information about the number of export products is lost), measures export concentration (diversification being the complement to 1 of concentration):

$$HHI_i = \frac{\left(\sum_{k=1}^N p_{ik}^2 - 1/N\right)}{1 - 1/N} \quad \text{with } p_{ik} = \frac{x_k}{X_i} \quad (3.1)$$

where  $p_k$  is the share of export line  $k$  (with  $x_k$  denoting the amount exported) in total exports of country  $i$  ( $X_i = \sum x_k$ ) and  $N$  is the total number of export products. The share of each product in a country’s total exports is weighted to make sure that a small export value has a minor influence on the outcome of the index. The lower the HHI, the less concentrated or more diversified exports are. The shares of each product  $k$  are used in whole percentages, so that the index for country  $i$  can range from 0

Table 3.1: Summary statistics of HHIs and RER indices (1995-2015)

	Variable	Obs.	Mean	Std. Dev.	Min	Max
WHOLE	HHI	924	1168.139	1242.802	29.0561	7956.216
	RER	924	112.183	22.107	36.237	233.777
Asia	HHI	441	1152.067	1299.882	29.056	6782.021
	RER	441	114.462	23.93	59.222	233.777
Latin America	HHI	483	1182.813	1189.461	114.17	7956.216
	RER	483	110.102	20.099	36.237	224.928

to 10,000.

The RER is defined here as the nominal exchange rate that is adjusted by the ratio of the foreign price level to the domestic level:

$$RER = EP^*/P \quad (3.2)$$

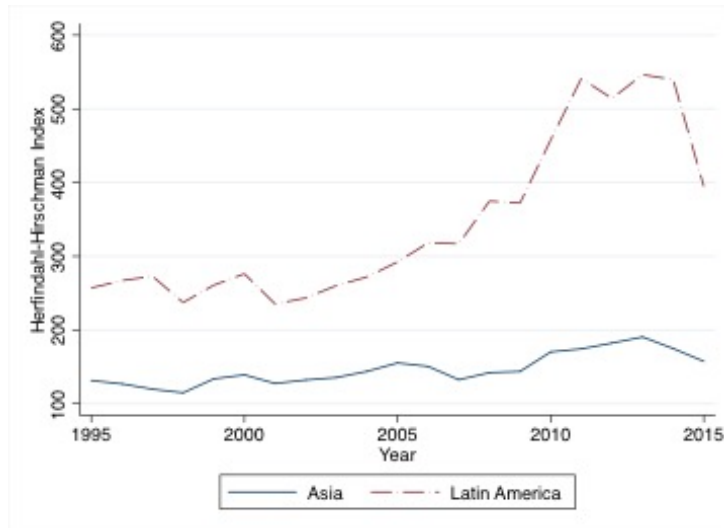
where  $E$  is the official nominal exchange rate (the number of local currency units per unit of foreign currency) and  $P^*$  and  $P$  are the foreign and domestic prices respectively. A decline will be interpreted as a real appreciation.

To calculate HHI, we use country-level data from the Basis for the Analysis of International Trade (BACI) dataset which is compiled by the CEPII at the HS 6-digit product level<sup>3</sup>. Original data are taken from countries' bilateral exports in value to all regions from 1995 to 2015. The sample is limited to a set of LMIs and UMIs in a comparative perspective, *i.e.*, 21 Asian countries and 23 Latin American countries<sup>4</sup>. For the RER, it is usually preferable to deflate the nominal exchange rate with producer prices or costs and weight bilateral exchange rates by the share of the main trading partners. Unfortunately, it is not possible to compute real effective exchange rates, as there are no available data on trade structure for all the LMI and UMI countries under consideration. In addition, it is crucial to choose a composite price index that takes account of all destination prices and their mutual dependence. Therefore, we decided to compute the RER for our sample by using the Consumer Price Indices (CPIs). The United States will be defined as foreign and the nominal exchange rates are the number of local currency units per US dollar. Annual data are extracted from the World Bank's World Development Indicators (WDI) database with base 2010 = 100.

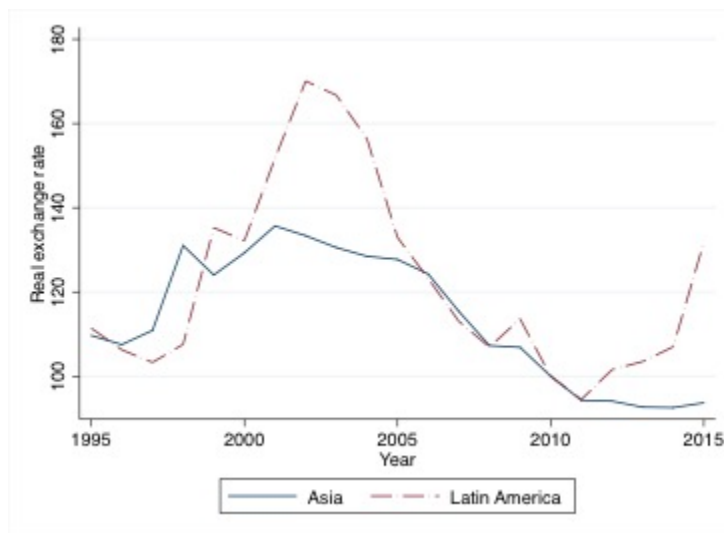
Using the available data, summary statistics are given in Table 3.1. In accordance with the literature linking the evolution of export diversification with development, our statistics provide evidence that export diversification is more prevalent in the MICs, although it is less pronounced in small countries. Figure 3.1 shows the evolution in Asia and Latin America over the period considered; the mean by

<sup>3</sup>See <http://www.cepii.fr/anglaisgraph/bdd/baci.htm> for further details.

<sup>4</sup>According to the World Bank classification, there are 28 LMI and UMI countries in South Asia, East Asia and Pacific and 25 LMI and UMI countries in Latin America and the Caribbean. However, because data are not available for all countries, our balanced sample is reduced to 44 countries over a 21-year period. The countries in our sample are listed in Appendix.



(a) Mean of HHI



(b) Mean of RER

Source: Authors' calculations.

Note: Individual HHI and RER are weighted by the share of each country in the regional GDP

Figure 3.1: HHI and RER in the middle income countries of Asia and Latin America (1995-2015)

region is individual HHI and RER data weighted by the share of each country in the regional GDP. The remarkable point is that mean HHI in both regions is relatively low, even if there was an increase in export concentration in Latin America over the last decade. On the other hand, the unweighted RER has a mean value of 114.5 in Asia and 110.1 in Latin America, which is quite low compared to previous decades (Table 3.1). In addition, standard deviation in both regions is 23.9 and 20.1 respectively, suggesting that the panel data sets are not so spread. An interesting point is that, on average, exports tended to become less diversified in Latin America while the RER was declining within the same period.

As our time period includes two financial crises, namely the East financial crisis of 1997 and

the global financial crisis of 2008, we wonder if these two shocks have affected the causal relationship between the real exchange rate and export diversification. For example, one might argue that the East Asian MICs have come out of the 1997 financial crisis with the decision to improve export performance through greater participation in GVCs. On the opposite, the global financial turmoil of 2008 resulted in global recession with a decline in international trade. It might play a role in the dynamics of exchange rates and the associated effects on GVC dynamics. In order to consider this possible impact of the two financial crises on the causality between RER and HHI, we will use dummy variables in our Granger causality techniques.

### 3.3.2 Methodology

The standard causality test defined by Granger (1969) has been widely applied in the empirical literature. However, because interactions along GVCs have increased with trade integration and globalization, the question of causality between export diversification and RER may exist in panels. A causality analysis using panel data then enables us to account for both cross-country dependence and heterogeneity across countries, *i.e.*, a causal link may exist for one country but may not exist for others. Taking these considerations into account, we use the Granger non-causality test developed by Dumitrescu and Hurlin (2012). The test is based on heterogeneous panel data models with fixed coefficients and stationary variables:

$$y_{i,t} = \alpha_i + \sum_{k=1}^K \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^K \beta_i^{(k)} x_{i,t-k} + \epsilon_{i,t} \quad (3.3)$$

We assume the lag orders  $K$  are identical for all cross-section units of the panel ( $i = 1, \dots, N$ ) observed at time period  $t$  ( $t = 1, \dots, T$ ), while the autoregressive parameters and the regression slopes differ across countries. Similarly,  $\alpha_i$  denotes the individual effects and all those coefficients are constant in time.

A variable  $x$  causes another variable  $y$  if the coefficients of its past values are statistically significant and help to explain and predict  $y$  on its own past values and other relevant information. The authors propose to test the Homogeneous Non Causality (HNC) hypothesis, which means that there is no causal relationship from  $x$  to  $y$  for all countries in the panel.

$$H_0 : \beta_i = 0 \quad \forall i = 1, \dots, N \quad (3.4)$$

A rejection of the null hypothesis suggests the existence of causality from  $x$  to  $y$  for at least one individual (see Tran et al. (2017)).

Our empirical investigation will be conducted separately for Asia and Latin America; however, in order to analyze the robustness of our results obtained by region and to compare them, we do the same

Table 3.2: Cross-sectional dependence test

Null hypothesis: Cross-sectional independence	F-statistics					
	WHOLE		Asia		Latin America	
	HHI	RER	HHI	RER	HHI	RER
Pesaran CD statistics	8.200***	58.440***	4.900***	39.160***	2.490**	21.820***

Note: The cross-sectional dependence test is performed following Pesaran (2004) approach. \*, \*\*, \*\*\* indicate the rejection of the null hypothesis at 10%, 5% and 1% level of significance respectively.

Table 3.3: Unit root test

Partner	Variable	Pesaran (2007)	Chang (2002)	Choi (2002)		
		CIPS	$S_n$	$P_m$	Z	$L^*$
WHOLE	HHI	-2.135**	9.729***	-7.387***	-7.839***	-8.351***
	RER	-2.374***	3.510***	-2.608***	-2.696***	-1.807**
Asia	HHI	-2.401***	4.159***	-4.035***	-3.967***	-4.546***
	RER	-2.737***	2.179***	-1.955**	-2.008**	0.182
Latin America	HHI	-1.979	9.483***	-6.361***	-7.052***	-7.207***
	RER	-2.020	2.772***	-1.739**	-1.810**	-2.673***

Note: Pesaran (2007), Chang (2002) and I. Choi (2002) test the null hypothesis of unit root test. \*, \*\* and \*\*\* indicate the rejection of the null hypothesis at 10%, 5% and 1% level of significance, respectively.

Granger causality analysis on the 44 individual countries. Our two variables are expressed in logarithms in order to include the proliferative effect of time series.

To estimate the sign of causality, for each country, we test the null hypothesis  $H_0 : \sum_{k=1}^K \beta^{(k)} = 0$  against the alternative  $H_1 : \sum_{k=1}^K \beta^{(k)} < 0$  (respectively  $H_1 : \sum_{k=1}^K \beta^{(k)} > 0$ ). Then, by using Fisher's method, we combined the p-values from these tests into a joint test whether the global null hypothesis can be rejected.

### 3.3.3 Preliminary test

To determine the appropriate method, Dumitrescu and Hurlin's causality test with panel data (Dumitrescu and Hurlin, 2012) requires some preliminary tests that involve verifying cross-sectional dependence, stationarity of the variables and selection of optimal lag length.

The statistics in Table 3.2 show clearly that the null hypothesis of no cross-sectional dependence is rejected in both the whole sample and sub-samples. Therefore, cross-sectional dependencies exist in our data and it confirms that the panel causality is appropriate.

We need to take into account cross-sectional and slope heterogeneity features when we have to verify the stationarity of our panel data sets. The results of the unit root tests are reported in Table 3.3. Taking the country sample as a whole, the statistics indicate a rejection of the null hypothesis and suggest stationarity at the level of both variables. We also obtain the same results for the regional sub-samples.

Choosing an appropriate lag length is important in the Granger causality test because its results

are sensitive to the number of lags. The omission of lags leads to a bias inference, while selecting more lags than the true lag length in the equation may cause the estimates to be inefficient. Therefore, we test the robustness of our findings by following two alternative approaches. On the one hand, we compute the statistics for various lags without choosing a common lag order; on the other hand, we select the optimal lag length to be set before testing our Granger causality. The optimal lag length selected under the Bayesian information criteria (BIC) and the modified BIC proposed by Han et al. (2016) is 3 for HHI and RER.

### 3.4 Empirical results

The preliminary analysis having been completed, we now turn to the Granger causality test. First, we define a benchmark model where the financial crises of 1997 and 2008 have not affected the causal relationship. The Granger causality test is based on the following model with fixed coefficients and stationary variables:

$$\begin{cases} \text{HHI}_{it} = \alpha_{\text{HHI},i} + \gamma_{\text{HHI},i}\text{HHI}_{i,t-1} + \beta_{\text{HHI},i}\text{RER}_{i,t-1} + \epsilon_{it} \\ \text{RER}_{it} = \alpha_{\text{RER},i} + \gamma_{\text{RER},i}\text{HHI}_{i,t-1} + \beta_{\text{RER},i}\text{RER}_{i,t-1} + \epsilon_{it} \end{cases} \quad (3.5)$$

In the benchmark model, the null hypothesis of HNC:  $H_0 : \beta_{\text{HHI},i} = 0$  with  $\forall i = 1, 2, \dots, N$  means that the RER does not Granger cause HHI and  $H_0 : \gamma_{\text{RER},i} = 0, \forall i = 1, 2, \dots, N$  means that HHI does not Granger cause the RER. The rejection of the null hypothesis implies the existence of causality in at least one country.

An alternative model consists in pointing out the possibility of external shocks on the causality relationship. This assumption allows us to introduce two dummy variables ( $D_{97}$  and  $D_{08}$ ) which indicate the financial crisis of 1997 and 2008, respectively. Therefore, the alternative model becomes:

$$\begin{cases} \text{HHI}_{it} = \alpha_{\text{HHI},i} + \theta_{1i}D_{97} + \theta_{2i}D_{08} + \gamma_{\text{HHI},i}\text{HHI}_{i,t-1} + \beta_{\text{HHI},i}\text{RER}_{i,t-1} + \epsilon_{it} \\ \text{RER}_{it} = \alpha_{\text{RER},i} + \theta_{1i}D_{97} + \theta_{2i}D_{08} + \gamma_{\text{RER},i}\text{HHI}_{i,t-1} + \beta_{\text{RER},i}\text{RER}_{i,t-1} + \epsilon_{it} \end{cases} \quad (3.6)$$

Where  $D_{97}$  (respectively,  $D_{08}$ ) takes a value of one for 1997-1998 (2008–2009) and zero otherwise.

The upper part of Table 3.4 provides the Granger causality results following (Dumitrescu and Hurlin, 2012) methodology without taking into account the financial crises. Firstly, the null hypothesis is rejected at 1% level of significance in both directions taking the whole sample. A bidirectional causality indicates that neither export diversification nor the RER can be considered exogenous here because feedback may occur. To get a deeper understanding, the same Granger causality analysis is conducted by dividing our sample by region. The results reported here provide strong evidence that the same bidi-



Table 3.4: Granger causality test with various lags

Without dummy	Lags	Statistics					
		From HHI to RER			From RER to HHI		
		$\bar{W}_{HNC}$	$\bar{Z}_{HNC}$	$\bar{W}_{HNC}$	$\bar{W}_{HNC}$	$\bar{Z}_{HNC}$	$\bar{W}_{HNC}$
WHOLE	k=1	2.766	8.281***	6.207***	2.670	7.832	5.845***
	k=2	3.881	6.239***	4.009***	5.425	11.358***	7.889***
	<b>(k=3)</b>	<b>(5.710)</b>	<b>(7.338***)</b> <i>(negative)</i>	<b>(4.188***)</b>	<b>(8.610)</b>	<b>(15.180***)</b> <i>(both)</i>	<b>(9.676***)</b>
Asia	k=1	2.412	4.575***	3.363***	2.854	6.007***	4.519***
	k=2	3.349	3.092***	1.847*	3.896	4.344***	2.795***
	<b>(k=3)</b>	<b>(4.722)</b>	<b>(3.222***)</b>	<b>(1.600)</b>	<b>(6.729)</b>	<b>(6.975***)</b> <i>(ambiguous)</i>	<b>(4.227***)</b>
Latin America	k=1	3.089	7.083***	5.372***	2.502	5.093***	3.766***
	k=2	4.366	11.349	3.781***	6.821	11.560***	8.241***
	<b>(k=3)</b>	<b>(6.611)</b>	<b>(21.211)</b> <i>(negative)</i>	<b>(4.263***)</b>	<b>(10.319)</b>	<b>(14.330***)</b> <i>(both)</i>	<b>(9.344***)</b>
WHOLE	k=1	2.806	8.473***	6.107***	3.001	9.385***	6.820***
	k=2	6.567	15.146***	10.171***	5.945	13.085***	8.678***
	<b>(k=3)</b>	<b>(10.219)</b>	<b>(19.548***)</b> <i>(both)</i>	<b>(11.717***)</b>	<b>(7.860)</b>	<b>(13.161***)</b> <i>(both)</i>	<b>(7.541***)</b>
Asia	k=1	1.948	3.071***	2.041**	2.968	6.377***	4.628***
	k=2	3.552	3.556***	2.022**	4.256	5.169***	3.191***
	<b>(k=3)</b>	<b>(6.327)</b>	<b>(6.225***)</b> <i>(negative)</i>	<b>(3.336***)</b>	<b>(6.036)</b>	<b>(5.679***)</b> <i>(negative)</i>	<b>(2.979***)</b>
Latin America	k=1	3.591	8.785***	6.496***	3.031	6.887***	5.011***
	k=2	9.320	17.552***	12.136***	7.487	13.158***	8.953***
	<b>(k=3)</b>	<b>(13.772)</b>	<b>(21.089***)</b> <i>(both)</i>	<b>(13.019***)</b>	<b>(9.526)</b>	<b>(12.776***)</b> <i>(both)</i>	<b>(7.584***)</b>

Note: The Granger causality test for panel data follows Dumitrescu and Hurlin (2012) methodology with an optimal lag order  $k$  selected in bold. The null hypothesis is the homogeneous non causality (HNC) from X to Y. The sign of causality is reported in the model with optimal lag. \*, \*\*, \*\*\* stand for significance at 10%, 5% and 1% respectively.

rectional relationship exists for the Latin American sub-sample, which implies that there is a two-way causality in at least one country within the region. In the case of Asia, there is strong evidence that RER Granger causes HHI. But the null hypothesis that HHI does not homogeneously cause RER is not rejected with the selected optimal lag length. Because the results may be influenced by lag-order misspecification, the same tests were performed with various lags. The sign of causality is estimated in the model with the optimal lag length. For the whole sample and the Latin America sub-sample, HHI Granger causes RER with a negative sign whereas the sign of causality from RER to HHI is both positive and negative. It is more ambiguous for the Asia sub-sample.

These results change when we introduce the two dummy variables which capture the effects of financial crises (the lower part of Table 3.4). Similarly to the results obtained previously, there is at least one country in the whole sample and the Latin America sub-sample where HHI Granger causes RER and vice versa at all lags, including the optimal one. While we obtain the same bidirectional causality in Asia, the results reported here provide a clear negative link, which means that export diversification (a lower HHI) helps to maintain competitive RER levels (a higher RER). All in all, our findings seem to reveal divergent effects of financial crises across countries in the two regions, calling for deeper investigation.

Table 3.5: Granger causality test for panel data: Individual statistics with optimal lag length

Country	Without dummies		With dummies		
	HHI does not cause RER	RER does not cause HHI	HHI does not cause RER	RER does not cause HHI	
Asia	Bangladesh	6.6396* <i>(negative)</i>	15.1728*** <i>(positive)</i>	6.9126* <i>(negative)</i>	6.9139* <i>(positive)</i>
	Bhutan	1.9664	3.7566	2.2522	2.32
	China	9.1761** <i>(negative)</i>	6.0601	7.1524* <i>(negative)</i>	5.1462
	Fiji	1.9618	3.0716	3.4648	4.5391
	Indonesia	0.798	3.4698	2.0907	3.6146
	India	0.7182	3.4494	0.5381	3.4076
	Kiribati	11.5302*** <i>(ambiguous)</i>	6.1622	14.3956*** <i>(positive)</i>	5.3713
	Lao PDR	15.6535*** <i>(negative)</i>	3.764	6.5496* <i>(negative)</i>	2.9267
	Sri Lanka	8.4896	11.0623** <i>(ambiguous)</i>	7.4452* <i>(negative)</i>	8.8789** <i>(ambiguous)</i>
	Maldives	2.1279	25.4498*** <i>(positive)</i>	1.9952	22.8269*** <i>(positive)</i>
	Mongolia	5.9118	1.8822	10.0885** <i>(ambiguous)</i>	1.9542
	Malaysia	2.0171	7.4177* <i>(negative)</i>	32.9712*** <i>(positive)</i>	17.2638*** <i>(negative)</i>
	Pakistan	1.7639	6.2859* <i>(negative)</i>	1.8297	7.2494* <i>(negative)</i>
	Papua New Guinea	0.6399	3.008	1.5126	3.7176
	Samoa	4.6716	2.5785	8.3263** <i>(ambiguous)</i>	2.5157
	Solomon lands	4.2537	0.7393	4.6881	1.3415
	Thailand	2.1394	8.3272** <i>(ambiguous)</i>	2.9129	7.3627* <i>(negative)</i>
	Tonga	3.9494	2.6233	1.1916	3.3867

Continued on next page

Country	Without dummies		With dummies		
	HHI does not cause RER	RER does not cause HHI	HHI does not cause RER	RER does not cause HHI	
The Philippines	5.4476	8.1629** <i>(ambiguous)</i>	1.5304	3.8966	
Viet Nam	8.7953** <i>(positive)</i>	12.7377*** <i>(ambiguous)</i>	13.2732*** <i>(positive)</i>	7.308* <i>(ambiguous)</i>	
Vanuatu	0.5157	6.1165	1.7542	4.8062	
Latin America	Belize	0.2556	20.3931*** <i>(ambiguous)</i>	0.0908	6.5504* <i>(negative)</i>
	Bolivia	9.8563** <i>(negative)</i>	8.4305** <i>(positive)</i>	21.9805*** <i>(negative)</i>	6.1475
	Brazil	2.3398	0.3379	2.5573	0.3545
	Colombia	13.0893*** <i>(ambiguous)</i>	8.6478** <i>(negative)</i>	12.3226*** <i>(ambiguous)</i>	22.1911*** <i>(negative)</i>
	Costa Rica	3.0164	13.8182*** <i>(ambiguous)</i>	2.831	18.8068*** <i>(negative)</i>
	Dominica	7.4633* <i>(ambiguous)</i>	4.7149	6.0897	3.1836
	Dominican Rep.	2.2234	5.2201	2.8156	3.9778
	Ecuador	13.1884*** <i>(positive)</i>	3.7438	19.5927*** <i>(positive)</i>	2.6922
	El Salvador	6.5631* <i>(ambiguous)</i>	6.0018	9.8418** <i>(positive)</i>	7.2663* <i>(negative)</i>
	Grenada	0.3556	18.5719*** <i>(negative)</i>	0.07	32.9537*** <i>(negative)</i>
	Guatemala	12.1242*** <i>(positive)</i>	1.4144	73.4433*** <i>(positive)</i>	0.4588
	Guyana	9.328** <i>(ambiguous)</i>	16.063*** <i>(negative)</i>	20.6466*** <i>(ambiguous)</i>	3.2694
Honduras	12.6781*** <i>(negative)</i>	6.556* <i>(positive)</i>	7.2337* <i>(negative)</i>	5.4274	
Jamaica	7.4579* <i>(ambiguous)</i>	12.5969*** <i>(positive)</i>	7.2022* <i>(ambiguous)</i>	7.4514* <i>(ambiguous)</i>	
Mexico	5.6997	9.634**	11.834***	7.9159**	

Continued on next page

Country	Without dummies		With dummies	
	HHI does not cause RER	RER does not cause HHI	HHI does not cause RER	RER does not cause HHI
		<i>(ambiguous)</i>	<i>(negative)</i>	<i>(ambiguous)</i>
Nicaragua	3.9003	26.0387***	2.4426	11.6492***
		<i>(negative)</i>	<i>(negative)</i>	
Panama	4.5545	13.9715***	7.0993*	8.5569**
		<i>(ambiguous)</i>	<i>(negative)</i>	<i>(positive)</i>
Paraguay	7.1028*	3.3039	5.1284	2.9137
	<i>(ambiguous)</i>			
Peru	15.408***	5.0602	68.8327***	4.1313
	<i>(negative)</i>		<i>(negative)</i>	
Saint Lucia	2.1076	0.8717	3.1386	6.4596*
				<i>(ambiguous)</i>
St Vincent and the Grenad.	8.4262**	5.4478	20.8038***	7.0356*
	<i>(negative)</i>		<i>(negative)</i>	<i>(positive)</i>
Suriname	2.1208	41.8874***	7.1099*	42.4387***
		<i>(positive)</i>	<i>(negative)</i>	<i>(positive)</i>
Venezuela	2.7997	4.6179	3.6376	7.2546*
				<i>(ambiguous)</i>

Note: \*, \*\*, \*\*\* indicate the rejection of the null hypothesis at 10%, 5% and 1%, respectively.

Therefore, Granger causality tests are conducted on individual countries and the results are displayed in Table 3.5. Firstly, if we compare both parts of the table, we find that ten countries show no causality between RER and export diversification in either direction, with or without dummies. Four MICs show a bidirectional causality in both models, namely: Bangladesh, Columbia, Jamaica, and Vietnam. Interestingly, the role of the RER as a conventional determinant of export diversification dynamics, whatever the model, is not systematic at all. Only seven countries (Belize, Costa Rica, Grenada, Maldives, Nicaragua, Pakistan, and Thailand) show a univocal causation from RER to HHI. On the opposite, six countries (China, Kiribati, Lao PDR, Ecuador, Guatemala, Peru) show a univocal link running from HHI to RER, which is very appealing in terms of economic policy.

Secondly, the individual statistics on the Granger causality test show some interesting results on the impact of financial crises. The link was disturbed by the financial crises in almost half of the countries in our sample. HHI now causes RER in seven countries, and with a negative sign in Sri Lanka, Mexico, Panama, and Suriname. On the opposite, RER does not explain HHI anymore in Bolivia, Guyana, Honduras, and the Philippines when considering the dummy variables. Moreover, the link becomes negative

in Thailand, Belize, Costa Rica and El Salvador with the financial crises.

All put together, a negative sign of causality between the two variables means that a competitive RER (a higher RER) helps in diversifying exports (a lower HHI) and vice-versa. We found that HHI causes RER with a negative sign in eleven countries, and the reverse negative link in ten other countries. One factor behind this result is countries' trade flows related to GVCs activities, and the way they use macro-economic policies to capture the benefits of dynamic scale economies and spillovers. In sum, we argue here that by diversifying trade under their GVC participation, some countries have succeeded in lowering their supply prices and this helps keeping low and competitive RER levels. Our study attempts to bridge the gap by showing a bidirectional relationship.

### **3.5 Conclusion**

Increased trade through deeper integration has been a powerful engine for growth in developing countries. However, by being more integrated in the global economy, they are now more vulnerable to external shocks. In particular, the role of exchange rates in promoting exports and in the macroeconomic adjustment process needs to be carefully re-assessed in a world where GVCs are increasingly important (Ahmed et al., 2015). Against this background, the purpose of our study was twofold. Firstly, unlike previous studies that mostly focus on unidirectional causality running from the RER to export diversification, an important purpose of the study was to go further by identifying the direction and the sign of the causality. Secondly, we attempted to identify the contribution of financial crises on the causality between the two variables. The pattern of trade produced by vertical integration means that production functions differ from stage to stage and that, consequently, the fragmented segments of the production process are located in different countries. However, financial crises might shift a 'localised' vertical specialisation with specific partners to another. Given cross-sectional dependencies and heterogeneity across countries stemming from their participation in GVCs, we examined this issue in a panel data set covering the sample of all middle-income countries over the period 1995-2015 and then by region.

A causal link running from real exchange rate to export diversification is consistent with the conventional literature. However, our causality results have revealed a reverse causality where export diversification might help to consolidate a competitive exchange rate policy. This causation is neglected in the existing studies. Panel causality tests which were performed with various lags and at individual countries revealed that a bidirectional causality exists. More precisely, it appears that the Asian countries have overcome the impact of financial crises by allowing diversification through GVC participation to become an alternative to devaluation in slowing down real appreciation of the exchange rate.

Finally, we also show that the two financial crises of 1997 and 2008 disturbed the link in almost half of the countries in our sample. Even though our findings do not permit drawing a strong causality direction, they direct attention on numerous emerging economies that has successfully combined partic-

ipation in GVCs with relevant exchange rate, FDI and trade policies to expand their export bundle.

# Appendix

## Country sample

Asia East Asia and Pacific (15)  South Asia (6)	China, Fiji, Indonesia, Kiribati, Lao PDR, Malaysia, Mongolia, Papua New Guinea, The Philippines, Samoa, Solomon Islands, Thailand, Tonga, Viet Nam, Vanuatu Bangladesh, Bhutan, India, Sri Lanka, Maldives, Pakistan
Latin America and the Caribbean (23)	Belize, Bolivia, Brazil, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Lucia, St. Vincent and the Grenadines, Suriname, Venezuela

## Chapter 4

# Should I stay or should I go? The role of Renminbi on trade partnerships in Asia <sup>1</sup>

### Abstract

In this chapter, we examine the price elasticity of China's aggregate imports and then provide further details on this elasticity in partner countries according to their participation in two alternative trading arrangements (TPP vs RCEP) and their level of development. By using different types of data and appropriate methodologies to conduct our analysis at both global and bilateral levels, we observe that the price elasticity of China's imports is negative, which is consistent with the most recent studies and challenges the conventional wisdom. One hypothesis that might explain this result is the suppliers' patterns of trade. Since export diversification by trading partners can affect the sensitivity of Chinese imports to relative price movements, we endogenise the import price elasticity accordingly. We find that negative elasticities are more prominent when China's trading partners are developing countries, and when we consider their diversification in export markets. On the whole, the more partner countries are diversified in their export destinations, the lower the import price elasticity is in absolute terms. We conclude that export diversification by partner countries allows China to increase her "resilience" to movements in its exchange rate. The same tests are performed in the case of the US for comparison.

Key words: Global value chains, regional integration, export diversification, exchange rate policy, emerging Asia

JEL Codes: F14, F15, F41, F63, O11, O24, O53, O57

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## **4.1 Introduction**

Signed on February 2016, the Trans-Pacific Partnership (TPP) was concluded after a decade of long and laborious discussions. While the United States (US) entered TPP negotiations in 2008, the partnership was designed to cut trade barriers in some of the fastest-growing economies of the Pacific Rim and to counter China's rising clout. However, the goal of creating the world's largest free trade area was blocked by President Trump, who signed an order on January 23, 2017 withdrawing his country from the agreement. Representing nearly 40% of the world's economic output and 30% of world trade, this partnership was to bring together 12 Pacific Rim countries, namely: Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, the US and Vietnam. After the US withdrew its signature, the remaining nations (accounting for about 13.5% of global GDP) renegotiated and signed on 8 March 2018 a new agreement called the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP, also known as TPP-11), which incorporates most of the provisions of the TPP.

At the same time, the Regional Comprehensive Economic Partnership (RCEP) negotiations were launched during the 21st Summit of the Association of Southeast Asian Nations (ASEAN) in November 2012. With the aim of boosting trade and economic growth around Asia and the Pacific, the RCEP negotiations on a regional Free Trade Agreement (FTA) bring together leaders from 16 countries, namely the 10 ASEAN countries (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam), as well as the 6 countries in the region that already have a bilateral FTAs with ASEAN<sup>2</sup>. The 16 countries participating in the RCEP account for almost half of the world's population, one third of global GDP and over one quarter of world exports. By including China and India as partners, the treaty will establish a large-scale with the prospect of further growth in future. It is expected that the FTA (also called ASEAN+6) will be signed in 2019 after several delays in negotiations.

Regardless of the geographical configuration, the economic and trade negotiations to establish an FTA in the heart of the Asia-Pacific region are actually hiding a battle of power between China and the US for control of the region. However, they cannot conceal one highly significant fact, namely that China is playing a leading role in bilateral and global trade in the Asia-Pacific region. Since the early 1990s, China and its neighbors have established complementarity in the regional division of production processes based on a close association between economic transition reforms and an "open door" policy (see *Box*). It is no coincidence that, on China's initiative, the RCEP treaty was instantly re-launched following the US withdrawal from the TPP. And most recently, the US President has announced that the TPP deal will be reconsidered in the face of concerns about the costs of a growing trade war with China.

Because of the triangular patterns of trade underlying Global Value Chains (GVCs), China imports products from neighborhood countries to be processed and re-exported to the rest of the world. One of the

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<sup>2</sup>ASEAN's FTA partners are the People's Republic of China (ACFTA), the Republic of Korea (AKFTA), Japan (AJCEP), India (AIFTA), Australia and New Zealand (AANZFTA).

major consequences of this division of labor is that the country's price elasticity of imports is affected by the associated patterns of trade and any effect of changes in the Chinese currency (the Renminbi, RMB) is clearly passed through third-party suppliers. While the existing literature is largely supportive of the fact that a real appreciation of the RMB reduces China's exports, the expected impact on the import side is less clear cut.

**BOX: The Asia-Pacific region in a nutshell**

1979 = China's open door policy with a transition process (Dec. 1978)

1985 onwards = Following the Plaza Accord (signed by the G5 nations at the Plaza Hotel in New York City), the appreciation of the yen against the US dollar led to the adoption of a relocation strategy by Japanese firms in the region

1994 = comprehensive market reforms in China (unified exchange rate policy, trade and price reforms)

1997 = The Asian currency crisis

1999 = China's "Go out" policy or Going Global Strategy (development of Chinese FDI abroad)

2001 = China's accession to WTO

2008 = the global crisis pushes China to position the RMB as an international currency and an alternative to the USD and the euro. Like Japan after the Plaza agreement, the "internationalization" of the RMB clearly reflects China's emergence as a real player in managing the international monetary system

2010 = the ACFTA is established (free trade area with China and the ASEAN countries)

2013 = "One Belt, One Road" (OBOR) initiative, an ambitious programme to connect Asia with Africa and Europe via land and maritime networks

2016 = TPP is signed, enhancing China's negotiations for RCEP

January 2017 = The US withdrawal from TPP

December 30, 2018 = The CPTPP enters into force among the first six countries to ratify the agreement (Canada, Australia, Japan, Mexico, New Zealand, and Singapore). It enters into force for Vietnam on January 14, 2019. It will enter into force for Brunei Darussalam, Chile, Malaysia and Peru 60 days after they complete their respective ratification processes.

The main argument put forward in this study is that export diversification by trading partners allows China to increase her "resilience" to movements in its exchange rate. Three elements underlie our investigation:

Firstly, the standard result in international macroeconomics assumes that any depreciation (appreciation) of the Real Exchange Rate (RER) reduces the current account deficit (surplus) provided that the Marshall-Lerner condition is fulfilled.

The latter states that the sum of the price elasticities of imports and exports (in absolute terms) must be  $> 1$ . In other words, the volume effects of a real depreciation (appreciation) outweigh the value effect.

However, the export patterns of trading partners can affect the volume effect of China's imports because it enables the country to respond differently to changes in relative prices. As a result, the Marshall-Lerner condition may no longer be fulfilled when this price elasticity is too low.

Secondly, this resilience is derived from China's strategy in the field of foreign exchange management combined with its trade policies (including the current RCEP negotiations).

Their growing dependence on imports of capital and intermediate goods suggests that most Asian countries are highly integrated into complex sub-contracting networks. As a result, exports from less developed countries have become more complements to than competition for those of China. The result is a pass-through effect on its exchange rate policy: if the real appreciation of the RMB can reduce Chinese exports, it will reduce those of its suppliers through the nested structure of trade (Hooy, Siong-Hook, and Tze-Haw, 2015).

Thirdly, this intra-regional development is in line with the so-called "flying geese paradigm" that describes industrial development in Asia (Akamatsu, 1962).

Just as when Japan adopted its relocation strategy following the Plaza Accord, so a comprehensive economic literature supports the idea that the international fragmentation of production has placed China at the heart of a regional clustering in Asia. In fact, as China moves into the product space vacated by the Asian NICs, Chinese exports have become the driving force of an interconnected trade system resulting from the formation of regional production and distribution networks within the area (Fu, Kaplinsky, and Zhang, 2012).

Policies to liberalize trade and Foreign Direct Investment (FDI) have made a major contribution to regional integration in East Asia. However, an increasing number of studies are examining the impact of currencies in this framework. For partner countries (particularly developing Asian countries), a unilateral exchange rate policy would not have a significant impact on their trade performance. On the other hand, however, a combined or even common policy between the RMB and the national currencies of China's supply chain countries may be more relevant (see Rahman, Thorbecke, et al. (2007)). In other words, a foreign exchange policy combined with that of China may be necessary (cross-currency effects) in order to drive their export-oriented industrialization.

In this context, we propose to measure the price elasticity of Chinese imports and to provide further details on this elasticity in partner countries according to their participation in the two alternative FTAs (TPP vs RCEP) and their level of development. For the sake of comparison, we will also apply our model to the US. Behind this comparative analysis, two kinds of North-South regional integration are emerging:

- the first, US-led kind conforms to a traditional North-South pattern in which the leader remains an advanced country;
- the second one is more singular, as for the first time a North-South integration scheme is shaped

by a developing country (China) whose exports to Northern countries are based on South-South trade.

Using different types of dataset, we conduct two separate analyses to investigate the import price elasticity in the two reporter countries (China and the US). We first carry out an empirical analysis of aggregate import data by applying an Autoregressive Distributed Lag (ARDL) model to a time series of trade variables over the period 1992-2016. In the traditional import demand model, we provide empirical evidence for a negative value of price elasticity in the case of China and a positive one in the case of the US. Moreover, China's imports are more price sensitive than those of the US.

The second analysis consists of splitting the bilateral imports of China and the US on the basis of their trading partners' level of development and participation in two alternative FTAs (TPP and RCEP). For this purpose, we use panel data on bilateral trade flows over the period 1995-2015. By applying a Feasible Generalized Least Squares (FGLS) model, we find three main results: (i) import price elasticities are negative in China while they remain positive in the US; (ii) negative elasticities are more prominent when China's trading partners are developing countries; (iii) the more partner countries are diversified in their export destinations, the lower the import price elasticity is in absolute terms.

The study will be structured as follows: after this introduction, section 4.2 will present a brief review of the literature. Section 4.3 will provide the theoretical framework, before section 4.4 outlines the empirical methodology and details the data to be collected. Section 4.5 will present the regression results before conclusions are drawn.

## **4.2 A literature review**

The issue of exchange rate levels and their effects on other major economic variables such as growth, income, current account balance, consumption and trade has been the subject of much debate, especially when global imbalances began to widen (OMC, 2011). However, understanding the relationship between China's trade and exchange rates has become an issue of particular importance in recent years (Thorbecke and Smith, 2012). Fu et al. (2012), among others, have stressed that one of the consequences of China's export performance is the impact this might have had on global prices, because of the country's large size coupled with its sustained productivity growth. Therefore, *"it is widely claimed that China's rapid expansion of manufactured exports has been a primary factor explaining the fall in the aggregate price of trade manufactures after the mid-1990s."* (p. 1483)

The "flying geese" pattern, which saw China moving into the upper level of manufacturing countries, created the potential for the exports of all Asian economies to grow in harmony (Ahearne, Fernald, Loungani, and Schindler, 2006). An initial set of studies focused on export rivalry in third-country markets by exploring the "spillover effect" of competition between China and other DCs. Using disaggregated trade data, Mattoo, Mishra, and Subramanian (2012) suggest that a 10% appreciation of China's

RER boosts a DC's exports of a typical 4-digit HS product category to third markets by an average of between 1.5 and 2%. However, cross-border production linkages seem to lower the real exchange rate elasticity of exports because an exchange rate depreciation improves the competitiveness of domestic value added in exports, but raises the cost of imported inputs. In their empirical analysis covering 46 countries over the period 1996-2012, Ahmed et al. (2015) find that the average REER elasticity of exports has decreased over time.

The literature provides extensive evidence that an appreciation of the RMB would lower China's exports. However, research findings on the import side are more ambiguous. According to Thorbecke and Smith (2012), import price elasticity should increase as China climbs the value chain in favor of import substitution. Thus an appreciation of the RMB should help to raise the country's imports. But the most recent studies examine the interaction between China and the supplier countries in order to challenge the conventional wisdom. Despite common export-oriented industrialization policies, major economic disparities across the region reflect a broad pattern of "complementarity" between China and its neighbors. Accordingly, export diversification by trading partners can affect the sensitivity of Chinese imports to exchange rate movements (the volume effect on imports in the Marshall-Lerner condition). While earlier studies have found that a real appreciation of the RMB has the effect of increasing Chinese imports, the most recent studies have ended up with very different findings. Some of them even came up with a counterintuitive result, revealing that Chinese imports are falling rather than rising.

A seminal contribution was that by García-Herrero and Koivu (2008), who perform a co-integration analysis using data for the period 1994-2005 to estimate China's aggregated export and import equations. They find that the exchange rate elasticity of imports is negative and generally significant for both ordinary and processing imports. Looking for the reasons behind this outcome, the authors then estimate several bilateral import equations for China and its major trading partners. They find that Chinese imports from South-East Asian countries are negatively affected by RMB appreciation but that the results for the other countries are ambiguous. They argue that the former negative effect might be a direct result of Asia's vertical integration, since a sizeable part of Chinese imports from those countries is used to produce goods for re-export, making the trade pattern with China more complementary than substitutive. Koopman, Wang, and Wei (2014), for instance, find that the import content of exports is as high as 90% for some sectors in China. Therefore, in the long run, a real appreciation of the RMB might reduce China's trade surplus but the effect would be limited.

Hooy et al. (2015), while studying different technology intensities and degrees of production fragmentation, use a panel dynamic ordinary least square (DOLS) estimator of exports from ASEAN countries (China's main chain suppliers) over the period 1994-2008. They find that a real RMB depreciation has a positive and significant impact on total ASEAN exports to China. Furthermore, they categorize disaggregated exports by use (basic goods, parts and components) and by technology levels (high-tech, medium-tech, low-tech, resource-based, primary product). The results of their estimates suggest that a positive response to RMB depreciation is due mainly to the dominance of ASEAN high-tech and medium-

tech exports of finished goods, as well as parts and components (particularly low-tech and resource-based goods) to China.

Regarding destination, this factor may also affect the elasticity of trade and the related trade balance. Some authors have pointed to differences in export diversification patterns between high and low-income countries (Amurgo-Pacheco and Pierola, 2008; IMF, 2014; Lee and Kim, 2012). More specifically, trade growth at the “extensive margin” is predominant for developing countries, within which geographical diversification seems to matter by adding new export markets. This pattern of export diversification is driven by the globalization of both trade and capital flows, which are now much stronger than in the previous century. Héricourt, Nedoncelle, et al. (2016) attempt to reconcile the evidence of the trade-detering effect of RER volatility at the firm level with the small or even insignificant effect on aggregate outcomes. They argue that, besides hedging strategies, French firms with multi-destination exports were able to reallocate exports across many destinations during the period 1995-2009 in order to avoid locations with high exchange rate risks and to minimize the impact of this volatility on their total exports. As a result, even though those firms account for a large share of total exports, their action leaves exports at the macro level unchanged.

All in all, it is not certain that any claim of a real appreciation in the RMB by the main competitors will reduce China’s current account surplus, since the price elasticities of exports and imports may both be negative. These elasticities are different from one type of product to another, and therefore might depend on the patterns of diversification that firms and countries adopt in order to deal with the unsettling exchange rate.

Rather than addressing the issue of the equilibrium level of the long-run RER (and its over- or undervaluation), or the linearity or otherwise of its relation to economic growth, particularly through the development of exports, our study will focus specifically on the impact of the exchange rate on import levels. Indeed, this relationship determines whether or not China’s current account surpluses with its partners, such as the US or the EU, are absorbed in the case of an appreciation of the RMB. The fall in import prices can be offset either totally or partly by the substitution of imported products by domestic products (which would involve an adjustment of domestic firms’ productive capacities, *i.e.*, production diversification) or by the same diversification on the part of suppliers. Because our objective is limited to relatively short-term and small-scale movements in competitiveness, we therefore take the nature of GVC and trade patterns across countries as given and do not consider the issue of endogenous off-shoring and production sharing decisions.

## 4.3 Theoretical framework

### 4.3.1 Global imports

The variable of interest here is the level of China's imports, which are merely the exports of its partners. In the standard approach, the demand for aggregate imports depends on relative prices and domestic income:

$$M = g\left(\frac{eP}{P^*}, Y\right) = \left(\frac{eP}{P^*}\right)^\alpha Y^\beta \quad \text{with } \alpha, \beta > 0 \quad (4.1)$$

where  $M$  is imports demanded by domestic residents,  $Y$  is the domestic income in constant prices and the relative price term defines the price of domestic substitutes for a country's imports compared to the price of imports in domestic currency.  $P$  is the domestic price,  $P^*$  is foreign competitor's prices (in foreign currency) and  $e$  is the nominal exchange rate. For convenience,  $e$  is defined here as the number of foreign currency units per home currency unit (denoted 1Home/eForeign). An *increase* in  $e$  reflects an *appreciation* of the home currency<sup>3</sup>.

By rewriting in log form and defining the RER as  $R = eP/P^*$ , the equation becomes:

$$m = \alpha r + \beta y \quad (4.2)$$

This allows us to interpret  $\alpha$  and  $\beta$  as, respectively, the price and income elasticities of the import function. An increase in  $r$  means the RER has appreciated, either because  $e$  increases (nominal appreciation) or because  $P$  increases with respect to  $P^*$ . The standard argument about a real appreciation is that it increases imports because they become cheaper in domestic currency.

### 4.3.2 Bilateral imports

Our contribution here is to endogenise the price elasticity of imports according to the degree of trade diversification. Let define a linear function of the import price elasticity<sup>4</sup>:  $\alpha_i = \alpha(Div_i) = \alpha_1 + \alpha_2 Div_i$  where  $Div_i$  denotes trade diversification in country  $i$ . The price elasticity is consistent with the standard result ( $\alpha_i = \alpha_1 > 0$ ) in two cases:

- first, when  $Div_i$  does not affect the import price elasticity ( $\alpha_2 = 0$ )
- second, when there is total concentration ( $\alpha_2 \neq 0, Div_i = 0$ )

<sup>3</sup>An alternative presentation of the exchange rate is the number of home currency units per foreign currency unit (1F/EH), where an appreciation is recorded as a fall in the index. It should be noted that standard market quotations for currencies may be in either format (because  $E = 1/e$ ). However, we will use the home currency (RMB, USD) as the denominator or numeraire because it is the international currency (or expected to become an international currency in the case of the RMB) in nearly all of Developing Asia's trade.

<sup>4</sup>This formalisation simplifies calculation without altering our broad results.

Diversification being the complement to 1 of concentration, the Herfindhal-Hirschman Index (HHI) will be used to measure export concentration in the empirical investigation. Hence:

$$\alpha_i = \bar{\alpha} - \alpha_0(HHI_i) \quad \text{with } \bar{\alpha} = \alpha_1 + \alpha_2 \text{ and } \alpha_0 = \alpha_2 \quad (4.3)$$

If we suppose that  $HHI_i$  affects the sensitivity of import demand to changes in relative prices ( $\alpha \neq 0$ ), the import price elasticity must satisfy in absolute terms:  $\alpha_1 < \alpha_i < \alpha_1 + \alpha_2$

The price elasticity may then be reduced and the Marshall-Lerner condition will be less likely to be verified (for an unchanged price elasticity of exports). In other words, a real appreciation can decrease exports *and* imports as a result of trade diversification: it is therefore not evident that an initial current surplus (particularly in China) will be reduced if the decline in its exports remains lower than the decline in imports.

By applying the model to bilateral trade, country  $i$  imports from country  $j$  as follows:

$$M_{ij} = \left( \frac{e_{ij} P_i}{P_j^*} \right)^{\alpha_{ij}} (Y_i)^{\beta_{ij}} \quad (4.4)$$

where the price elasticity of imports depends on bilateral diversification:

$$\alpha_{ij} = \alpha(Div_{ij}) = \alpha_1 + \alpha_2 Div_{ij} \quad (4.5)$$

Replacing by HHI, the logarithm form of the import function can be expressed as:

$$m_{ij} = [\bar{\alpha} - \alpha_0 (HHI_{ij})] r_{ij} + \beta_{ij} y_i = \bar{\alpha} r_{ij} - \alpha_0 (HHI_{ij}) r_{ij} + \beta_{ij} y_i \quad (4.6)$$

Country  $i$ 's imports from country  $j$  have three determinants: the bilateral relative price ( $r_{ij}$ ), an interacting term between this relative price and bilateral trade diversification ( $HHI_{ij} \cdot r_{ij}$ ), and domestic income ( $y_i$ ). The net effect of any change in relative prices on import demand will result from the first two terms.

## 4.4 Data and methodology

### 4.4.1 Data

Our aim is to investigate the price elasticity of reporter country  $i$  at both aggregate and bilateral imports. To get a sense of perspective, we undertake a comparative analysis between China and the US.

In performing the aggregate analysis, we collect import data from the World Bank WITS database in current US dollars over the period from 1992 to 2016 (see Appendix 4.B). To obtain constant values, we deflate the import flows by the import price indexes between the US and the rest of the world provided by the US Bureau of Labor Statistics. The Real Effective Exchange Rate (REER) and other macroeconomic



data are collected in constant terms from the WDI database. All variables of interest are constructed for the same base year of 2010.

To represent trade diversification, we use the Herfindhal-Hirschman concentration index (HHI): the lower HHI is, the less concentrated or more diversified exports (imports) are. For illustration, the export HHI in products for country  $i$  is calculated as follows:

$$HHI_i = \frac{(\sum_{k=1}^N p_{ik}^2 - 1/N)}{1 - 1/N} \quad (4.7)$$

where  $p_k = x_{ik} / \sum_k x_{ik}$  is the weighted share of export line  $k$  in total exports, in which  $x_k$  denotes the amounts exported. We also compute the same HHI in partners, which is calculated from the weighted share of partner  $j$  in total exports of country  $i$ . Moreover, we use the import HHI in products and in partners of reporter countries to check the robustness of our empirical results. These indexes of trade diversification are calculated from the Basis for the Analysis of International Trade (BACI) which is compiled by the CEPII for a wide range of countries at the HS 6-digit product level.

Due to the lack of available data on bilateral HHI, the bilateral analysis only covers the period from 1995 to 2015. We collect reporters' bilateral import flows with their partners in two regional FTAs, namely TPP and RCEP (see Appendix 4.A). As in the case of aggregate analysis, we deflate imports by the import price indices between the US and its different partners.

The bilateral RER is calculated as follows:

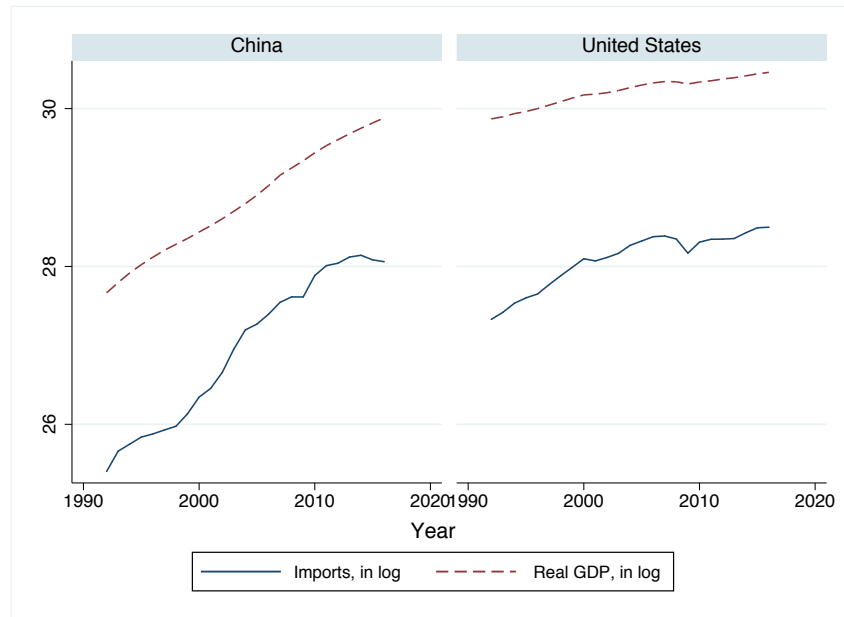
$$RER_{ij} = e_{ij} \frac{P_i}{P_j} \quad (4.8)$$

where  $P_i$  is the reporter's prices,  $P_j$  is partners' prices,  $e_{ij}$  is the nominal bilateral exchange rate, which denotes the amount of partners' currencies per unit of RMB or USD. Thus, an increase in the bilateral  $RER_{ij}$  records an appreciation of the RMB or USD.

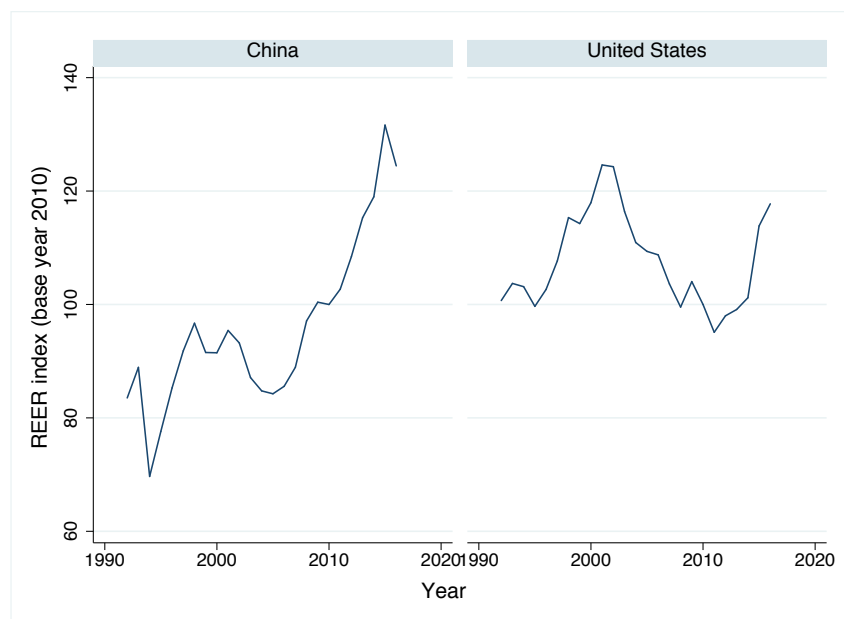
In the bilateral analysis, we endogenize the import price elasticity in two ways. Firstly, we consider bilateral export diversification in products between  $i$  and  $j$  and secondly, we take into account export diversification indices in products and in partners of suppliers  $j$ . The same dataset is used in both analyses to compute the related HHIs. Lastly, to overcome a size bias in the income variable, the real GDP of country  $i$  is also weighted by the ratio of per capita GDP between  $i$  and  $j$ . Because an endogeneity issue may arise from the latter, a correlation test was carried out. We found that there was no correlation between the concentration indices of partners and the ratio of GDP per capita between  $i$  and  $j$ <sup>5</sup>.

Tables 4.1 and 4.2 show descriptive statistics on our variables considered, at the aggregate and bilateral level respectively. The growth rates of imports and real GDP for China are higher than the ones registered by the US (Figure 4.1a). While US imports appear to grow at the same rate as that of real GDP, the import growth rate is higher than the GDP growth rate in the case of China. Due in part to pressure

<sup>5</sup>Estimated results are available upon request.



(a) Real GDP and aggregate imports, in log



(b) Real effective exchange rate index (base year 2010)

Figure 4.1: Aggregate imports, real GDP, real effective exchange rate

from its trading partners (including the US), China announced in July 2005 that it would appreciate the RMB by 2.1%, peg its currency to a basket of currencies (not just the dollar), and allow the Chinese currency to gradually appreciate (described by some as a managed peg). From June 2005 through June 2015, the RMB appreciated by 35.3% on a nominal basis against the USD. But even though the RMB has depreciated in recent years against the US currency, the REER index reflects overall changes in the country’s exchange rate with its major trading partners as a whole. Figure 4.1b shows that the RMB on a REER basis had appreciated over the past decade.

At the bilateral level, China’s imports from High Income (HI) countries are higher than those from

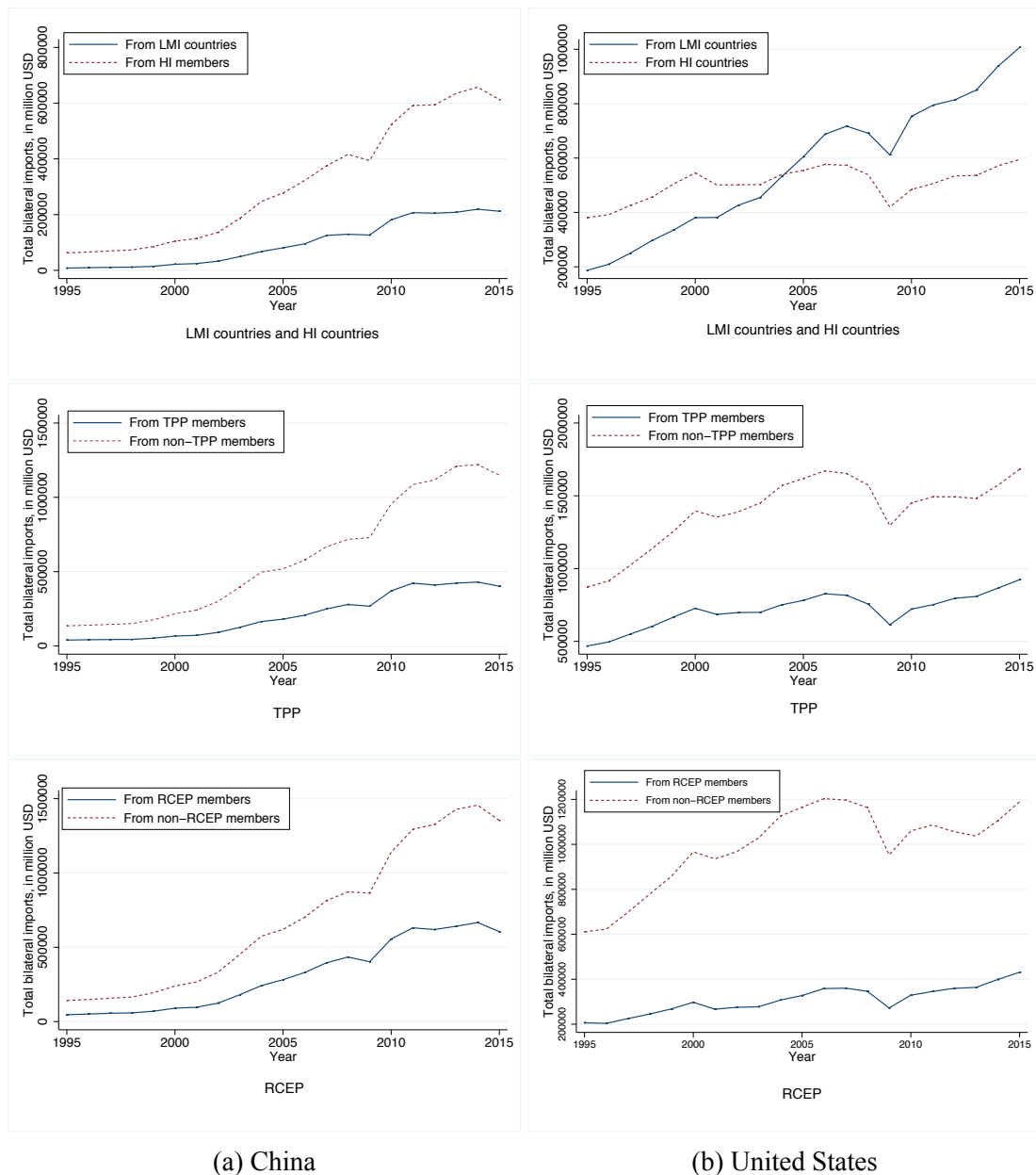
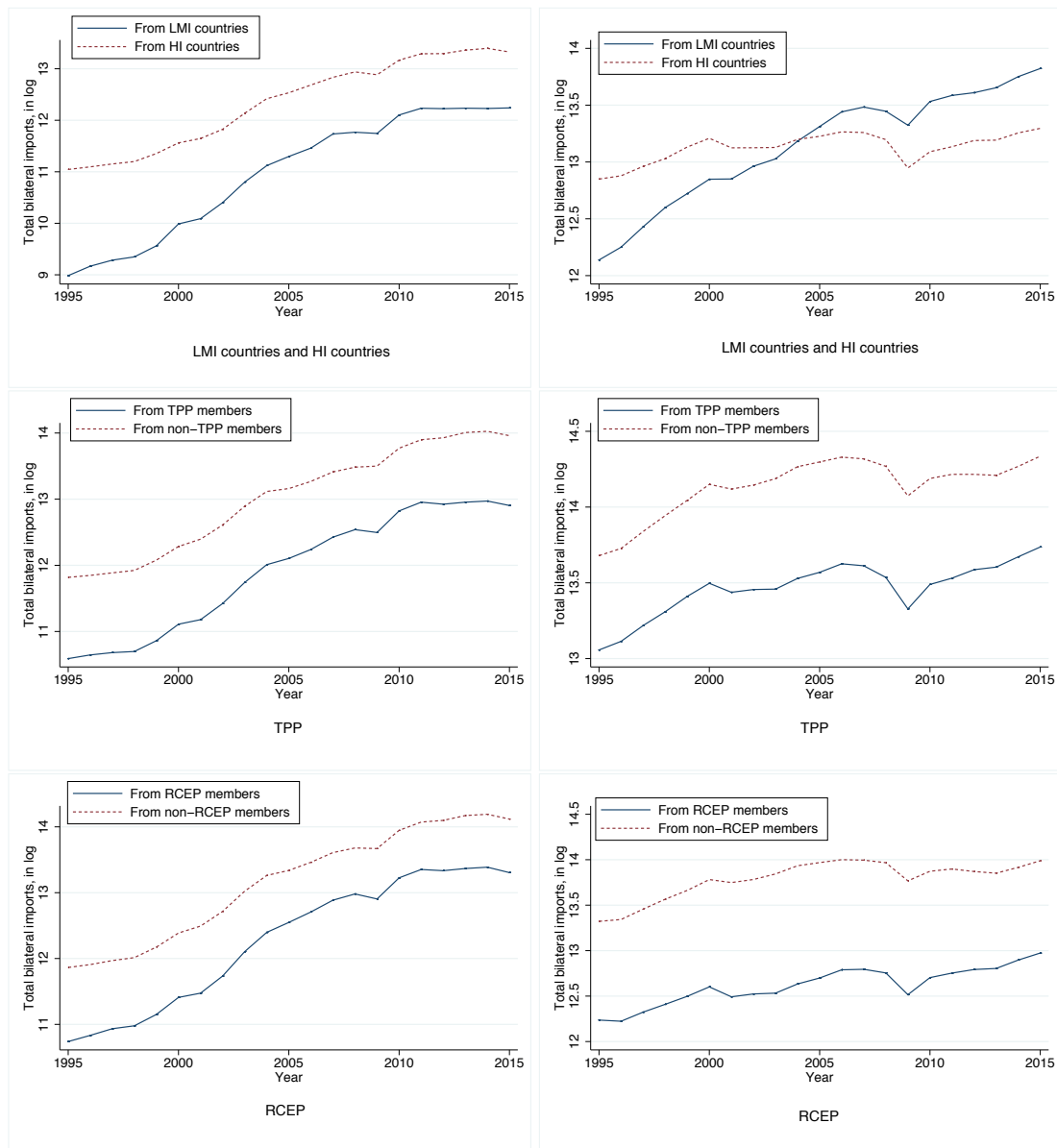


Figure 4.2: Bilateral imports in different groups of partners (million USD)

Low- and Middle-Income (LMI) countries, while the reverse tendency is recorded in the case of the US (Figure 4.2). This picture provides clear evidence of a North-South trade pattern, even though imports from LMI countries have grown at a faster pace in both countries. In addition, third partners generate the bulk of import demand in both countries, but the TPP and RCEP blocks have steadily increased at a much higher pace in China (Figure 4.3).

Lastly, Figure 4.4 depicts product diversification indices in bilateral trade between  $i$  and  $j$ , and the same indices at the product and partner levels for partner  $j$  depending upon its development level (LMI vs HI sub-group). The reported indices provide evidence that bilateral trade between China and its partners is more diversified compared to the US. For both countries, their LMI partners also have a higher degree of export diversification (either in products or in partners) than their HI ones. Furthermore, HHIs are



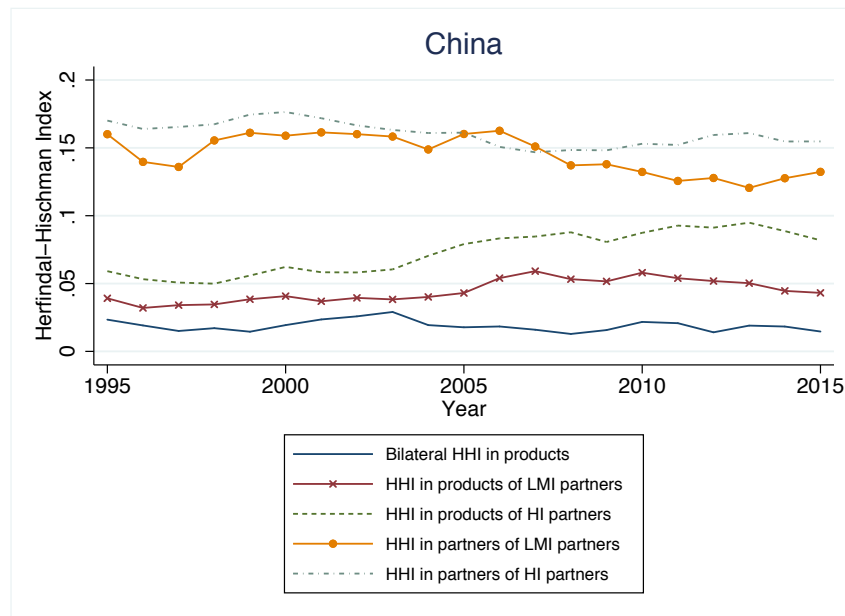
(a) China

(b) United States

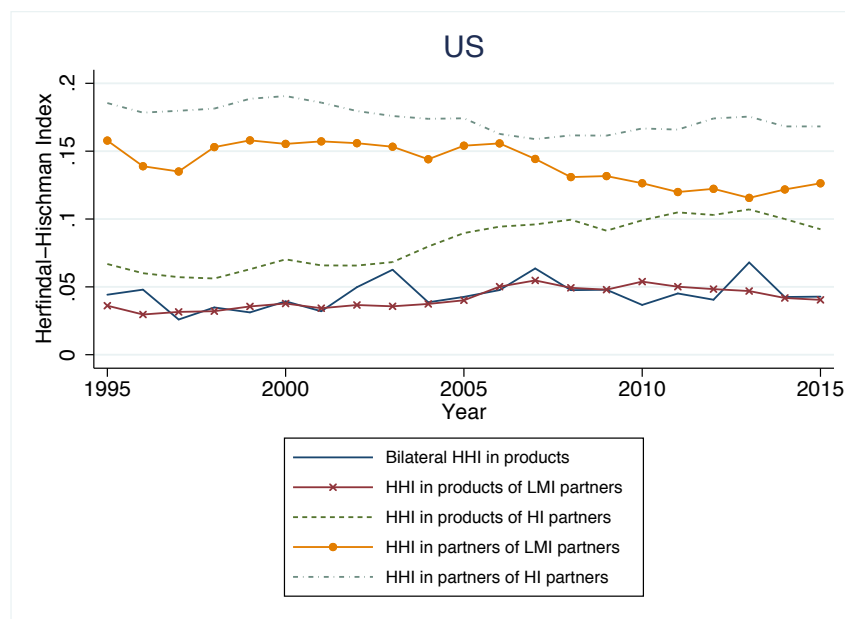
Figure 4.3: Bilateral imports in different groups of partners (in logs)

more diversified in products than in partners, and this is confirmed by the descriptive statistics shown in Table 4.2.

All observed data support our research question here, which consists of looking at China’s chain suppliers and their influence on the country’s import price elasticity. Because  $Div_i \neq 0$ , the above assumption of an endogenous price elasticity of imports allows us to emphasize the corresponding parameter  $\alpha$ .



(a) China



(b) United States

Figure 4.4: Export diversification index (HHI)

## 4.4.2 Methodology

In the aggregate analysis, several reasons led us to use ARDL specification or bound co-integration technique in time series variables, as suggested by (Pesaran, Shin, and Smith, 2001). Firstly, this methodology is appropriate for a small or finite sample size of time series data. In our specific case, the dataset comprises only 25 observations from 1992 to 2016. Secondly, it does not require pretests of the variables, such as a unit root test. It is still applicable when the variables are  $I(0)$  or  $I(1)$  or a combination of both, provided that none of the variables is  $I(2)$ . Thirdly, it provides both long-run and short-run relationships

Table 4.1: Descriptive statistics for aggregate analysis

Country	Variable	Obs	Mean	Std. Dev.	Min	Max
China	Global imports (USD, constant 2010)	25	739,462,742,505	569,030,643,136	107,723,191,897	1,666,610,913,740
	REER (constant 2010)	25	95.79	14.63	69.68	131.63
	GDP (USD, constant 2010)	25	4,122,961,155,478	2,668,742,356,104	1,035,554,630,016	9,504,208,187,205
United States	Global imports (USD, constant 2010)	25	1,669,703,973,999	503,998,918,794	739,891,838,705	2,379,417,019,208
	REER (constant 2010)	25	107.66	8.41	95.10	124.60
	GDP (USD, constant 2010)	25	13,445,769,659,132	2,284,969,823,336	9,379,735,498,400	16,920,327,941,800

Table 4.2: Descriptive statistics for bilateral analysis

Country	Variable	Obs	Mean	Std. Dev.	Min	Max
China	Bilateral imports (USD, constant 2010)	399	21,445,965,149	37,749,474,155	514	189,230,224,764
	Bilateral RER Index (constant, 2010)	399	103.67	16.73	63.765	209.443
	Weighted GDP (USD, constant 2010)	399	5,040,779,034,624	8,798,398,840,832	44,975,177,728	56,469,349,203,968
	Bilateral HHI in products	399	0.019	0.021	0.004	0.162
	HHI in products of exporters	399	0.0565	0.089	0.005	0.52
	HHI in partners of exporters	399	0.152	0.167	0.033	0.692
	United States	Bilateral imports (USD, constant 2010)	399	56,539,008,188	98,372,167,150	2,837,302
Bilateral RER Index (constant 2010)		399	113.413	21.612	74.085	17,270
Weighted GDP (USD, constant 2010)		399	239,985,861,066,752	308,158,937,432,064	9,867,611,865,088	1,337,633,473,036,288
Bilateral HHI in products		399	0.044	0.062	0.005	0.627
HHI in products of exporters		399	0.057	0.089	0.003	0.520
HHI in partners of exporters		399	0.153	0.164	0.033	0.692

between the variables. The error correction model derived from ADRL specification integrates short-run adjustments with long-run equilibrium without losing long-run information.

From equation 4.2, our empirical ARDL( $p_1, p_2, p_3$ ) model is given by:

$$\Delta m_t = \alpha_0 + \lambda_1 m_{t-1} + \lambda_2 r_{t-1} + \lambda_3 y_{t-1} + \sum_{i=1}^{p_1-1} \beta_{1i} \Delta m_{t-i} + \sum_{i=1}^{p_2-1} \beta_{2i} \Delta r_{t-i} + \sum_{i=1}^{p_3-1} \beta_{3i} \Delta y_{t-i} + u_t \quad (4.9)$$

where  $\beta_1, \beta_2, \beta_3$  represent the short-run dynamics of the model and  $\lambda_1, \lambda_2, \lambda_3$  the long-run relationship. The null hypothesis of no co-integration in the long-run relationship is:  $\lambda_1 = \lambda_2 = \lambda_3 = 0$ . (Pesaran et al., 2001) propose a bounds test for the null hypothesis of no co-integration. The F-statistics value will be compared with the upper and lower bounds critical values. If the computed F-statistics value is higher than the upper bound critical values, then the null hypothesis of no co-integration is rejected. If the F-statistics value lies between the upper and lower bound critical values, then the null hypothesis of no co-integration is inconclusive. If the F-statistics value lies below the lower bounds critical value, this provides evidence of no co-integration among the estimated variables.

If the variables include a co-integration, OLS estimation at level can be used to estimate the long-run coefficients:

$$m_t = \eta_0 + \eta_1 r_t + \eta_2 y_t + \varepsilon_t \quad (4.10)$$

The dynamic short-run causality model is then:

$$\Delta m_t = \phi_0 + \sum_{i=1}^{p_1-1} \phi_{1i} \Delta m_{t-i} + \sum_{i=1}^{p_2-1} \phi_{2i} \Delta r_{t-i} + \sum_{i=1}^{p_3-1} \phi_{3i} \Delta y_{t-i} + \psi ECT_{t-1} + \vartheta_t \quad (4.11)$$

where  $\psi$ , the coefficient of Error Correction Term ( $ECT_{t-1}$ ), defines the speed of adjustment factor or a feedback effect which brings the variables back towards their long-run level<sup>6</sup>. This coefficient shows how much of the disequilibrium is being corrected: if the estimate of  $\psi$  equals 1, there is instantaneous and full adjustment within the period. Conversely, if it equals 0, there is no adjustment. A positive coefficient indicates a divergence, while a negative coefficient indicates a convergence.

For the bilateral analysis for each reporter, we have panel data with  $N = 21$  and  $T = 19$ . Accordingly, we use the Feasible Generalized Least Squares (FGLS) specification which accounts for cross-sectional correlation. We seek to compare bilateral import price elasticities between China and the US across partner countries according to their participation in the two alternative FTAs (TPP vs RCEP) and their level of development. For this purpose, two dummy variables are introduced into the model. First, we define a dummy variable  $D_{lmi}$  which equals 1 for developing partners (LMI countries) and 0 for developed ones (HI countries). Second, to investigate the effect of different FTAs on the price elasticities, we introduce two other dummies, namely:  $D_{tpp}$  which equals 1 if trading partners belong to the TPP block under consideration, 0 otherwise, and  $D_{rcep}$  equals 1 for RCEP, 0 otherwise. We then undertake estimations for the two alternative member blocks.

<sup>6</sup> $ECT_{t-1}$  denotes residuals obtained from equation 4.10,  $ECT_{t-1} = m_{t-1} - \hat{\eta}_1 r_{t-1} - \hat{\eta}_2 y_{t-1}$ .

Without export diversification, our empirical model for the whole sample is given by:

$$m_{it,t} = \phi + \bar{\alpha}r_{ij,t} + \beta y_{i,t} + \epsilon_{ij,t} \quad (4.12)$$

where  $m_{ij,t}$  is country  $i$ 's real bilateral imports from partner  $j$ ,  $r_{ij,t}$  is the bilateral RER and  $y_{i,t}$  is the weighted GDP of reporter country  $i$ . All variables are taken in natural logarithm.  $\bar{\alpha}$  denotes the price elasticity of imports. By investigating our variable of interest across country groups, we introduce dummy variables  $D_g$ ,  $g$  could be either *lmi* or *tpp* or *rcep*. The model then becomes:

$$m_{it,t} = \phi_g + \bar{\alpha}_{1g}r_{ij,t} + \bar{\alpha}_{2g}D_g r_{ij,t} + \beta_g y_{i,t} + \epsilon_{g,ij,t} \quad (4.13)$$

By introducing export diversification, our model for the whole sample of partners becomes:

$$m_{it,t} = \phi_g + \bar{\alpha}_g r_{ij,t} + \gamma_g HH_t r_{ij,t} + \beta_g y_{i,t} + \epsilon_{g,ij,t} \quad (4.14)$$

where  $HH_t$  denotes bilateral export diversification in products between  $i$  and  $j$ .

If  $\gamma_g$  is statistically significant, one could say that price elasticities of imports,  $\bar{\alpha}_g + \gamma_g HH_t$ , depend on the degree of export diversification.

In order to compare the price elasticity between different groups of partners, we introduce, as before, dummy variables:

$$m_{it,t} = \phi_g + \bar{\alpha}_{1g}r_{ij,t} + \gamma_{1g}HH_t r_{ij,t} + \bar{\alpha}_{2g}D_g r_{ij,t} + \gamma_{2g}D_g HH_t r_{ij,t} + \beta_g y_{i,t} + \epsilon_{g,ij,t} \quad (4.15)$$

The import price elasticity is then a function of product diversification. The price elasticity of imports from group  $g$  is  $(\bar{\alpha}_{1g} + \bar{\alpha}_{2g}) + (\gamma_{1g} + \gamma_{2g}) HH_{ij,t}$  and from the reference group  $\bar{\alpha}_{1g} + \gamma_{1g} HH_t$ .

Moreover, in order to check the robustness of our empirical results, we conduct two alternative investigations by looking at export diversification indices in products *vs* in partners of supplier  $j$  ( $HH_{jt}^k$  and  $HH_{jt}^n$ , respectively).

## 4.5 Results

### 4.5.1 Global import level

We define our benchmark model as the one where we investigate the impact of price change on reporter  $i$ 's global imports without introducing trade diversification (4.2). Here, we use the ARDL model, whose condition is that none of the considered variables is I(2). Table 4.3a shows the results of the Augmented Dickey-Fuller (ADF) test for unit root. We observe a mixed record of stationarity at level and at first difference in both reporter countries, however none of the variables is I(2).



Table 4.3: Aggregate (benchmark) analysis

(a) Unit root test

Variable	China		United States	
	At level	At first difference	At level	At first difference
$m_t$	5.493***		3.453***	
$reer_t$	1.067	-5.076**	0.691	-3.371***
$y_t$	22.061***		7.353**	

Note: The null hypothesis of ADF is unit root test. \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

(b) ARDL bound test

Country	F-statistics
China	4.605*
US	10.441***

Note: The null hypothesis of bound test is no co-integration. \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

(c) ARDL regression

Variables		China	US
Long-run		ARDL(2,1,2)	ARDL(1,1,1)
	$reer_t$	-1.897*** (0.533)	0.362** (0.168)
	$y_t$	1.719*** (0.077)	1.973*** (0.092)
	const.	-13.815*** (0.932)	-33.310*** (2.899)
Short-run	$\Delta m_{t-1}$	0.536** (0.221)	
	$\Delta reer_t$	-1.179** (0.425)	-0.221* (0.110)
	$\Delta y_t$	1.902 (1.910)	3.675*** (0.369)
	$\Delta y_{t-1}$	-2.851** (1.222)	
	EC term	-0.934*** (0.258)	-0.401*** (0.116)
	R-squared	0.718	0.918

Note: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

Since the ARDL model provides not only short-run but also a long-run relationship between the variables considered, it is necessary to perform a co-integration test beforehand. For that purpose, Pesaran et al. (2001) propose the ARDL bound test with the null hypothesis of no co-integration. The results of the bound test are reported in Table 4.3b, in which the null hypothesis of no co-integration is rejected for both China and the US, *i.e.*, there is strong evidence of a long-run relationship between imports, RER and real GDP in our sample.

Table 4.3c compares the price elasticity of Chinese and US global imports without taking into account trade diversification. In the long-run, our coefficients of interest are statistically significant for

both countries. However, they have a different sign, reflecting two distinctive models of North-South regional integration. In the traditional US-led model, the import price elasticity is positive; in the new model in which China has an intermediate role through GVCs, the sign is negative. This long-run negative sign for exchange rate elasticity in the case of China is consistent with the finding reported by García-Herrero and Koivu (2008). Since China imports goods in order to export to the rest of the world, a real appreciation of the RMB reduces both China's exports and imports. Moreover, in comparison with the US, we note that China's imports are more responsive to change in relative prices than US imports. Indeed, a 1% appreciation of the RMB may reduce China's imports by 1.9%, whereas a 1% appreciation of the USD only increases imports by 0.36%.

Turning to the dynamic short-run causality with ECM, the negative and statistically significant value of the *ECT* coefficient for both countries indicates a convergence among variables towards their long-run level, meaning that part of the changes in imports embodies an adjustment to last-period deviations from its long-run steady-state equilibrium. The speed of adjustment to the equilibrium is slightly higher in the case of China than in that of the US.

In brief, the results of our estimates seem to highlight a matter of fact: because China's aggregate demand for imports is negatively affected by relative prices, the country's price elasticity of imports might be explained by trading partnerships and related patterns of trade.

## **4.5.2 Bilateral import level**

In this part, we investigate the price elasticities by looking at bilateral flows between reporter country  $i$  and its partners  $j$ . In order to compare the bilateral import price elasticities, we split the partner country sample on the basis of: (i) their development level (LMI *vs* HI countries), (ii) TPP membership, (iii) RCEP membership. The analysis is first conducted using panel data without export diversification indices. We then introduce successively the bilateral index of product diversification and  $j$ 's export diversification indices in products and in partners. The same investigation will be carried out for China and the US in order to introduce a comparative perspective. Results from the different specifications are reported in Table 4.4.

First, we re-estimate our benchmark model without trade diversification by using panel data on bilateral trade. Table 4.4a presents regression results from equations 4.12 and 4.13. Whatever the configurations under consideration, the price and income elasticities of imports are statistically significant. In the case of China, we confirm the negative value of price elasticities when considering either the whole sample or different groups of exporters according to their level of development and their participation in the two regional FTAs (**Columns 1-4**). The Chinese imports from LMI countries are slightly more responsive to change in the RER than those from HI countries. Specifically, a 1% appreciation of the RMB

Table 4.4: Bilateral analysis  
(a) Without export diversification

Variables	China				United States			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$r_{ij,t}$	-0.623*** (0.008)	-0.598*** (0.010)	-0.522*** (0.011)	-0.703*** (0.022)	0.806*** (0.008)	1.169*** (0.012)	0.442*** (0.002)	0.508*** (0.001)
$D_{lmi}r_{ij,t}$		-0.039** (0.017)				-0.585*** (0.012)		
$D_{tpp}r_{ij,t}$			-0.193*** (0.017)				0.647*** (0.002)	
$D_{rcep}r_{ij,t}$				0.113*** (0.027)				0.376*** (0.000)
Weighted GDP	0.014*** (0.001)	0.014*** (0.001)	0.016*** (0.001)	0.015*** (0.001)	-0.001*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	-0.001*** (0.000)
Constant	-377.174*** (13.176)	-377.765*** (13.311)	-374.646*** (12.789)	-377.751*** (13.353)	-107.432*** (8.191)	-126.764*** (10.325)	-52.724*** (6.691)	-94.227*** (4.398)
Observations	399	399	399	399	399	399	399	399
Number of exporters	19	19	19	19	19	19	19	19

Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

(b) With bilateral export diversification

Variables	China				United States			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$r_{ij,t}$	-0.670*** (0.001)	-0.566*** (0.006)	-0.397*** (0.012)	-0.732*** (0.005)	0.843*** (0.003)	1.180*** (0.013)	0.557*** (0.004)	0.394*** (0.007)
$(HH_{ij,t})r_{ij,t}$	0.991*** (0.002)	2.212*** (0.040)	-1.281*** (0.060)	3.873*** (0.017)	-0.267*** (0.005)	-0.317*** (0.015)	-0.393*** (0.006)	-0.443*** (0.036)
$D_{lmi}r_{ij,t}$		-0.054*** (0.011)				-0.557*** (0.016)		
$D_{lmi}(HH)_{ij,t}r_{ij,t}$		-2.488*** (0.045)				0.100*** (0.016)		
$D_{tpp}r_{ij,t}$			-0.304*** (0.023)				0.532*** (0.006)	
$D_{tpp}(HH_{ij,t})r_{ij,t}$			3.359*** (0.090)				0.287*** (0.008)	
$D_{rcep}(ij,t)$				0.090*** (0.006)				0.554*** (0.009)
$D_{rcep}(HH_{ij,t})r_{ij,t}$				-2.934*** (0.017)				0.174*** (0.035)
Weighted GDP	0.019*** (0.000)	0.012*** (0.000)	0.015*** (0.001)	0.018*** (0.000)	-0.001*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	-0.001*** (0.000)
Constant	-273.424*** (7.112)	-368.913*** (13.113)	-365.661*** (12.390)	-382.173*** (12.452)	-108.930*** (8.274)	-126.781*** (10.335)	-122.337*** (9.704)	-114.419*** (8.818)
Observations	399	399	399	399	399	399	399	399
Number of exporters	19	19	19	19	19	19	19	19

Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

reduces imports from LMI and HI countries by 0.637% and 0.598% respectively (**Column 2**)<sup>7</sup>. When accounting for exporters' participation in the two alternative FTAs, trading with TPP members makes China's imports more responsive to price changes than trading with countries that are not involved in this agreement. A 1% appreciation of the RMB would cause China's imports from TPP members to fall by 0.193% more than those from non-TPP members (**Column 3**). Most interestingly, trading with RCEP

<sup>7</sup>Note that the net price elasticity of imports from group g equals the sum of all coefficients associated with  $r_{ij,t}$ . For the LMI group:  $-0.637\% = -0.598\% - 0.039\%$ .

Table 4.4: Bilateral analysis (continued)

(c) With diversification in products of exporters

Variables	China				United States			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$r_{ij,t}$	-0.464*** (0.001)	-0.264*** (0.015)	-0.509*** (0.004)	-0.523*** (0.006)	0.758*** (0.015)	1.123*** (0.025)	0.384*** (0.013)	0.539*** (0.017)
$(HH_{j,t})r_{ij,t}$	2.925*** (0.011)	4.985*** (0.132)	0.439*** (0.034)	1.668*** (0.009)	1.485*** (0.039)	1.883*** (0.058)	1.210*** (0.055)	0.715*** (0.045)
$D_{lmi}r_{ij,t}$		-0.327*** (0.018)				-0.577*** (0.027)		
$D_{lmi}(HH_{j,t})r_{ij,t}$		-4.335*** (0.146)				-0.833*** (0.066)		
$D_{tpp}r_{ij,t}$			0.234*** (0.008)				0.679*** (0.009)	
$D_{tpp}(HH_{j,t})r_{ij,t}$			4.157*** (0.042)				0.483*** (0.074)	
$D_{rcep}r_{ij,t}$				0.034*** (0.007)				0.261*** (0.012)
$D_{rcep}(HH_{j,t})r_{ij,t}$				1.351*** (0.011)				0.796*** (0.060)
Weighted GDP	0.005*** (0.000)	0.014*** (0.001)	0.018*** (0.000)	0.005*** (0.000)	-0.001*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	-0.001*** (0.000)
Constant	-278.097*** (8.656)	-203.657*** (15.759)	-216.356*** (13.364)	-272.900*** (8.504)	-52.801*** (9.756)	-58.269*** (10.876)	-61.778*** (10.225)	-54.083*** (9.859)
Observations	399	399	399	399	399	399	399	399
Number of exporters	19	19	19	19	19	19	19	19

Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

(d) With diversification in partners of exporters

Variables	China				United States			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$r_{ij,t}$	-0.594*** (0.003)	-0.325*** (0.002)	-0.576*** (0.000)	-0.554*** (0.008)	0.678*** (0.009)	1.219*** (0.025)	-0.163*** (0.008)	0.382*** (0.008)
$(HH_{j,t})r_{ij,t}$	-1.309*** (0.010)	-2.098*** (0.006)	-0.821*** (0.001)	-0.512*** (0.006)	0.629*** (0.004)	-1.001*** (0.014)	1.657*** (0.016)	0.334*** (0.003)
$D_{lmi}r_{ij,t}$		-0.365*** (0.003)				-1.027*** (0.027)		
$D_{lmi}(HH_{j,t})r_{ij,t}$		1.264*** (0.011)				2.468*** (0.016)		
$D_{tpp}r_{ij,t}$			0.031*** (0.000)				1.235*** (0.013)	
$D_{tpp}(HH_{j,t})r_{ij,t}$			-1.018*** (0.001)				-2.266*** (0.018)	
$D_{rcep}r_{ij,t}$				-0.088*** (0.009)				0.360*** (0.006)
$D_{rcep}(HH_{j,t})r_{ij,t}$				-1.160*** (0.006)				0.440*** (0.011)
Weighted GDP	-0.016*** (0.001)	-0.006*** (0.000)	-0.005*** (0.000)	-0.024*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.001*** (0.000)	0.000*** (0.000)
Constant	-438.737*** (17.640)	-502.664*** (18.718)	0.000 (0.000)	-454.720*** (19.260)	-77.309*** (10.271)	-166.958*** (11.441)	-144.719*** (9.355)	-75.304*** (10.990)
Observations	399	399	399	399	399	399	399	399
Number of exporters	19	19	19	19	19	19	19	19

Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

members attenuates China's import responsiveness to any change in the RER. Indeed, imports from RCEP members would fall by 0.113% less than imports from non-RCEP countries when the Chinese currency

appreciates by 1% (**Column 4**). Accordingly, when trading with RCEP members, any change in price has smaller net effects on China's imports than when trading with TPP members (price elasticities of imports from RCEP members are -0.59, lower in absolute value than those of imports from TPP members, -0.715). With a nested trade structure, such results provide evidence-based support to China for negotiating RCEP partnership.

The picture for the US is different, as import price elasticities are globally positive and their values are more substantial (**Columns 5-8**). Firstly, in contrast to the Chinese case, we confirm that US imports from LMI countries are less sensitive to price changes (**Column 6**). In fact, imports from LMI countries would increase by 0.585% less than imports from HI countries when the USD appreciates by 1%. Secondly, US imports are more sensitive to the RER when they trade with TPP or RCEP members rather than with third countries (**Columns 7-8**). Interestingly, price changes have relatively higher effects when the US imports from the TPP block (the net price elasticity is 1.089) than when it imports from the RCEP block (net price elasticity is 0.884), which means that any real appreciation of the USD will lead to a greater increase in US imports from TPP members.

To summarize, our findings using panel data on bilateral trade are consistent with the earlier results conducted at the aggregate level, *i.e.*, a negative (respectively positive) sign for China's price elasticity (the US). Moreover, while China's imports from LMI countries are more sensitive to price changes than those from the HI group, the opposite result is obtained for the US. Lastly and above all, while trading with RCEP members attenuates the responsiveness of China's imports to the RER, trading with both RCEP and TPP members makes US imports more sensitive to the RER than imports coming from outside the two blocks.

In a second step, we endogenize the import price elasticities according to different types of export diversification indices: bilateral diversification in products between  $i$  and  $j$  (Table 4.4b), diversification in products for  $j$  (Table 4.4c) and diversification in partners for  $j$  (Table 4.4d). Globally speaking, our findings provide empirical evidence that the export diversification indices affect the import price elasticities, since the coefficients associated with HHI are all statistically significant. In this context, country  $i$ 's price elasticity of imports depends upon country  $j$ 's export diversification. For convenience, we compile results from all tables above into Table 4.5 and display them graphically in Figure 4.5, where the parameter  $\alpha_{ij}$  is depicted as a function of HHI<sup>8</sup>. The net effect of any change in relative prices on the import demand is resumed by the parameter  $\alpha_{ij}$  which must satisfy in absolute terms:  $\alpha_1 < \alpha_{ij} < \alpha_1 + \alpha_2$ .

Looking first at China, a result which is straightforward here is an homogenous negative import price elasticity with  $j$ 's diversification in partners, and this finding is consistent for all China's partner groups (Table 4.5). Above all, the more  $j$  is diversified in export markets (*i.e.*, HHI close to 0), the lower the import price elasticity is in absolute value. It means that the extent to which trading partners

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<sup>8</sup>It is worth recalling that export diversification is measured by the Herfindhal-Hischman Index (HHI); therefore, the lower the HHI, the higher the degree of export diversification. All types of HHI, which are shown in Figure 4.5, remain within the range given in Table 4.2.

Table 4.5: A summary of import price elasticities in bilateral analysis with export diversification ( $\alpha_{ij}$ )

	China		United States	
	$\alpha_{ij}$ (1)	$HH^*$ (2)	$\alpha_{ij}$ (3)	$HH^*$ (4)
<b>Bilateral export diversification</b>				
Whole sample	$-0.67 + 0.991(HH_{ij,t})$	$\alpha_{ij} = 0$ when $HH_{ij,t} = 0.676$	$0.843 - 0.267(HH_{ij,t})$	$\alpha_{ij} > 0 \forall HH_{ij,t}$
LMI countries	$-0.62 - 0.276(HH_{ij,t})$	$\alpha_{ij} < 0 \forall HH_{ij,t}$	$0.623 - 0.217(HH_{ij,t})$	$\alpha_{ij} > 0 \forall HH_{ij,t}$
TPP members	$-0.707 + 2.078(HH_{ij,t})$	$\alpha_{ij} = 0$ when $HH_{ij,t} = 0.340$	$1.089 - 0.106(HH_{ij,t})$	$\alpha_{ij} > 0 \forall HH_{ij,t}$
RCEP members	$-0.642 + 0.939(HH_{ij,t})$	$\alpha_{ij} = 0$ when $HH_{ij,t} = 0.684$	$0.948 - 0.269(HH_{ij,t})$	$\alpha_{ij} > 0 \forall HH_{ij,t}$
<b>Export diversification in products of <math>j</math></b>				
Whole sample	$-0.464 + 2.925(HH_{ij,t})$	$\alpha_{ij} = 0$ when $HH_{ij,t} = 0.159$	$0.758 + 1.485(HH_{ij,t})$	$\alpha_{ij} > 0 \forall HH_{ij,t}$
LMI countries	$-0.591 + 0.65(HH_{ij,t})$	$\alpha_{ij} = 0$ when $HH_{ij,t} = 0.909$	$0.546 + 1.05(HH_{ij,t})$	$\alpha_{ij} > 0 \forall HH_{ij,t}$
TPP members	$-0.275 + 4.596(HH_{ij,t})$	$\alpha_{ij} = 0$ when $HH_{ij,t} = 0.06$	$1.063 + 1.693(HH_{ij,t})$	$\alpha_{ij} > 0 \forall HH_{ij,t}$
RCEP members	$-0.489 + 3.019(HH_{ij,t})$	$\alpha_{ij} = 0$ when $HH_{ij,t} = 0.162$	$0.8 + 1.511(HH_{ij,t})$	$\alpha_{ij} > 0 \forall HH_{ij,t}$
<b>Export diversification in partners of <math>j</math></b>				
Whole sample	$-0.594 - 1.309(HH_{ij,t})$	$\alpha_{ij} < 0 \forall HH_{ij,t}$	$0.678 + 0.629(HH_{ij,t})$	$\alpha_{ij} > 0 \forall HH_{ij,t}$
LMI countries	$-0.69 - 0.834(HH_{ij,t})$	$\alpha_{ij} < 0 \forall HH_{ij,t}$	$0.192 + 1.467(HH_{ij,t})$	$\alpha_{ij} > 0 \forall HH_{ij,t}$
TPP members	$-0.545 - 1.839(HH_{ij,t})$	$\alpha_{ij} < 0 \forall HH_{ij,t}$	$1.072 + 3.923(HH_{ij,t})$	$\alpha_{ij} > 0 \forall HH_{ij,t}$
RCEP members	$-0.642 - 1.672(HH_{ij,t})$	$\alpha_{ij} < 0 \forall HH_{ij,t}$	$0.742 + 0.774(HH_{ij,t})$	$\alpha_{ij} > 0 \forall HH_{ij,t}$

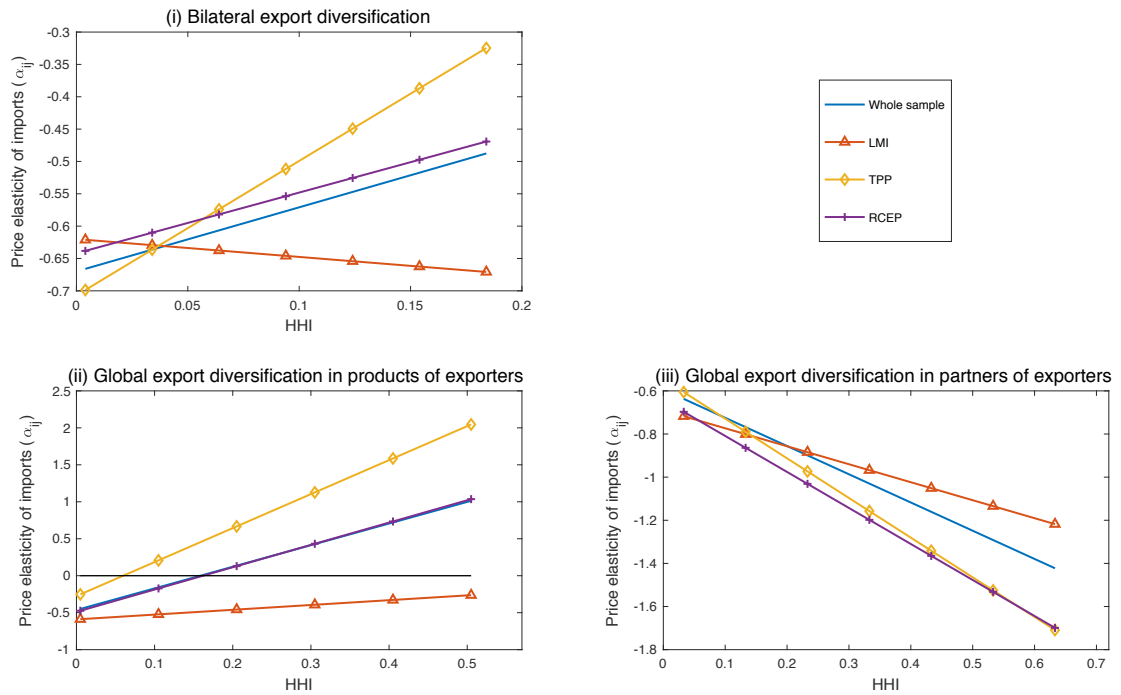
Note: Columns (1) and (3) report import price elasticities ( $\alpha_{ij}$ ) in term of export diversification for China and the US. Those entries are constructed from regression results in 4.4b, 4.4c and 4.4d. Columns (2) and (4) represent values of the Herfindal-Hischman index corresponding with different signs of  $\alpha_{ij}$ .

are allowed to access export markets has a significant effect on China’s “resilience” to movements in its exchange rate.

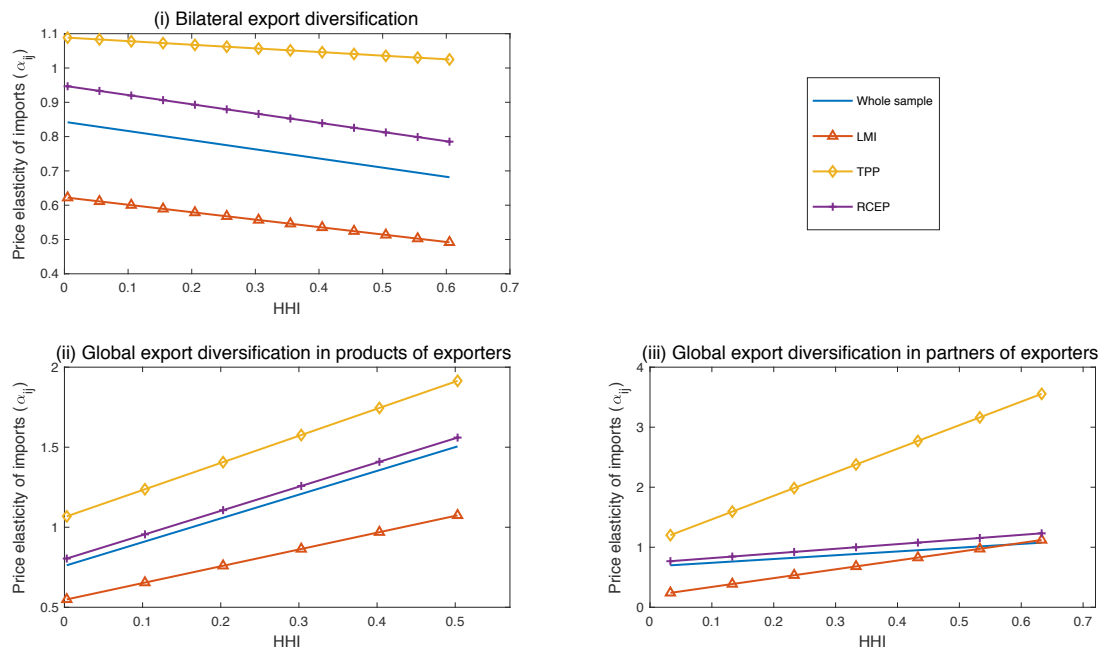
The remaining results show a more heterogeneous picture: depending upon the value of the HHIs, the parameter  $\alpha_{ij}$  can cross the horizontal line 0 as depicted in Figure 4.5a. In the first row of Table 4.5, for example, the import price elasticity for the whole sample of partner countries becomes positive when bilateral export diversification in products between  $i$  and  $j$  is higher than the critical value 0.676. However, if we consider the minimum and maximum values of the corresponding HHI in Table 4.2 (0.004 and 0.162 respectively), the price elasticity is negative when the index stays in the range (which is rather low). This finding is consistent for all of China’s partner groups: because the import price elasticity is homogenously negative, we find that a high degree of bilateral export diversification in products helps China’s imports to become less sensitive to price change.

Against this background, another striking feature here is the homogenous negative price elasticity when trading partners are LMI countries, whatever the HHI taken into account. More specifically, the parameter  $\alpha_{ij}$  corresponding to the LMI group is always negative when the export diversification index in products of  $j$  is in the range depicted in Table 4.2 (0.005 and 0.52 respectively). Regardless of how they diversify, LMI partners explain the negative sign of China’s price elasticity in imports, and the lower the HHI (*i.e.* the higher the degree of export diversification), the lower China’s responsiveness to relative prices.

Because the price elasticity can be either positive or negative depending on the HHI value, comparing RCEP and TPP blocks in their ability to diversify exports in products is a meaningful way to



(a) China



(b) United States

Figure 4.5: Price elasticity of imports across export diversification indices

further understanding current trade negotiations in Asia-Pacific. As shown in Figure 4.5a, the discussion is less straightforward even though the parameter  $\alpha_{ij}$  for RCEP members can remain negative within a larger range of HHI than for the TPP group. More precisely, when their HHI in products is less than

about 0.162, China's imports are negatively affected by change in the RMB. In short, if RCEP members succeed in diversifying their exported products (*i.e.*, HHI close to 0), China will become less sensitive to relative price change than when the country imports from non-RCEP members.

In the US case, we observe different patterns but ones that are consistent with our former findings without export diversification. At a given degree of export diversification, (i) the price elasticity of imports is positive in all cases; (ii) exports from LMI countries to the US are less sensitive to price change than those from HI countries; (iii) exports from TPP and RCEP members are more sensitive to change in the USD than those from third countries. Because the US imports are positively affected by relative prices, a high degree of  $j$ 's export diversification (*i.e.*, HHI close to 0) lowers the country's responsiveness to changes in the RER. Conversely, the more concentrated partner countries are in their exports, the more sensitive the US imports are to price change. This finding is consistent for all partner groups. By further diversifying their exports, LMI countries allow the US imports (as in China) to become less sensitive to changes in the RER than when they trade with HI countries. But by comparing the parameter  $\alpha_{ij}$  between TPP and RCEP blocks, we find that import price elasticities in the former case reach higher values whatever the HHI taken into account (purple curve in Figure 4.5b). Therefore, withdrawing from the TPP agreement has allowed the US to attenuate any effect of changes in the RER on its import flows.

The contrary results obtained when comparing import price elasticities between China and the US reflect two different models of regional North-South trade integration: on the one hand, a conventional model led by the US, an advanced economy, and, on the other, a new model led by China, a developing country. Traditionally, any appreciation of the home currency could worsen trade balances in the long term since it decreases exports and increases imports. This is not, however, the situation we observe in China. Indeed, the negative sign of the country's import price elasticity indicates that a real appreciation of the RMB could also decrease imports. In that case, the ability of trading partners to diversity their exports helps to produce this effect.

## **4.6 Conclusion**

China has grown into one of the main competitors in international markets during the last three decades. As a large country with rapid economic growth and huge volume of trade, China's accession to the WTO in 2001 has exerted a profound influence on the world economy. Less developed exporting countries have reason to be concerned about their ability to compete with China in global markets. However, it is hoped that China's increasing power will generate considerable potential for upgrading DCs' export performance through product diversification and quality improvement. Indeed, complementarity in the regional division of production processes has been established between China and its Asian neighbors through a coincidental development of international integration and economic transition processes. Because of the triangular patterns of trade underlying GVCs, China imports products from its Asian neighbors that are subsequently processed and re-exported to the rest of the world. In this context,



new prospects are emerging for the role of emerging Asian countries in general, and China in particular, in the economic revival of the developing world.

The US and China are the two principal trading partners of most countries in Asia and the Pacific Rim. On the one hand, the US already has bilateral trade deals with 6 of the 11 nations involved in the CPTPP (with Japan the biggest of those nations). On the other hand, the formation of regional production and distribution networks in East Asia has increased each country's dependence on trade with other neighboring countries, thereby boosting regional economic integration. Within this framework, China is undoubtedly growing in influence in the Asia-Pacific region. While buying from other countries, the country is busy selling to the US and it is not certain that a real appreciation of the RMB will help narrow the trade surplus with the US. Rising trade tensions between the two key players, in addition to the country's long term "Made in China 2025" strategy (import substitution and a shift away from cheap goods towards higher-value manufacturing), may result in Chinese imports decreasing at a faster rate than exports. Accordingly, the Asia-Pacific Rim countries (especially the least developed ones) will suffer the most from the trade war between the US and China as their economic growth is driven by exports to those two largest trading partners.

The relationship between the exchange rate and trade is influenced by many fundamental factors, which include the price elasticity of each product traded (some being more or less sensitive to exchange rate variations), the country's market share for the product concerned, the product mix of exports and imports and the pricing strategy of importers and exporters. China's currency policy has often been the main target of trade disputes with the US or the EU. However, the currency policies of other countries, as well as China's trade policy, have also come under scrutiny. Our results show that the mechanisms of price transmission, and more precisely of the real appreciation of the Renminbi, are different from one partner to another; so that the impact on China's imports diverges from the conventional results. This is in line with the results of an OECD study on the impact of exchange rate movements on trade in the world's three largest economies, the United States, the Eurozone, and China (OECD, 2011). It found that, overall, short-term exchange rate movements have an impact on trade, but *"this effect is difficult to interpret; in some cases the impact is positive, in others it is negative. This is consistent with other studies which conclude that short-term effects do not seem to follow a specific trend"*.

Our study confirms that the value of US-China trade would be more affected by monetary changes than expected. In terms of direct effects of the exchange rate, an appreciation in the real exchange rate reduces imports from China that use Asian-made parts and components. This effect of an appreciation of the RMB on Chinese trade is observed in the context of GVCs. By lowering China's export production, the currency appreciation reduces China's demand of imports from other Asian countries. As a result, an appreciation of the renminbi hurts producers of intermediate goods in emerging Asia. Therefore, China's policy of product diversification accompanied by a policy of commercial partnership with its regional partners (notably focused on standardising tariffs in Developing Asia) is part of a deliberate strategy of resilience to the real appreciation of its currency.

The emergence of global supply chains in recent decades has helped China to consolidate this strategy in response to trade pressures generated by imports from low-wage countries, as well as from high-income countries. To include a geographical dimension in our discussion, our proposed model provides evidence to support the argument that export diversification from trading partners causes imports in the case of China. In the long-run, the import price elasticity is negative and this finding is more pronounced for developing trading partners. On the whole, the more partner countries are diversified in their export destinations, the lower China is responsive to price change in absolute terms. As a result, the Marshall-Lerner condition set at the unilateral level may no longer be verified as globalization gathers pace.

# Appendix

## 4.A Country sample

Our country sample (exporters  $j$ ) is TPP and RCEP members composed of Developing ASEAN, other emerging economies and the rest (HI countries).

Sample of 21 countries $j$	Low- and Middle-Income (LMI) countries	High Income (HI) countries
<b>Regional Comprehensive Economic Partnership (RCEP-16)</b>	Developing ASEAN = Cambodia, Indonesia, Lao PDR, <i>Malaysia</i> <sup>a</sup> , Myanmar <sup>b</sup> , Philippines, Thailand, <i>Vietnam</i> , India, China <sup>c</sup>	ASEAN2 = <i>Brunei, Singapore Australia, New Zealand Japan</i> , South Korea
<b>Trans-Pacific Partnership (TPP-12)</b>	<i>Malaysia, Vietnam</i> , Chile, Mexico, Peru	<i>Australia, New Zealand Brunei, Singapore, Japan, Canada, US</i> <sup>c</sup>

<sup>a</sup> Countries in *italics* are involved in the two FTAs

<sup>b</sup> due to missing data, Myanmar has not been included in our econometric investigation

<sup>c</sup> We exclude China (the US) when we regress Chinese (US) imports, but include it when we regress US (Chinese) imports

## 4.B Data sources

The HHI data are computed from trade statistics from the CEPII's BACI database:

<http://www.cepii.fr/anglaisgraph/bdd/baci.htm>

The WITS database is freely accessible on the World Bank's website:

<https://wits.worldbank.org/default.aspx>

The other data on macroeconomic variables are taken from the World Bank's World Development Indicators(WDI):

<http://databank.worldbank.org/ddp/home.do>

# Chapter 5

## Real exchange rate and firm productivity in an emerging country

### Abstract

In this chapter, we attempt to find the linkage between real exchange rate and firm productivity. Observing the Vietnamese dong (VND) movement during the period 2000-2015, we assume 2004 as the critical year when there was a change in real exchange rate policy. Using the difference-in-differences methodology, we find a positive effect of a persistent real appreciation in VND on firm productivity in the Vietnamese manufacturing sector. One of the mechanisms that could explain this effect is that real appreciation boosts firm productivity through R&D. We also find that small and medium firms benefit more from real appreciation than large firms.

Key words: real exchange rate, firm-level, productivity, R&D

JEL Codes: F14, F31, F41

### 5.1 Introduction

The welfare of a nation depends on many factors of which the aggregate productivity growth is considered to be one of the most important elements. Therefore, throughout history, many scholars have tirelessly tried to discover the essential factors that promote productivity growth. A large literature supports the benefits of free trade policies on productivity growth through firm dynamic (Pavcnik, 2002), or better firms' reallocation of resources (Aghion, Blundell, Griffith, Howitt, and Prantl, 2009; Melitz, 2003). This impact is evidenced in either developed countries (Lileeva and Trefler, 2010; Trefler, 2004) or emerging ones (Amiti and Konings, 2007; Pavcnik, 2002; Topalova and Khandelwal, 2011). Firms can also improve their productivity through the so called learning-by-exporting mechanism (Atkin, Khandelwal, and Osman, 2017; De Loecker, 2007; Harrison and Rodríguez-Clare, 2010). Some other factors



Figure 5.1: Real effective exchange rate movement (2000=100)

boosting firm productivity are documented such as foreign direct investment (Haskel, Pereira, and Slaughter, 2007; Smarzynska Javorcik, 2004), R&D investment (Aw, Roberts, and Xu, 2011; Bøler, Moxnes, and Ulltveit-Moe, 2015; Doraszelski and Jaumandreu, 2013). Recently, real exchange rate became a factor of interest in explaining the changes in firm productivity in either developed or developing countries. While other trade-policy instruments such as export subsidies and import tariffs are restricted by WTO membership, real exchange rate policies are not constrained by the WTO (Alfaro, Cuñat, Fadinger, and Liu, 2018).

In this research, our main objective is investigating the impact of the real appreciation in the Vietnamese dong (VND) on productivity using a rich firm-level database in the Vietnamese manufacturing sector. This research covers a long period of 15 years, from 2000 to 2016. As shown in Figure 5.1, the Vietnamese dong experiences a large and consecutive appreciation from 2004 with an annually growth rate of around 4%, despite a short-run depreciation during the period 2009-2011 which was probably due to the Global financial crisis in 2008<sup>1</sup>. Specifically, there was a real depreciation of 3% per year before 2004. In this context, we consider 2004 as a milestone in which there was a change in real exchange rate policy. To examine the effect of real appreciation on firm productivity, we decide to use the difference-in-differences methodology, suggested by Trefler (2004). We define the firms' exposure to currency in terms of their trade status instead of net exposure as in Ekholm, Moxnes, and Ulltveit-Moe (2012). The reason is that the database, unfortunately, does not provide good information on firms' exports and imports in every year. Hence, the treatment group consists of firms having either export or import activities, while the control group includes firms with no external trading activities.

We find that a large and persistent real appreciation can significantly increase firm productivity.

<sup>1</sup>In our research, an increase in real effective exchange rate (REER) implies an appreciation in VND.

To check the validity of this effect, we perform various placebo tests: (i) whether there is a common trend in both treatment and control group in the absence of intervention, *i.e.*, before 2004, (ii) whether other policy reforms, such as WTO accession in 2007, or the business conditions such as the world financial crisis in 2008 affect the final results.

Strongly related to previous studies such as B.-Y. Choi and Pyun (2018); Ekholm et al. (2012), etc., our research contributes to this strand of literature in threefold. Firstly, while previous studies concentrate on upper-middle- or high-income countries, our research, to our best knowledge, is the first one which focuses on a lower-middle-income economy. Secondly, we examine the heterogeneous effect of real appreciation in firm productivity according to their size or ownership status, which has not been documented in literature as yet. Thirdly, we confirm the previous studies in the sense that real appreciation may induce high investment in R&D, hence increasing firm productivity.

This chapter is structured as follows. Section 5.2 reviews literature and the channels through which currency movements can affect firm productivity. In Section 5.3, we depict our econometric methodology. Section 5.4 describes the data. After representing the results in Section 5.5, we discuss further investigation in Section 5.6. Finally, Section 5.7 concludes.

## 5.2 Literature review

The question of how RER affects productivity has drawn much more attention in recent years. While extensive studies have investigated the impact of RER on aggregate level, not many analyses have been based on firm-level data. However, the evidence is far from conclusive. While some studies show a positive (negative) effect of real appreciation (depreciation) on firm productivity (Ekholm et al., 2012; Fung, 2008; Tomlin, 2014), others find an opposite effect (Fung, Baggs, and Beaulieu, 2011; Fung and Liu, 2009) and a mixed impact (Alfaro et al., 2018; B.-Y. Choi and Pyun, 2018)<sup>2</sup>.

The direction of the RER impact on productivity might be different, depending on whether firms rely on imported intermediate inputs or they are export-oriented. Using a firm-level database of 76 emerging countries and 23 developed economies, Alfaro et al. (2018) point out the contrast in responses of manufacturing firms to medium-term RER changes between emerging countries in Asia, Latin America, Eastern Europe and industrialised economies. For Asian emerging countries where firms are export oriented rather than relying much on imported intermediate goods, RER depreciations have *on average* a positive effect on firms productivity. It also increases the export entry rate and the probability of R&D. On the contrary, in others emerging countries with heavy dependence on imported intermediate goods, real depreciation slows down TFP and sales growth of manufacturing firms. However, there is no effect

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<sup>2</sup>In the case of Taiwanese manufacturing firms, Fung (2008) points out a positive impact of RER appreciation following the 1986 Plaza Accord on firm productivity using the 1986, 1991 and 1996 census data; Fung and Liu (2009) use a more restricted number of firms on the Taiwan Stock Exchange between 1991 and 2001, and find a positive effect of real depreciation on firm productivity.

of RER depreciation on firms' performance in industrialized countries.

The different impacts of RER on productivity could depend on how its movement persists. Using firm-level data of South Korean manufacturing industries, B.-Y. Choi and Pyun (2018) find a considerable productivity gains following an immediate RER depreciation. However, a *persistent* depreciation in currency has a negative effect on productivity since it decelerates innovation effort and prevents efficient resource allocation in firms. This result supports the previous finding of Ekholm et al. (2012) in the case of Norway. They found that a *sharp* real appreciation of Norwegian Krone could trigger an increase in productivity but also lead to a reduction in employment.

Some researches attempt to figure out the channels through which real appreciation (or depreciation) might affect productivity. Industry-wide, Tomlin (2014) points out the impact of exchange rate movement on the entry and exit decision of individual plants, leading to a change in productivity. Including plant entry and exit components in a dynamic empirical structural model, he finds that an appreciation can decrease the probability of surviving of lower productivity firms (i.e. less productive firms are more likely to exit the market) and increase the chance for more productive firms to enter the market. Indeed, a currency appreciation induces the falling of aggregate demand for exported goods, and then reduces the firm's output and market share. It can, at the same time, increase imported goods, contributing to a decrease in market share. This pressure forces less productive firms to leave the market and sets a higher threshold of productivity and competitiveness for newly entering firms in the new strong-currency environment. The reactions of both incumbents and potential entrants will result in an increase in average productivity.

The exchange rate movement may also affect exporting firm's efficiency through its allocation of resources. Several studies suggest that high competition forces firms to eliminate their lowest performing products and pay close attention to their more competitive ones. In other words, firms go through re-allocative changes in terms of scope of products. An appreciation, at first, can have less benefits for exporters, but the persistent high competition in foreign markets may increase firm productivity since it boosts the efficient internal reallocation of resources among exporters. On the other hand, B.-Y. Choi and Pyun (2018) imply that a negative effect of persistent change in exchange rate depreciation on innovation might lower productivity because it restrains firms from more effective allocation of resources.

Another channel which should be thoroughly considered is the impact of exchange rate movement on imported input prices. For example, an appreciation might make imported goods less expensive. as a result, lower input costs would increase productivity, especially for firms with higher intermediate input import shares.

There is a large set of literature that is related to this research. One strand of literature exploits the heterogeneous reactions of firms following exchange rate movements. Berman, Martin, and Mayer (2012) investigate the response of exporters in terms of prices, quantities and firms dynamic. On average, real depreciation increases both export prices and volumes. Moreover, larger firms can incorporate an

exchange rate variation in their markups in order to offset its impact. Li, Ma, and Xu (2015) also confirm the heterogeneous reaction from Chinese exporters. Berthou and Dhyne (2018) find that in each country and sector, the least productive firms seem to have more intense responses to real exchange rate movements than the most productive firms. Furthermore, different works point out the impact of exchange rate changes on the intensive margin (variation of firms' exports) and the extensive margin (firms' entry and exit).

## 5.3 Econometric strategy

### 5.3.1 Model specification

To investigate the impact of a large and persistent real appreciation in VND on firm productivity, we use the difference-in-differences specification suggested by Trefler (2004). Because the Vietnamese Dong (VND) appreciated consecutively from 2004, we define the years 2000-2004 as the pre-RER shock period, and the years 2004-2015 as the RER shock period. Using difference-in-differences methodology, one could be concerned about issues related to the standard error of the estimate. One of the two techniques that help to solve the serial correlation problem is removing the time series dimension by aggregating the data into two periods: pre- and post-intervention (Bertrand, Duflo, and Mullainathan, 2004). Therefore, we consider the outcome as the average annual growth rate of productivity of firm  $i$  in period  $s$ , denoted as  $\Delta y_{i,s}$  where  $s = 1$  indexes the RER shock period and  $s = 0$  indexes the pre-RER shock period.  $\Delta y_{i,s}$  is then defined as:

$$\begin{aligned}\Delta y_{i1} &\equiv (\ln Y_{i,2015} - \ln Y_{i,2004}) / (2015 - 2004) \\ \Delta y_{i0} &\equiv (\ln Y_{i,2004} - \ln Y_{i,2000}) / (2004 - 2000)\end{aligned}\tag{5.1}$$

Since we are interested in the effect of change in RER shock on firm productivity, we define  $\Delta rer_s$  as average annual change in RER in period  $s$ , that means:

$$\begin{aligned}\Delta rer_1 &\equiv (\ln REER_{2015} - \ln REER_{2004}) / (2015 - 2004) \\ \Delta rer_0 &\equiv (\ln REER_{2004} - \ln REER_{2000}) / (2004 - 2000)\end{aligned}\tag{5.2}$$

The linear model that specifies the impact of RER shock on the change in firm outcome is provided as:

$$\Delta y_{i,s} = \alpha_i + \theta_s + \beta D_{i0} \Delta rer_s + \epsilon_{i,s}\tag{5.3}$$

where  $\alpha_i$  is fixed effect at firm level,  $\theta_s$  is a period-specific effect. To estimate consistently the coefficient  $\beta$ , we differentiate Equation 5.3 and obtain the baseline difference-in-differences (DD) spec-



ification:

$$\Delta y_{i1} - \Delta y_{i0} = \theta + \gamma D_{i0}^{trade} (\Delta rer_1 - \Delta rer_0) + v_i \quad (5.4)$$

where  $\theta \equiv \theta_1 - \theta_0$ ,  $D_{i0}^{trade}$  is an indicator that equals 1 if firm  $i$  trades in base year 2000. The firm-fixed effect  $\alpha_i$  is ruled out in the equation. The coefficient of interest,  $\beta$ , indicates the effect of RER movement on the change in firm productivity. It is natural that one could use a period dummy, that equals 1 in RER-shock period and 0 otherwise, to distinguish the pre- and post-intervention, as in the standard difference-in-differences approach. The use of  $(\Delta rer_1 - \Delta rer_0)$ , however, stresses the effect of the change in RER shock on firm outcome. Thus,  $\gamma$  reflects the difference in change in average productivity growth between trade and non-trade firms following a certain degree of RER shock. A positive sign of the coefficient implies a positive effect of real appreciation on firm productivity. Following Trefler (2004) and Ekholm et al. (2012), we introduce a vector of firm level control,  $x_{i0}$ , from the base year 2000. The control variables include number of employees, capital (in logs) and the Herfindahl index which represents the market power of industry  $j$ . We also control for industry fixed effects,  $\eta_j$ , in regression results. Our difference-in-differences model become then:

$$\Delta y_{i1} - \Delta y_{i0} = \theta + \gamma D_{i0}^{trade} (\Delta rer_1 - \Delta rer_0) + \phi x_{i0} + \eta_j + v_i \quad (5.5)$$

### 5.3.2 Production function estimation

The main outcome in this research is related to the firms' productivity. One of the most widely used techniques to estimate the production function is the "proxy variable" approach pioneered by Olley and Pakes (1996) and then augmented by Levinsohn and Petrin (2003) (hereafter OP, LP). The common feature of these two approaches is that the unobserved productivity shock can be controlled for by conditioning on a non-parametric representation of an inverse demand function. While OP use the inverse investment demand function, LP invert the intermediate input function to control for unobserved productivity shock. In both approaches, the inverted demand functions are unconditional on the labour input, that is criticized by Akerberg, Caves, and Frazer (2015). The authors, augmenting the OP and LP methodologies, use the conditional demand function to produce consistent estimates in more general cases<sup>3</sup>. On the identification of production function, one could rely on three alternative technologies: gross output, restricted profit value-added and structural value-added production functions, that depends on how intermediate inputs are introduced in the model Gandhi, Navarro, and Rivers (2018)<sup>4</sup>. Since the gross output production functions are not suggested in the ACF methodology, we use the structural

<sup>3</sup>This approach allows unobserved, autocorrelated, firm-specific shocks to the price of labour; firm chooses other variable inputs after labour; dynamic labour; unobserved firm-specific adjustment costs of labour.

<sup>4</sup>The intermediate inputs are introduced in the gross output production function, while removed from the profit value-added specification. The structural value-added technology is the gross output production function that is Leontief in the intermediate inputs.

value-added production function in the main analysis <sup>5</sup>. This approach is based on the assumptions that intermediate inputs are perfect complement to the combination of labour and capital (*i.e.*, Leontief). So, the production function for each industry is specified as follows.

$$z_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \epsilon_{it} \quad (5.6)$$

where  $z_{it}$  is firm sales,  $l_{it}$ ,  $k_{it}$  denotes labour, capital,  $\omega_{it}$  is productivity. All variables are taken in natural logarithm.

We start with the insight of Levinsohn and Petrin (2003) by relying on intermediate input demand to proxy for productivity:

$$m_{it} = m_t(k_{it}, \omega_{it}) \quad (5.7)$$

where  $m_{it}$  is intermediate input. The firm's intermediate input demand must be strictly increasing in productivity  $\omega_{it}$  for all relevant  $k_{it}$  in order to be considered as an applicable proxy. Conditional on capital, more productive firms while trying to maximize profit will use more intermediate input. Note that the input demand function under LP approach is unconditional on  $l_{it}$ . However, it is natural that  $m_{it}$  can be chosen after  $l_{it}$ . Based on this insight, to control for unobserved productivity, one can use an input demand function conditional on  $l_{it}$  by introducing  $l_{it}$  in the right-hand side of Equation 5.7 (Akerberg et al., 2015). In the case that  $m_{it}$  and  $l_{it}$  are chosen at the same time, this conditional input demand function can also qualify as in LP's less conditional input demand function <sup>6</sup>. Besides, we can use further variables which possibly influence the differences in input demand choices of firms as suggested by De Loecker and Warzynski (2012). The inclusion of these variables depends on the application but will certainly catch the variables resulting in differences in optimal input demand across firms. In our research, we include export dummies, which influence a firm's residual demand and therefore determine the firm's optimal input demand.

The intermediate input demand becomes:

$$m_{it} = m_t(k_{it}, l_{it}, \omega_{it}, e_{it}) \quad (5.8)$$

where  $e_{it}$  is export dummy, which equals to 1 if firm  $i$  exports in time  $t$  and 0 otherwise.

Since the input demand function is monotonic in  $\omega_{it}$ , we can invert function 5.8 to proxy for productivity <sup>7</sup>, *i.e.*,

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<sup>5</sup>The profit value-added are used for robustness check. In this case,  $z_{it}$  indicates firm value-added.

<sup>6</sup>We assume that the input and output prices are the same across firms.

<sup>7</sup>LP's approach allows us to introduce additional variables without revisiting whether the invertibility is preserved, see De Loecker (2011).

$$\omega_{it} = m_t^{-1}(m_{it}, k_{it}, l_{it}, e_{it}) = h_t(m_{it}, k_{it}, l_{it}, e_{it}) \quad (5.9)$$

The production function becomes:

$$\begin{aligned} z_{it} &= \beta_0 + \beta_l l_{it} + \beta_k k_{it} + h_t(m_{it}, k_{it}, l_{it}, e_{it}) + \epsilon_{it} \\ &= \phi_t(l_{it}, k_{it}, m_{it}, e_{it}) + \epsilon_{it} \end{aligned} \quad (5.10)$$

Then, we use the two-step approach proposed by Akerberg et al. (2015) to estimate the consistent parameters of production function. The conditional input demand function distinguishes this approach from that of LP. Instead of identifying the coefficient of labour input in the first stage, all coefficients will be estimated in the second stage. In the first stage, we estimate the model:

$$z_{it} = \phi_t(l_{it}, k_{it}, m_{it}, e_{it}) + \epsilon_{it} \quad (5.11)$$

where  $\phi_t(l_{it}, k_{it}, m_{it}, e_{it})$  can be approximated by a polynomial of  $l_{it}, k_{it}, m_{it}$ . We then obtain estimates of expected output,  $\hat{\phi}_t$ , and the residuals  $\hat{\epsilon}_{it}$ .

In the second stage, we rely on the law of motion of productivity, that means the AR(1) process, to get consistent coefficients. The function of productivity is then:

$$\omega_{it} = g_t(\omega_{it-1}) + \xi_{it} \quad (5.12)$$

From the first stage, with each value of  $\beta$ , where  $\beta = (\beta_0, \beta_l, \beta_k)$ , we can calculate the productivity:

$$\omega_{it}(\beta) = \hat{\phi}_t - \beta_0 - \beta_l l_{it} - \beta_k k_{it} \quad (5.13)$$

By applying a nonparametrical regression of  $\omega_{it}(\beta)$  on its lags,  $\omega_{it-1}(\beta)$ , we obtain the estimates of idiosyncratic shock to productivity given  $\beta$ ,  $\hat{\xi}_{it}(\beta)$ . For labour to have dynamic implications, firms can choose  $l_{it}$  at period  $t$ , or  $t - 1$  or at some point in-between. Therefore, to obtain estimates of production function, we base on the moment conditions as follow:

$$E \left( \hat{\xi}_{it}(\beta) \begin{pmatrix} 1 \\ l_{it-1} \\ l_{it} \\ k_{it} \end{pmatrix} \right) = 0 \quad (5.14)$$

For the estimation of the production function, we apply standard GMM techniques, and for the standard errors, we use on block bootstrapping. In this specification of production function, the output elasticity of labour,  $\theta_{it}^L$ , is simply  $\hat{\beta}_l$ .

## 5.4 Data

### 5.4.1 Source

At the micro-level, we rely on a comprehensive dataset covering all registered firms in Vietnamese manufacturing over the period 2000-2015. The data are taken from the Vietnamese Enterprise Survey and collected annually by the General Statistics Office of Vietnam (GSO). The unit of observation in the survey is an establishment (or a plant). In this research, we choose to refer to this unit of observation as a firm. For data cleaning process, we consider only firms with number of employees not less than 10 and drop out re-entry firms. So, we obtained the dataset with information on more than 5000 firms and it is an unbalanced panel, *i.e.*, we also observe the information on firms dynamics (entry and exit). Since the difference-in-differences methodology is based on firms operating in three years, 2000, 2004 and 2015, the sample is restricted in about 900 continuing firms<sup>8</sup>. We can extract from the data relevant firm-level information, including firms' sales, number of employees, wages, capital, and other variables<sup>9</sup>. All monetary variables are deflated by the producer price index of two-digit industrial products<sup>10</sup>. Moreover, the dataset provides information on the ownership of a firm and on its trade status. This information is crucial in the context of an Asian emerging country which uses exports to boost economic growth, such as Vietnam. Unfortunately, the firms' export and import status are not recorded in some years. Therefore, defining trading firms is based on other information such as firm export/ import tax incurred in the operating years. Even so, the firm trade status is well defined in a limited number of years (2000, 2002-2004, 2010-2015). However, this does not have much influence on this research since the econometric methodology relies on the information on trade status in just 2000, 2004 and 2015.

For macro-level data, we use the data on the VND real effective exchange rate (REER) from Bruegel. The dataset provides the annual and monthly consumer price index (CPI)-based REER of VND with 172 trading partners from 1992. Moreover, we consider the change in most-favoured-nation (MFN) tariff rate at two-digit industry-level as proxy for the effect of trade liberalization. This data is collected from the World Integrate Trade Solution (WITS) developed by World Bank and available in 2001-2015<sup>11</sup>.

### 5.4.2 Descriptive statistics

Table 5.1 provides the price elasticities of input for manufacturing industries at two-digit level. It is obvious that price elasticities of labour are higher than that of capital, and this indicates that Vietnamese

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<sup>8</sup>We use the unbalanced panel instead to estimate the production function.

<sup>9</sup>Since we cannot observe intermediate inputs, we calculate it as:  $\text{Intermediate input}_{it} = \text{Sales}_{it} - \text{Wages}_{it} - \text{Depreciation}_{it} - \text{Pre-tax Profit}_{it}$

<sup>10</sup>Throughout the period studied, there are two different industrial classification, the Vietnam Standard Industrial Classification (VSIC) 1993 and that 2007. We choose VSIC 1993 as classification and convert VSIC 2007 to that 1993.

<sup>11</sup>The data in 2011 is interpolated by using that in 2010 and 2012.

Table 5.1: Industry output elasticities of inputs

VSIC 1993	Industry name	L	K	RS
15	Food products and beverage	0.865	0.345	1.210
16	Tobacco products	0.736	0.291	1.026
17	Textiles	0.592	0.366	0.958
18	Wearing products	0.720	0.172	0.892
19	Leather products	0.639	0.210	0.849
20	Wood and cork manufacturing	0.786	0.311	1.097
21	Paper products	0.829	0.198	1.027
22	Publishing, printing, recording media	0.788	0.207	0.996
23	Manufacture of coke, refined petroleum products and nuclear fuel	0.605	0.475	1.080
24	Chemical manufacturing	0.877	0.268	1.145
25	Rubber and plastics products	0.773	0.237	1.010
26	Other non-metallic mineral products	0.825	0.334	1.159
27	Basic metals manufacturing	0.828	0.271	1.099
28	Fabricated metal products, except machinery and equipment	0.807	0.232	1.038
29	Machinery and equipment	0.849	0.165	1.014
30	Office, accounting and computing machinery	0.775	0.185	0.960
31	Electrical machinery and apparatus	0.731	0.249	0.980
32	Radio, television and communication equipment	0.760	0.309	1.069
33	Medical, precision and optical instruments, watches and clocks	0.767	0.203	0.970
34	Motor vehicles, trailers and semi-trailers	0.869	0.279	1.148
35	Other transport equipment	0.892	0.225	1.117
36	Furniture	0.789	0.203	0.992

manufacturing industries are mainly labour-intensive. In term of productivity, the firm-level productivity is calculated as <sup>12</sup>:

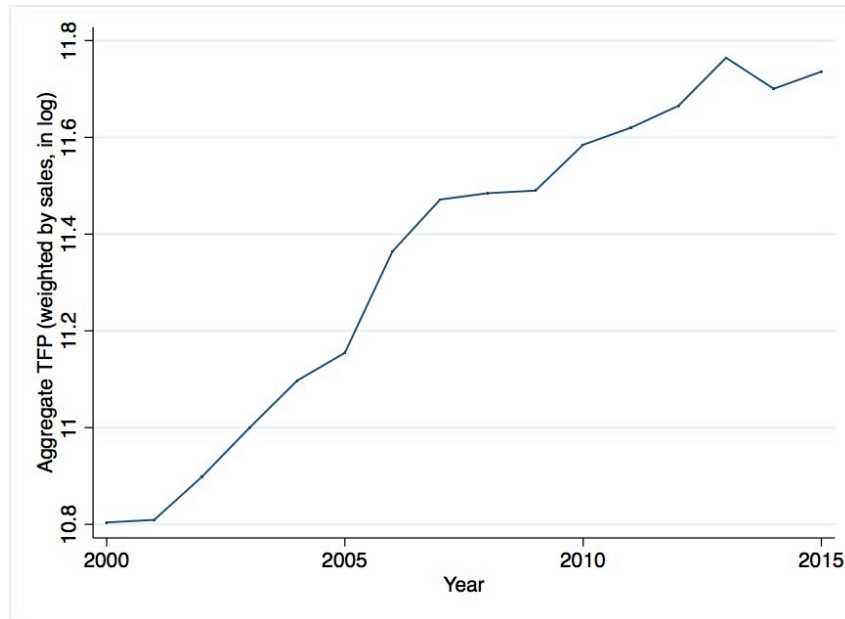
$$tfp_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it} \quad (5.15)$$

The aggregate productivity is computed as the sales-weighted average of firm productivity  $tfp_{it}$ . Figure 5.2 shows the evolution of aggregate TFP overtime. When considering all firms in the manufacturing sector, the (weighted) aggregate TFP increases significantly with the annual growth rate of 6% approximately (Figure 5.2). Interestingly, dividing the sample into two groups of firms according to their trade status  $D_i^{trade}$ , the patterns of TFP evolutions between the treatment ( $D_i^{trade}=1$ ) and control ( $D_i^{trade}=0$ ) group seem to be different after the RER-shock in 2004 (Figure 5.2b). In the later years of this period, the aggregate TFP of the treatment group increases consistently while it fluctuates for control group. However, in the absence of real appreciation shock (i.e, before 2004), these two groups share the same pattern of TFP evolution. This figure supports the crucial assumption of parallel trends for difference-in-differences approach <sup>13</sup>. That means, the difference-in-differences estimator is consistent only when the outcome treatment and control group have similar evolution in the absence of intervention (in this case, the real appreciation shock in VND).

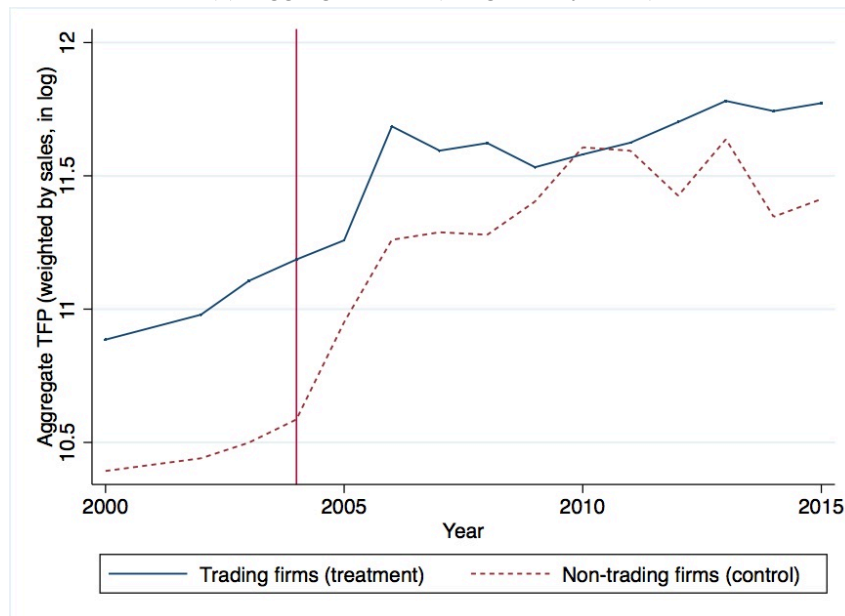
Since we could observe the entry and exit firms through the data, it is worth investigating the

<sup>12</sup>All variables are taken in log.

<sup>13</sup>In the Figure 5.2b, we drop out the year 2001 due to no information on import status. Nevertheless, as mentioned above, it does not impact on the difference-in-differences estimators. For further check on the parallel trends assumptions, we perform the placebo test later.



(a) Aggregate TFP (weighted by sales)



(b) Aggregate TFP (weighted by sales) by trade status

Figure 5.2: Aggregate productivity evolution

contribution of firm dynamics to the aggregate productivity growth to get a better understanding of the sector's reaction in terms of the intensive and extensive margin in response to the real appreciation. To do so, we follow the methodology of productivity decomposition suggested by Melitz and Polanec (2015)<sup>14</sup>, the results are recorded in Table 5.2. Although the number of entrants is large, the aggregate productivity growth is contributed mostly by continuing firms. In this line, as in the study of Ekholm et al. (2012), we restrict this main research to firms that survive throughout the period 2000-2015. However, we will discuss more on firm dynamics in Section 5.5.

<sup>14</sup>see Appendix 5.7 for further details on methodology.

Table 5.2: Productivity decomposition

$t_1$	$t_2$	Survivors	Entrants	Exiters	TFP growth
2000	2004	0.289	-0.0015	0.0059	0.293
<i>Number of firms</i>		2 154	7 076	3 091	
2004	2015	0.670	-0.107	0.076	0.639
<i>Number of firms</i>		2 705	20 884	6 525	

Table 5.3: RER shock on firm productivity

Variables	Dependent variable: Change in productivity growth			
	(1)	(2)	(3)	(4)
$D_{i0}^{trade} (\Delta rer_1 - \Delta rer_0)$	0.721*** (0.206)	0.929*** (0.235)	0.920*** (0.236)	1.190*** (0.267)
$l_{i0}$		0.026*** (0.007)	0.025*** (0.007)	0.027*** (0.008)
$k_{i0}$		-0.024*** (0.005)	-0.023*** (0.005)	-0.025*** (0.006)
$H_{j0}$			-0.074 (0.175)	-14.420*** (4.063)
Constant	-0.058*** (0.012)	0.223*** (0.072)	0.222*** (0.072)	0.497*** (0.110)
Observations	892	892	892	892
R-squared	0.014	0.039	0.039	0.067
Industry fixed effect	No	No	No	Yes

Note: Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## 5.5 Results

Table 5.3 represents the estimation results of model 5.5. The coefficient of interest,  $\gamma$ , is statistically significant in all cases (including or not firm and industry controls). Therefore, there is evidence that real appreciation policy affects firm productivity growth. Moreover, the positive sign of coefficient  $\gamma$  implies that the "large and persistent" real appreciation increases productivity growth of manufacturing firms. These results coincide with previous studies of Ekholm et al. (2012) and B.-Y. Choi and Pyun (2018).

The difference-in-differences methodology is performed under the assumption of parallel trends, that means, firms in the treatment group ( $D_i^{trade} = 1$ ) and the control group ( $D_i^{trade} = 0$ ) share the same pattern of outcome (productivity growth) in the absence of RER shock, *i.e.*, before 2004. In other words, the difference-in-differences estimator is consistent only if this assumption holds. Therefore, it is necessary to conduct some falsification tests to examine the consistency of coefficient  $\gamma$ .

Firstly, one could be concerned that the increase in productivity growth might occur before the

Table 5.4: RER shock on firm productivity in pre-RER shock period

Variables	Dependent variable: Change in productivity growth			
	(1)	(2)	(3)	(4)
$D_{i0}^{trade} (\Delta rer_1 - \Delta rer_0)$	0.899 (1.671)	1.299 (1.990)	1.331 (1.995)	2.988 (2.129)
$l_{i0}$		0.031** (0.014)	0.032** (0.014)	0.042*** (0.016)
$k_{i0}$		-0.027*** (0.010)	-0.028*** (0.010)	-0.034*** (0.011)
$H_{j0}$			0.088 (0.356)	-12.250 (7.689)
Constant	0.005 (0.020)	0.319** (0.132)	0.319** (0.132)	0.656*** (0.211)
Observations	2,152	2,152	2,152	2,152
R-squared	0.000	0.004	0.004	0.027
Industry fixed effect	No	No	No	Yes

Note: In this case, we consider the period 2000-2004, the base year is 2004, the treatment is assumed to be occurred in 2002. Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

RER shock. To deal with this problem, we consider the period before 2004, such as 2000-2004, and 2002 as a "placebo" year of currency policy, then we re-estimate Equation 5.5. If the coefficient of interest is statistically significant in this case, the real appreciation policy is not a reason to boost firm productivity, the estimator in Table 5.3 become inconsistent. As shown in Table 5.4, since the coefficient in this placebo test is statistically insignificant, the effect of currency shock on firm productivity growth is valid.

Secondly, another issue in this research is that the increase in firm-level productivity growth might be due to another policy, not to the real appreciation one since there are various economic events that occurs during the 2000s, such as WTO accession in 2007 and the global financial crisis in 2008 (We will discuss more about controlling these events later). To deal with this problem, we choose another similar period which does not cover the events, *i.e.*, 2010-2015, and considered 2011 as the year of intervention. Indeed, as shown in Figure 5.1, VND slightly depreciated two years before 2011 and turned to appreciate again from 2011. We also observe a similar TFP pattern for the treatment and control groups during 2010-2011, the TFP evolution diverged after 2011 (Figure 5.2b). Because of the similar periods, the difference-in-differences estimator is expected to be the same as in Table 5.3. Obviously, according to Table 5.5, the positive and statistical significance of the coefficient  $\gamma$  support the main finding.

The third way to examine the methodological consistency is by choosing another group of firms that might be influenced by the RER shock. If real appreciation increases firm productivity in the new treatment group, the estimator is consistent. To do so, we replace the trade status dummy by an export and import one at base year 2000. The results are recorded in Table 5.6. By distinguishing firms according



Table 5.5: RER shock on firm productivity in RER shock period

Variables	Dependent variable: Change in productivity growth			
	(1)	(2)	(3)	(4)
$D_{i0}^{trade} (\Delta r_{er1} - \Delta r_{er0})$	0.838*** (0.182)	0.782*** (0.219)	0.789*** (0.219)	0.882*** (0.228)
$l_{i0}$		0.017** (0.007)	0.017** (0.007)	0.023*** (0.008)
$k_{i0}$		-0.011** (0.005)	-0.010** (0.005)	-0.012** (0.005)
$H_{j0}$			-0.165 (0.158)	-15.382** (7.601)
Constant	-0.146*** (0.009)	-0.036 (0.069)	-0.038 (0.069)	0.111 (0.096)
Observations	8,424	8,424	8,424	8,424
R-squared	0.003	0.003	0.003	0.011
Industry fixed effect	No	No	No	Yes

Note: In this case, we consider the period 2010-2015, the base year is 2010, the treatment is assumed to be occurred in 2011. Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

to their export and import status, we obtain positive and statistically significant difference-in-differences estimators, that means, the positive effect of real appreciation on firm productivity is confirmed.

Table 5.6: RER shock on firm productivity with export/ import status

Variables	Dependent variable: Change in productivity growth							
	Export status				Import status			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$D_{i0}^{export} (\Delta r_{er1} - \Delta r_{er0})$	0.919*** (0.200)	1.047*** (0.226)	1.045*** (0.228)	1.261*** (0.258)				
$D_{i0}^{import} (\Delta r_{er1} - \Delta r_{er0})$					0.303 (0.203)	0.578** (0.237)	0.582** (0.237)	0.865*** (0.258)
$l_{i0}$		0.022*** (0.007)	0.022*** (0.007)	0.025*** (0.008)		0.030*** (0.007)	0.029*** (0.007)	0.031*** (0.008)
$k_{i0}$		-0.022*** (0.005)	-0.022*** (0.005)	-0.024*** (0.005)		-0.024*** (0.005)	-0.023*** (0.005)	-0.025*** (0.006)
$H_{j0}$			-0.014	-14.693***			-0.144	-13.407***
Constant	-0.062*** (0.010)	0.213*** (0.070)	0.213*** (0.070)	0.488*** (0.108)	-0.036*** (0.010)	0.219*** (0.076)	0.219*** (0.076)	0.490*** (0.114)
Observations	892	892	892	892	892	892	892	892
R-squared	0.023	0.045	0.045	0.071	0.003	0.028	0.029	0.057
Industry fixed effect	No	No	Yes	Yes	No	No	No	Yes

Note: Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

For a further robustness check, we also use alternative production function specification to estimate the change in firm productivity growth. Besides the gross output production function that is Leontief in intermediate inputs, Akerberg et al. (2015)'s methodology could be applied to the profit value-added

specification which rules out intermediate inputs. According to Table 5.7, the positive effect of real appreciation on firm productivity growth is consistent.

Table 5.7: RER shock on firm productivity. Alternative production function estimation.

Variables	Dependent variable: Change in productivity growth			
	(1)	(2)	(3)	(4)
$D_{i0}^{trade} (\Delta r_{er1} - \Delta r_{er0})$	0.680*** (0.222)	0.674*** (0.253)	0.671*** (0.254)	0.796*** (0.289)
$l_{i0}$		0.038*** (0.008)	0.037*** (0.008)	0.042*** (0.009)
$k_{i0}$		-0.023*** (0.005)	-0.023*** (0.006)	-0.025*** (0.006)
$H_{j0}$			-0.019 (0.188)	-9.671** (4.390)
Constant	-0.030** (0.012)	0.193** (0.077)	0.193** (0.077)	0.365*** (0.119)
Observations	892	892	892	892
R-squared	0.010	0.040	0.040	0.063
Industry fixed effect	No	No	No	Yes

Note: Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The main objective of this chapter is exploring the effect of real exchange rate on firm productivity. However, it is worth discussing further the mechanism of this effect. Some recent studies show that R&D might be the channel through which the real exchange rate affects firm productivity Alfaro et al. (2018); B.-Y. Choi and Pyun (2018). In Table 5.8, we point out the evolution of R&D growth rate and the share of R&D expenditure in some important years. In the pre-RER shock, R&D expenditures declined sharply with the average annual growth rate of -12%, but increased then with the rate of 2.71%. This pattern is also recorded for share of R&D expenditure. Moreover, together with real appreciation after 2004, share of R&D expenditure increases considerably from 0.16% in 2004 to 10.55% in 2011. Although the dataset does not allow an investigation of the transmission mechanism in a more structural way, the similar change in R&D expenditure and VND currency after 2004 implicitly reflects the fact that real appreciation might boost firm productivity through R&D.

## 5.6 Discussion

### 5.6.1 Selection

The econometric strategy is applied for firms that operated throughout the period 2000-2015, so those which entered and exited during the sample period are dropped. Although continuing firms contribute mostly in aggregate productivity growth, they may respond differently to shock than those exiting.

Table 5.8: R&amp;D expenditure in Vietnamese manufacturing

(a) R&amp;D expenditure annual growth before and after RER shock in 2004

	Pre-RER shock 2000-2004	RER shock 2004-2011
Annual growth rate	-12%	2.71%

Source: GSO and authors' calculations.

(b) Share of R&amp;D expenditures (in percentage)

	Year		
	2000	2004	2011
Share of R&D expenditures	1.93	0.16	10.55

Source: GSO and authors' calculations.

This could potentially bias the results.

To deal with this problem, we use the two-step Heckman (1979) procedure for sample selection bias. We re-run Equation 5.5 with the Heckman selection equation where the dependent variable is dummy  $S_i$  taking the value 1 if firms are present from the beginning to the end of the sample.  $S_i$  equals to 0 if firms were present in 2000 but exited before 2015. Independent variables of the selection equation are firms' labour and capital (in log) at the base year 2000. The Heckman procedure provides the test on whether  $\rho$  (correlation between the errors in main equation and selection one) equals to 0. That means, if the null hypothesis that  $\rho = 0$  is rejected, the simple OLS for Equation 5.5 may face the selection bias, and it is necessary to account for the Heckman procedure. As shown in Table 5.9, the DID estimators are still statistically significant and positive, confirming the positive impact of RER shock on firm productivity. Moreover, the null hypothesis that  $\rho = 0$  is not rejected in all cases (with or without firm and industry controls), so the selection bias is not a problem and the simple OLS approach is appropriate to estimate Equation 5.5.

## 5.6.2 WTO accession and business condition controls

One issue for examining the effect of RER shock during 2000-2015 is that this period covers the WTO accession of Vietnam in 2007. Since several studies support the positive effect of trade liberalization on firm productivity, one could be concerned about the endogeneity that may bias the estimation. In fact, a large literature supports the positive effect of trade liberalization on firm productivity. To address this problem, we control for industry-specific shocks by introducing industry  $j$ 's average tariff changes in pre- and post-RER shock period,  $\delta T_{j,s}$ , more precisely:

Table 5.9: Selection bias

Variables	Dependent variable: Change in productivity growth			
	(1)	(2)	(3)	(4)
$D_{i0}^{trade} (\Delta rer_1 - \Delta rer_0)$	0.893** (0.409)	0.929** (0.391)	0.920** (0.379)	1.190*** (0.420)
$l_{i0}$		0.026*** (0.006)	0.025*** (0.006)	0.027*** (0.007)
$k_{i0}$		-0.024*** (0.007)	-0.023*** (0.006)	-0.025*** (0.007)
$H_{j0}$			-0.074 (0.198)	-14.420*** (1.022)
Constant	-0.106** (0.050)	0.218** (0.111)	0.217** (0.110)	0.498*** (0.121)
$\rho$	0.143 (0.215)	0.006 (0.326)	0.005 (0.317)	-0.001 (0.311)
Observations	5,209	5,209	5,209	5,209
Industry fixed-effect	No	No	No	Yes

Note: Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

$$\begin{aligned} \Delta T_{j1} &\equiv (Tari f f_{j2015} - Tari f f_{j2004}) / (2015 - 2004) \\ \Delta T_{j0} &\equiv (Tari f f_{j2004} - Tari f f_{j2000}) / (2004 - 2000) \end{aligned} \quad (5.16)$$

We also examine the effect of RER shock on firms' outcome in a similar period after WTO accession of Vietnam for robustness check. To do so, we choose the period 2010-2015, where the currency slightly depreciates during 2009-2011 and then sharply appreciate from 2011<sup>15</sup>.

Another event that occur in the period studied is the global financial crisis (GLC) in 2008. To accounting for the GLC, we follow Trefler (2004) by including a regressor  $\Delta b_{js}$  that captures how movements in GDP affect industry  $j$ . For each industry  $j$ , we regress industry productivity growth  $\Delta t f p_{jt}$  on the GDP growth  $\Delta g d p_t$ , where  $\Delta t f p_{jt} = t f p_{jt} - t f p_{j,t-1}$ ,  $\Delta g d p_t = g d p_{jt} - g d p_{t-1}$ . This is a time-series regression and we obtain then the prediction  $\Delta t \hat{f} p_{jt}$  for each industry  $j$ . This represents the effect of business condition on industry productivity growth.

Adding  $\Delta T_{js}$  and  $\Delta b_{js}$  into Equation 5.3 yields

$$\Delta y_{is} = \alpha_i + \theta_s + \beta D_{i0} \Delta r e r_s + \gamma_1 \Delta T_{js} + \gamma_2 \Delta b_{js} + \epsilon_{is} \quad (5.17)$$

Differencing Equation 5.17 and including control variables at base year, we obtain the difference-

<sup>15</sup>We choose 2010 as base year instead of 2009 because firms' export status is well defined in 2010. In this case, the base year is 2010.

Table 5.10: Control for the WTO accession of Vietnam and the Global financial crisis

Variables	Dependent variable: Change in productivity growth					
	(1)	(2)	(3)	(4)	(5)	(6)
$D_{i0}^{trade} (\Delta r_{er1} - \Delta r_{er0})$	0.918*** (0.236)	1.190*** (0.267)	0.900*** (0.238)	1.190*** (0.267)	0.904*** (0.238)	1.190*** (0.267)
$l_{i0}$	0.024*** (0.007)	0.027*** (0.008)	0.026*** (0.007)	0.027*** (0.008)	0.024*** (0.007)	0.027*** (0.008)
$k_{i0}$	-0.023*** (0.005)	-0.025*** (0.006)	-0.023*** (0.005)	-0.025*** (0.006)	-0.023*** (0.005)	-0.025*** (0.006)
$H_{j0}$	0.059 (0.195)	-0.430 (0.644)	-0.060 (0.176)	-1.040 (0.653)	0.062 (0.195)	4.178* (2.410)
$(\Delta T_{j1} - \Delta T_{j0})$	-0.016 (0.010)	-0.123*** (0.036)			-0.015 (0.011)	-1.050* (0.600)
$(\Delta b_{j1} - \Delta b_{j0})$			-0.031 (0.044)	-0.402*** (0.117)	-0.021 (0.044)	3.036 (1.921)
Constant	0.202*** (0.073)	0.100 (0.083)	0.218*** (0.072)	0.260*** (0.076)	0.200*** (0.073)	-1.108 (0.770)
Observations	892	892	892	892	892	892
R-squared	0.041	0.067	0.039	0.067	0.042	0.067
Industry fixed effect	No	Yes	No	Yes	No	Yes

Note: Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

in-differences specification as following:

$$\begin{aligned} \Delta y_{i1} - \Delta y_{i0} = & \theta + \gamma D_{i0}^{trade} (\Delta r_{er1} - \Delta r_{er0}) + \\ & + \gamma_1 (\Delta T_{j1} - \Delta T_{j0}) + \gamma_2 (\Delta b_{j1} - \Delta b_{j0}) + \phi x_{i0} + \eta_j + v_i \end{aligned} \quad (5.18)$$

Table 5.10 records the estimation results of model 5.18. By according for the WTO accession of Vietnam and the GFC, DD coefficient.  $\gamma$ , is still positive and statistically significant. That confirms the finding that a persistent real appreciation increases firm productivity.

### 5.6.3 Heterogeneous treatment effect

In order to figure out the heterogeneous effect of real appreciation on firms according to their size, we introduce in model 5.5 the dummy variable  $L_{i0}$  which equals 1 for large firms at base year, 0 otherwise. To differentiate firms according to their size, we follow the classification criteria in the Vietnamese regulation<sup>16</sup> by defining the large firms as ones with a number of employees higher than 200 or total sales more than 200 billion dong. We obtain then the triple-differences model as following:

$$\begin{aligned} \Delta y_{i1} - \Delta y_{i0} = & \theta + \delta_0 D_{i0}^{trade} (\Delta r_{er1} - \Delta r_{er0}) + \delta_1 D_{i0}^{trade} L_{i0} (\Delta r_{er1} - \Delta r_{er0}) + \\ & + \phi x_{i0} + v_i \end{aligned} \quad (5.19)$$

<sup>16</sup>The Decree No. 39/2018/ND-CP provided in 11/03/2018 by the Vietnamese government.

Table 5.11: Productivity growth (in percentage) and firm size.

Exposed	Size	Number of firms	$\Delta y_{i0}$	$\Delta y_{i1}$	$\Delta y_{i1} - \Delta y_{i0}$
No	Small and medium	270	0.542	4.011	3.469
No	Large	75	8.902	3.856	-5.046
Yes	Small and medium	231	-2.727	3.269	5.996
Yes	Large	316	3.447	4.498	1.052

Source: GSO and authors' calculations.

The coefficient of interest,  $\gamma_1$ , refers to the difference in the impact of RER shock on large firms and SMEs in the treatment group. The same methodology is applied to investigate the heterogeneous treatment effect on firm productivity according to their ownership status (state-owned enterprise (SOE) or non-SOE; foreign direct investment (FDI) firms or non-FDI firms)<sup>17</sup>. Tables 5.11 to 5.13 show the change in different groups of firms' productivity growth (weighted by sales) before and after the currency treatment in 2004. Recall that we consider continuing firms throughout the period 2000-2015, only this group of firms has information in three years 2000, 2004 and 2015. There are some points from these tables: (i) the currency-exposed firms (treatment group) experience a faster annual productivity growth in RER shock period (after 2004) than in the pre-RER shock period, represented by the fact that  $\Delta y_{i1} > \Delta y_{i0}$ ; (ii) within the trading firms, small and medium firms have larger change in annual productivity growth before and after the real appreciation in VND than large firms, the change in annual productivity growth in SOEs (or FDI firms) is less remarkable than non-SOEs (or non-FDI firms, respectively).

Table 5.12: Productivity growth (in percentage) and state-owned enterprise.

Exposed	SOE	Number of firms	$\Delta y_{i0}$	$\Delta y_{i1}$	$\Delta y_{i1} - \Delta y_{i0}$
No	No	229	2.235	4.248	1.853
No	Yes	116	8.261	3.761	-4.500
Yes	No	433	-2.483	4.351	1.867
Yes	Yes	114	3.026	4.323	1.297

Source: GSO and authors' calculations.

Table 5.13: Productivity growth (in percentage) and foreign-owned enterprise.

Exposed	FDI	Number of firms	$\Delta y_{i0}$	$\Delta y_{i1}$	$\Delta y_{i1} - \Delta y_{i0}$
No	No	337	5.704	3.842	-1.862
No	Yes	8	2.943	5.346	-2.408
Yes	No	312	1.433	4.350	2.917
Yes	Yes	235	3.637	4.335	0.698

Source: GSO and authors' calculations.

Table 5.14 represents the heterogeneous treatment effect in regressing Equation 5.19. Unfortunately, there is no evidence on the heterogeneous effect of real appreciation on firms according to their

<sup>17</sup>We rely on firm size and status at the base year to differentiate firms into different groups.

ownership status. Meanwhile, the positive effect of a sharp and persistent RER shock on productivity seems to be higher for SMEs than for large firms, although the coefficient  $\delta_1$  is less significant.

Table 5.14: Productivity growth (in percentage) and foreign-owned enterprise.

Variables	Dependent variable: Change in productivity growth		
	Size (1)	SOE (2)	FDI (3)
$D_{i0}^{trade} L_{i0} (\Delta rer_1 - \Delta rer_0)$	-0.661* (0.347)		
$D_{i0}^{trade} soe_{i0} (\Delta rer_1 - \Delta rer_0)$		-0.440 (0.346)	
$D_{i0}^{trade} fdi_{i0} (\Delta rer_1 - \Delta rer_0)$			-0.078 (0.295)
$D_{i0}^{trade} (\Delta rer_1 - \Delta rer_0)$	1.410*** (0.291)	1.268*** (0.274)	1.215*** (0.284)
Constant	0.477*** (0.110)	0.518*** (0.111)	0.486*** (0.118)
Observations	892	892	892
R-squared	0.070	0.068	0.067
Firm controls	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes

Note: Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## 5.7 Conclusion

This research contributes to previous studies about the impact of real exchange rate on firms productivity, especially in the long-run. With regard to a long and sharp movement of real exchange rate in the Vietnamese dong after 2004, we use the difference-in-differences approach and find the positive effect of real appreciation on firm productivity. Even accounting for the WTO accession in 2007 and the financial crisis in 2008, the results are still robust. Moreover, we find that the impact of real appreciation is different between large firms and SMEs: the effect is greater for small and medium firms than for large ones. There is, however, no heterogeneous effect on firm productivity in term of their ownerships. Although this research mainly figures out the effect of real appreciation on firm productivity, we also observe an increase in R&D investment during this period. This suggests that innovation investment might be a channel through which real appreciation boosts firm productivity. However, a systematic research would be necessary to clarify the possible channels.

# Appendix

## Productivity decomposition

The aggregate productivity at time  $t$ ,  $\Phi_t$  is defined as a share-weighted average of firm productivity  $\varphi_{it}$ :

$$\Phi_t = \sum_i w_{it} \varphi_{it} \quad (5.20)$$

where  $w_{it}$  is sales share of firm ( $\sum_i w_{it} = 1$ ). The variable of interest is the change in productivity from  $t = 1$  to 2, that means,  $\Delta\Phi = \Phi_2 - \Phi_1$ . Surviving firms involve firms which are present in both  $t = 1$  and  $t = 2$ , exiting firms designate firms which are present in  $t = 1$  but not in  $t = 2$ , entering firms are firms being present only in  $t = 2$ .

To decompose aggregate productivity growth,  $\Delta\Phi$ , into contribution of three groups of firms (survivors, entrants and exiters), Melitz and Polanec (2015) define  $w_{Gt} = \sum_{i \in G} w_{it}$  as market share of a group  $G$  and  $\Phi_{Gt} = \sum_{i \in G} (w_{it}/w_{Gt}) \varphi_{it}$  as group  $G$ 's (weighted) average productivity. For each period, aggregate productivity is calculated from (weighted) average productivity of survivors ( $S$ ), entrants ( $E$ ) and exiters ( $X$ ):

$$\begin{aligned} \Phi_1 &= w_{S1}\Phi_{S1} + w_{X1}\Phi_{X1} = \Phi_{S1} + w_{X1}(\Phi_{X1} - \Phi_{S1}) \\ \Phi_2 &= w_{S2}\Phi_{S2} + w_{E2}\Phi_{E2} = \Phi_{S2} + w_{E2}(\Phi_{E2} - \Phi_{S2}) \end{aligned} \quad (5.21)$$

The productivity change is then decomposed as follows:

$$\Delta\Phi = (\Phi_{S2} - \Phi_{S1}) + w_{E2}(\Phi_{E2} - \Phi_{S2}) + w_{X1}(\Phi_{S1} - \Phi_{X1}) \quad (5.22)$$

Equation 5.22 decomposes the aggregate productivity growth into components for the three groups of firms: survivors, entrants and exiters. Different from other decomposition methods (Foster, Haltiwanger, and Krizan, 2001; Griliches and Regev, 1995), Melitz and Polanec (2015) compare productivity of entrants and exiters to that of survivors in the same period. Therefore, each group contribution can be related to a specific counterfactual scenario: the contribution of surviving firms,  $(\Phi_{S2} - \Phi_{S1})$  is simply



the aggregate productivity that would have been obtained in case of no entry and exit. The contribution of entry,  $w_{E2} (\Phi_{E2} - \Phi_{S2})$ , is the change in aggregate productivity generated by adding or removing the group of entrants. In the same logic, the contribution of exit,  $w_{X1} (\Phi_{S1} - \Phi_{X1})$ , is the change in aggregate productivity generated by adding/removing the group of exiting firms. From this decomposition, entrants positively contribute to productivity growth if (and only if) they have higher productivity  $\Phi_{E2}$  than the remaining (surviving) firms  $\Phi_{S2}$  in the same time period when they enter the market ( $t = 2$ ). Exiters positively contribute to productivity growth if (and only if) they have lower productivity  $\Phi_{X1}$  than the remaining (surviving) firms  $\Phi_{S1}$  in the same time period when they exit ( $t = 1$ ).

# General Conclusion

For a long time, developing countries suffered from the widely held view that, since their products were largely similar (mainly raw materials and basic goods), complementary relationships with other developing countries did not exist. This absence of complementarity, combined with a lack of outlets because of limited markets, was supposedly the reason why they tended to favour trade relations with developed countries. Over the last two decades, however, a "new geography of international trade" has begun to emerge, based on a complementary dynamic between the increased involvement of Southern countries in international trade, on the one hand, and an expansion of South-South trade, on the other.

Moreover, increased trade through deeper integration has been a powerful engine for growth in developing countries. However, when being more integrated into the global economy, they are now more vulnerable to external shocks. In particular, the role of exchange rates in promoting exports and in the macroeconomic adjustment process needs to be carefully re-assessed in a world where GVCs are progressively important (Ahmed et al., 2015).

In this context, we investigate the causal relationship between export diversification and real exchange rate through two scopes. Firstly, in Chapter 2, we explore this link in two models of trade, the traditional North-South trade and the South-South trade. We apply the Granger causality methodology on panel data covering the entire sample of MICs in Asia and Latin America over the period 1995-2013. At the aggregate level, we find a bidirectional causality between export diversification and real exchange rate. However, by considering export diversification across destination (diversification to the North *versus* that to the South), the results diverge. Indeed, while the bidirectional link is confirmed in exports destined to the Northern countries, the analysis for the South shows a unidirectional link from the RER to changes in export diversification. This result allows us to investigate further on individual countries. We find that five countries show a two-way causality in their exports to the North. More interestingly, the role of the RER as a conventional determinant of export diversification dynamics, whatever the destination country, is validated for only three countries. Our remaining countries seem to reveal a heterogeneous causality between export diversification and the RER across destinations. The empirical results on individual countries suggest that a "price-driver-export diversification" prevails in Asian South-South trade. The relevance of heterogeneous causal links between our two variables implies that different policies should be applied to different subgroups of MICs.

Secondly, in Chapter 3, we divide our sample by region and also investigate the effect of financial

crises in 1997 and 2008 on the causal relationship between export diversification and real exchange rate. Using a similar sample of countries as the above chapter but extending the period to 2015, we find that the Asian countries have overcome the impact of financial crises by allowing diversification through GVC participation to become an alternative to devaluation in slowing down real appreciation of the exchange rate. We also show that two financial crises disturbed the link in almost half of the countries in our sample.

Furthermore, the triangular pattern of trade with China in an intermediate role suggests that any effect of change in the Chinese currency (RMB) is passed through third-party suppliers. In this line, we argue that export diversification by trading partners allows China to increase her "resilience" to movements in her exchange rate. In Chapter 4, we use either aggregate or disaggregate level data to conduct two separate analyses to measure the import price elasticity of China and the US for comparison. Under this comparative analysis, we figure out the difference between a traditional North-South pattern of trade, led by the US, and the "new" North-South integration, where China imports goods from the South for its production for exports to the North. Our analysis confirms a robust negative import price elasticity of China and a positive sign in the case of the US, that implies the difference between two models of integration. Moreover, when trading partners are successful in diversifying their export destinations, the import price elasticity of China and the US (in absolute term) becomes very low. In that case, the Marshall-Lerner condition may not be verified. Particularly, in the case of China, a real appreciation can reduce exports and imports as a result of trade diversification, therefore, it is not evident that an initial current surplus will be reduced if the decline in its exports remains lower than the decline in imports.

Inside the most dynamic region, one problem posed to an emerging Asian country is how to improve productivity to expand and diversify exports. A competitive environment is one of the most important things that will boost firm productivity since it forces firms to better allocate their resources. This also affects the decision of entry or exit of firms and as a result, impacts the aggregate productivity. In this line, using a firm-level dataset of the Vietnamese manufacturing sector over 16 years, Chapter 5 argues that together with trade liberalization, a long and sharp real currency appreciation could have a positive impact on firm productivity. Although there was an increase in R&D during this period and it is likely that real appreciation improves firm productivity through R&D, further structural analysis on the mechanism is necessary to better understanding this effect.

In the debate on development, much attention has been given to the role that external trade plays in explaining economic growth. The successful experiences of the Newly Industrializing Countries (NICs) in East and Southeast Asia have notably given credence to the belief in a positive correlation between trade integration and economic performance. Motivated by the above observations, this thesis attempted to explore the causal link between export diversification and the real exchange rate in developing countries. Only interested in the dynamic in the short- and medium-term, we addressed neither exchange rate misalignment nor exchange rate volatility but rather concentrated on the relationship between international trade and real exchange rate. In looking not only at demand-side but also at the supply-side factors, our thesis tries to contribute to a better understanding of the successful integration of the Asian

NICs into the world economy.

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