Global value chains and the missing link between exchange rates and export diversification

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Abstract

Conceptually, the present paper links export diversification and the real exchange rate (RER) by investigating the direction of causation. On one hand, a stable and competitive exchange rate is a key instrument in promoting export diversification through the tradable sectors' profitability. But on the other hand, export diversification can help to reduce macroeconomic volatility, which in turn helps to consolidate a stable and competitive exchange rate. We propose a Granger causality test using panel data of the relationship in the middle-income countries of Asia and Latin America over the period from 1995 to 2015. We augment our baseline specification by examining how FDI (a key vehicle of GVC participation) and financial crises (which expose GVCs to disruptions) affect the causal relationship. Intuitively, the benefits of participation in GVCs may differ across countries, depending on external factors that might influence economic outcomes.

Looking at the whole sample, our study finds a unidirectional positive causality running from export diversification to RER changes when we consider financial crises. However, we observe no causality for the regional sub-samples, meaning that it is global interactions that are the issue here. To go further, we rule out small islands from the Granger causality test. Again, our empirical findings show that the financial crises affect the causation but in contrast to the previous result, we observe the same unidirectional positive causality in the Asian sub-set. Overall, there is clear evidence that during financial crises, export diversification helps to reduce RER fluctuations, corroborating recent development studies that make a case for diversification to build macro resilience.

JEL Codes: F14, F41, 011, O24, O53, 057

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

1. Introduction

For many developing countries, export expansion has become crucial in order to make international integration an efficient instrument for development. Building domestic supply capacity and enhancing international competitiveness while managing integration into the world 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, export diversification has attracted increasing interest in the recent literature (IMF, 2014; Newfarmer et al., 2009). A prominent feature is that diversification, which goes against the benefits of specialization driven by comparative advantage, encompasses a structural transformation and reallocation of the resources that lie behind the path of development and growth. Another argument is that diversification helps developing countries to hedge against price volatility and external shocks. The literature on the "natural resource curse" (*i.e.* a negative relationship between natural resource abundance and growth) has shown that resource-rich countries experience more volatile export revenue, dependency on world prices for their main export commodities, and slower growth (Harding and Venables, 2016).

This has led developing countries to target diversification of their export portfolios, especially in manufactured goods. One way to diversify is to integrate into the world economy though participation in regional or Global Value Chains (GVCs). GVC integration may open up opportunities to engage in global markets through improved market access and give countries greater scope to embrace different activities and hence to increase the number of exported products as well as the number of destinations (Kowalski et al., 2015). Firstly, the evolution of export diversification indicators for different regions of the world shows that exports have tended to become more diversified for Asia over time (Amurgo-Pacheco and Pierola, 2008). In

Southeast Asia, the largest changes are seen in Viet Nam and the Philippines, where the gap in the number of exported products and markets served between them and the better performing economies like Thailand, Indonesia, Malaysia and even China has been bridged (Kowalski et al., 2015). Secondly, the major players in supply chains are located in East Asia, suggesting that part of their success in the most dynamic GVCs can be found in export diversification (Gill and Kharas, 2007).

While the level of diversification appears to become an important measure of competitiveness and quality of integration in world markets, the early experiences of the Newly Industrializing Countries (NICs) of East Asia, and most recently China, have also directed 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). Guzman et al. (2018) add that the RER acts as a subsidy and has a higher impact when complemented by industrial policies that increase the elasticity of the aggregate supply. Better export performance in the East Asian experiences is due to a combination of exchange rate and active diversification policies that framed firms' production environment and access for their exports to international markets (Rodrik, 2008; Stiglitz and Yusuf, 2001).

Two important strands of the literature are combined in the present study: the first focuses on the drivers of export diversification, and the second on the RER. However, even if one accepts the strong association between the two variables, there is still the question of causality. When the two variables are associated, most studies focus on a univocal direction: RER undervaluation and stability promote export diversification by increasing the profitability of the export sector. We posit here that the relationship could run in the opposite direction, highlighting a missing link in the related studies in international and development macroeconomics.

Using data for the Middle Income Countries (MICs) of Asia and Latin America, a previous paper examined the directional causality between RER and export diversification, which had not been done before (Diaw et al., 2017). It focused on 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 country level revealed a heterogeneous causality across trading partners, one wonders if foreign factors would have explained such results. Intuitively, the causal relationship might change because the benefits of participation in GVCs, one of the prominent features of trade globalization, may differ across countries depending on global conditions that might influence economic outcomes.

The present paper augments the bivariate causality analysis with two elements. First, it complements the causal relationship by using Foreign Direct Investment (FDI) as a control variable to account for GVC integration. Second, we investigate the impact of common external shocks by examining the effects of the East Asian crisis of 1997 and the global crisis of 2008 on the relationship. We do not take a stand on the mechanisms behind GVCs and the two variables of interest. Instead, we focus on making an empirical case for a causal effect. First, both export diversification and RER may arise through an interaction of country-specific and evolving global conditions. Some of the domestic variables might be affected by global factors and this could lead to potential endogeneity issues that are captured by the causality framework. Second, given the large number of potential mechanisms and the resulting uncertainty in the theoretical model, one of the attractive features of the causality framework is that it is simple and intuitive.

The remainder of this paper is organised as follows. Section 2 provides a review of the related literature. Section 3 presents the general options of our econometric approach before we report our empirical findings in Section 4. Section 5 summarizes the results and concludes.

2. Conceptual framework

2.1. RER causes export diversification

In traditional trade theory based on factor endowments, a country should specialize (not diversify) in the goods 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 drawbacks in this pattern of trade according to free trade theory (Meija, 2011). Firstly, export concentration is correlated with volatile and adverse terms of trade shocks (especially in raw materials or primary commodities), rendering free trade less beneficial for developing countries. Secondly, too much reliance on a small set of products or markets 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 wherein evidence supporting the "Dutch disease" syndrome in resource-rich countries can be found in smaller non-resource traded sectors, a decline in capital accumulation and in manufacturing value-added, *i.e.* deindustrialization (Corden and Neary, 1982; Harding and Venables, 2016).

A large body of literature has emerged to demonstrate the need for and benefit from diversification in both exports and output as a key determinant of growth. A difference in the level of diversification can cause differences in growth rate across countries (IMF, 2014; Giri et al., 2019). This development has followed the seminal work of Imbs and Warcziag (2003) who shed light on stages of diversification along the development path with a U-shaped relationship between specialization and income. While IMF (2014) analyses diversification more broadly from a structural change perspective (providing evidence for a causal effect of diversification on growth and development), other studies develop a perspective on export diversification based on

the concepts of extensive margin, *i.e.* the introduction of new export products or markets, and intensive margin, *i.e.* a more even distribution of export sales across the existing set (Amurgo-Pacheco and Pierola, 2008; Cadot et al., 2013; Newfarmer et al., 2009 among others). By diversifying along the intensive margin, countries reduce the risk of macroeconomic instability stemming from shocks in a few export sectors. Similarly, an economy exporting to a large number of markets will be less sensitive to large fluctuations in demand from one country or region. Geographic diversification, like product diversification, can moderate the transmission of adverse international shocks. Additionally, those countries that diversify their exports in manufactured goods tend, by and large, to have higher income elasticity of demand and more stable export earnings (Haddad et al., 2010). The recent literature on new growth and trade models has shifted the focus on the emergence of and trade in high-productivity varieties of goods. Countries that produce more diversified and high-productivity goods experience faster export growth (Hausmann et al., 2007; Hummels and Klenow, 2005).

The issue of export diversification then became an important economic issue. However, what kind of diversification should be put in place? What are the underlying determinants? An extensive recent literature has attempted to answer these questions. All in all, there is potentially a large set of determinants but a consensus is still lacking on the channels through which these determinants are transmitted. Given the multiplicity of mechanisms affecting diversification, Giri et al. (2019) adopt a Bayesian Model Averaging (BMA), which addresses model uncertainty and ranks factors in order of importance *vis-à-vis* their explanatory power. They reveal that the most robust factors associated with higher export diversification are human capital accumulation, openness to trade and quality of institutions. But the vector of potential determinants also includes our variables of interest, namely: market access, FDI and exchange rates.

Among the determinants of export diversification, market access through bilateral or multilateral trade arrangements is a key factor. 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). Thus 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). When FDI is involved, it can promote diversification and upgrading of the host country's export basket through spillover benefits (Iwamoto and Nabeshima, 2012).

The above-mentioned points suggest that developing export capacity outside the resource-based sector should be a priority. But this process will take place if factors are reallocated to tradable goods, if more resources are made available or freed up, thereby facilitating inter-sectoral reallocations. 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 manufactured products that are labour-intensive and highly exposed to price competition. In heterodox economics, the RER is perceived as a crucial variable in the process of economic development as it encourages the transformation of economic structures (Cimoli and Procile, 2011). In the presence of market failures and related externalities, a conscious effort by governments is required to alter the incentive structure in order to smooth the way for a structural change (Frenkel and Rapetti, 2014; Rodrik, 2008). In the same vein, Guzman et al. (2018) argue that a stable and competitive RER acts as a subsidy to the tradable sectors, supporting the idea that it can be an important tool of industrial policy.

2.2. Export diversification causes RER: the missing link

In developing countries, the possibilities for undervaluation 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. A key concern then is whether there are other ways to slow down real appreciation or to maintain stable and competitive RER levels. One option would be to look at the reverse causation between export diversification and the RER, an issue which is rarely addressed, maybe because it is much harder to ascertain. This allows us to focus primarily on the structural determinants of the RER.

In international macroeconomics, the literature attempts to identify factors influencing the RER "fundamentals" and deviations from its equilibrium level. 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 has yet addressed export diversification as a determinant of the RER. The existing literature has invested more in documenting the impact of RER misalignment on export diversification than in identifying any feedback in the relationship.

To the best of our knowledge, only two studies have addressed the issue. First, Bodart et al. (2011) propose an interesting study that found that the degree of export diversification, among

several other 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. In this set of studies, the mechanisms involved are the extent of exchange rate pass-through into trade prices and the sensitivity of trade to price changes.

Second, in a general equilibrium framework inspired by the footlose capital model, Béjean (2008) compares three determinants of the RER. Among them, a "variety supply" effect explains long-run RERs by the endogenous distribution of firms across countries. Measured here by the endogeneous number of varieties produced under monopolistic competition, export diversification can have an impact on the RER and this structural factor is missing in open macroeconomics. Most importantly, depending on several parameters, the "variety supply" effect can mitigate the Balassa-Samuelson effect and slow down real appreciation.

A priori, several mechanisms through which export diversification affects the RER can be identified here. First, productivity gains in a given country can affect firms' location decisions, which in turn impact relative price levels. Both higher domestic supply coming from firm entry (either by expanding inputs into export production or by enlarging the export basket) and lower producer prices (domestically produced goods are cheaper than imported ones in the presence of international trade costs) help to consolidate the tradable sectors and maintain the competitive advantage. A second mechanism is the relative size of countries that depends on market access: any change in this structural factor leads to a spatial re-allocation of the production of traded goods and ultimately affects the relative price level. The higher the share of domestically

produced goods (firms enter to benefit from a large local demand through the home market effect), the lower is the relative price of traded goods (a real depreciation).

While the investigations in this literature are conducted at firm level, more theoretical work is still needed at the macroeconomic level to better understand the reverse causality between the RER and export diversification. In particular, models of export-led growth (with a structural transformation through resource reallocation and cumulative causation) have emphasized demand-side factors. As a result of the interaction between better access to foreign markets and the development of domestic supply capacity, growing trade integration tends to increase diversification because countries can benefit from demand spillovers (Diaw et al., 2012). Diversification in export sectors eases the balance-of-payments constraint through inter-sector demand externalities, dynamic economies of scale associated with the so-called Kaldor-Verdoorn Law (a positive causality running from output growth to productivity growth in manufacturing), and this in turn nourishes domestic competitiveness. As Cimoli and Porcile note (2013): *"Various variables affecting trade may have a more prominent and interesting part in influencing the direction and intensity of the diversification process; among others, the role of the RER"* (p.98).

Another potential idea from development theories is that concentrated exports undermine sustainable growth because structures of production with low structural change lead to high macroeconomic volatility and unstable RER. As Rodrik (2008) and Guzman et al. (2018) recall, a stable and competitive RER policy may correct for institutional weaknesses and market failures in the presence of learning-by-doing externalities in the traded goods sectors. The RER is seen as an endogenous variable whose effects are intertwined and complementary for both macroeconomic stability and development. One operative channel is through diversification: *"A*

more competitive and stable RER leads to diversification,[…], which contributes to macro-stability; and macro-stability increases the power of a competitive and stable RER as a tool of industrial policy" (p. 52). Thus the links between exports, balance of payments, macro stability and growth are a key issue in investigating the RER in emerging economies. If modern tradable activities display some form of increasing returns to scale, market forces alone are unable to determine relative prices (and tradable profitability) that would make capital accumulation optimal in these activities (Frenkel and Rapetti, 2014). This approach contributes to the existing literature, in which it is assumed that the RER is determined outside the system. Here, the RER is a variable that can be influenced by export diversification and the related policy issues.

Such theoretical considerations imply that the relationship 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 and this is why the causality framework is chosen here.

2.3. GVCs and causality

Participating in GVCs, a prominent feature of trade globalization, has opened up opportunities for developing countries to engage in global markets, to overcome domestic supply side constraints and to build a competitive export mix. Although not new, the fragmentation and internationalization of production processes have recently taken on a more global dimension through the increased involvement of developing economies (Kowalski et al., 2015). It is also noteworthy that FDI, which is an important part of the economic liberalization process, is the most important point of the GVC literature and connectivity between the different regions has

increased over time. For some Southeast Asian countries, FDI inflow has been found to increase GVC participation by over 20 percentage points (Kowalski et al., 2015).

However, the benefits of GVC participation naturally differ between firms and policymakers. Whereas firms participate in GVCs primarily to make profits, policymakers are concerned with the policy environment in which firms operate and take into account the economic outcomes of GVC participation at the country level. This gives rise to two opposite standpoints. First, firms seek to fragment the value chain by facilitating specialization in specific segments of the value chain according to the notion of comparative advantage. For Arslan et al. (2018), this has resulted in long production chains that span multiple sectors over many countries in order to exploit differences in factor endowments and relative skills. Longer GVCs are therefore a sign of increasing specialization and efficiency gains, but may be more vulnerable to shocks or disruptions (for instance, financial crises) because they involve multiple shipments of goods across borders. By contrast, policymakers seek to build a competitive advantage and to favor the diversification of exports through attractive policies. To this end, active industrial and technological policies can be adopted in order to compensate for the effects of the RER on the composition of production structures not related to current or "natural" comparative advantage (Cimoli and Porcile, 2013). Trade globalization *via* GVC is, therefore, an opportunity for developing countries to raise their competitiveness in world trade and to induce changes in industrial structure (IMF, 2016).

The research question to be tackled here is how GVC integration affects the relationship between export diversification and RER. Intuitively, as countries become increasingly integrated into the world economy, so participation in GVCs also becomes influenced by the global macroeconomic context and the causal relationship might change.

- **GVCs and export diversification**

Product and market diversification indicators together indicate 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 respect (Gill and Kharas, 2007; World Bank, 2017). On conceptual grounds, international production sharing has enabled developing countries to move into new activities or new markets and to diversify their exports because different stages of the production process can be carried out in different countries.

Kowalski et al. (2015) identify the main determinants of GVC participation and divide them into two categories, structural (country-specific characteristics are the key factors) and policy related. The authors also point out that the developing Asia, which displays high participation rates, shows some of the most pronounced changes in levels of diversification. In fact, both GVC participation and export diversification have certain characteristics in common; they include domestic market size as well as industrial structure, quality of institutions and geographical location (distance from the main manufacturing hubs). Geography clearly matters here because survival rates seem to be linked to intra-regional trade. Involved in a deeper regional integration, Southeast Asian countries outperform the survival observed in the rest of the world and can be more prepared for competition in global markets. In this context, FDI has become the main driver of supply chains, and this influences the distribution of production stages across national borders. In order to be attractive in the face of global competitors, producers from developing countries try to create new production processes and diversify their portfolios by investing in research and development as well as imitating or copying technologies from developed countries (UNIDO, 2015). Closer integration into GVCs may help foster export diversification if domestic suppliers are competitive enough. In addition, export diversification helps to build domestic

supply capacity and, at the same time, increase export competitiveness through productivity gains along the GVCs. As long as international trade is costly in the presence of increasing returns to scale, location decisions (or the spatial distribution of traded goods production) are important determinants of relative price levels (Béjean, 2008).

Product diversification and participation in GVCs are well documented explanations of high export performance in East Asia (Jankowska et al., 2012). But they went through cycles of "boom and bust", which seem to be closely linked to financial crises. Arslan et al. (2018) report that, by being more integrated in GVCs, developing countries have become more vulnerable to external disruptions and declines in overseas demand. By increasing uncertainty and reducing the profitability of the exportable sector, financial shocks discourage investment and the emergence of new tradable activities (IMF, 2014; 2016). And because it affects the causation between export diversification and the RER, evidence of the link is not definitive.

- **GVCs and RER**

This leads us to turn to the role of involvement in GVCs in determining the RER's impact on trade. A number of recent studies question the effectiveness of RER depreciations in boosting exports, showing that GVC linkages reduce the elasticity of trade and exchange rate pass-through. Using a panel framework covering 46 countries over the period 1996-2012, Ahmed et al. (2017) analyse how the formation of GVCs has affected the exchange rate elasticity of exports over time and across countries. They find evidence that GVC participation reduces the RER elasticity of manufacturing exports by 22 percent on average. To deal with the causality issue in this new strand of the literature, Phi and Tran (2020) endogenize the price elasticity of import demand for China and the US by the export diversification indices of their partners. Against all the odds, a negative and statistically significant coefficient of China's elasticity

obviates traditional "beggar-thy-neighbor" concerns. Against the competitive wisdom, a currency appreciation in China reduces the country's exports, as well as those of the partners from which it sources inputs through import demand spillovers. Most importantly, the more partner countries are diversified in their exports, the lower China's import price elasticity is in absolute terms.

From a value chain perspective, there are some emerging studies linking GVCs and the Real Effective Exchange Rate (REER) at sector level (Patel et al., 2017). Bems and Johnson (2017) present an interesting study by proposing the concept of the "value-added real effective exchange rate". They use GDP deflators (instead of consumer price indices) to measure price changes, and base the weights of these price indices on value-added bilateral trade flows in order to allow for sectoral heterogeneity in measuring REER.

Unfortunately, the main challenge for such studies is the availability of data on value-added bilateral trade, especially for developing countries. The scarcity of econometric and empirical studies of GVC integration is linked to the lack of inter-country input–output trade tables. For instance, the World Input-Output Database (WIOD) covers only 43 countries because of missing information in some sectors. Moreover, measures of GVC participation or trade in value-added (such as the OECD-WTO database, TiVA) is not the primary object of interest here because, as Patel et al. (2017) note, *"productivity gains from exports may be linked to gross exports rather than their value added counterparts, due to positive spillovers from imported inputs and technology"* (p. 2). Therefore, examining how relative prices influence value-added trade measures and the inherent difference in the composition of goods (in terms of final *versus* intermediate goods trade, or foreign *versus* domestic value added) is beyond the scope of our study.

3. Empirical framework

3.1. Data

As in a previous study (Diaw 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):

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

Where p_k is the share of export line *k* (with x_k denoting the amount exported) in total exports of country *i* ($X_i=\Sigma x_k$) 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 only 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 to 10,000.

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. 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.* 23 Asian countries and 24 Latin American countries listed in the ***Appendix***.

Alternative options were checked before conducting our empirical tests as data coverage differs greatly among them. Firstly, the Theil's entropy index is another frequently used diversification index; however, it is better suited to exploring the modelling framework of extensive *vs* intensive margin, which is beyond the scope of the present article. We identify the HHI indices as the best option for handling the intensive margin from the perspective of macroeconomic mechanisms. Secondly, export diversification indices from UNCTADStat were used; based on the 3-digit level of SITC (Revision 3), however, they are highly aggregated compared to our HHIs using BACI and the ensuing results are less restrictive and powerful[1].

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:

$$RER = EP^*/P$$

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 in RER implies a real appreciation of the domestic currency.

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. Although the REER is one of the most cited indices in international macroeconomics, we measure the RER by making two key assumptions. Firstly, we consider the nominal exchange rate against the US dollar in accordance with what Gopinath et al. (2020) call the "dominant currency paradigm", *i.e.* the exchange rate pass-through into import prices depends on how a country's currency fares against the US dollar (as opposed to bilateral exchange rates). Given that the US dollar is the main currency of trade invoicing for the majority of exports around the world, this is an indirect

[1] For further details, see http://www.cepii.fr/anglaisgraph/bdd/baci.htm on BACI data coverage and https://unctadstat.unctad.org/EN/IndicatorsExplained.html on UNCTADstat indicators.

way of considering GVC integration (Cook and Patel, 2018). Accordingly, the nominal exchange rates are the number of local currency units per US dollar.

Secondly, our research question focuses on gross exports, not on the decomposition of value-added[2]. It is thus 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 GDP deflator. First, it captures any potentially missing information on product diversification on the demand side. Second, the GDP deflator, as a combination of both home and foreign prices, tends to cover more broadly tradable and non-tradable goods than consumer price indices. Annual data are extracted from the World Bank's World Development Indicators (WDI) database with base 2010 = 100.

(Insert Table 1 and Figure 1 here)

Using the available data, summary statistics are given in *Table 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 diverges across country groups and is less pronounced in small countries. The mean of individual HHI seems to be similar for Asian and Latin American countries, with a low dispersion within sub-samples. On the other hand, the unweighted RER has a mean value of 85 in Asia and 97.4 in Latin America, which is quite low compared to previous decades[3]. *Figure 1* shows the evolution in Asia and Latin America over the period considered; the mean by region is individual HHI and RER data weighted by the share of each country in the regional GDP. The remarkable point is that the

[2] See Patel et al. (2017), who develop a framework to compute REER at both the sector and country level in this perspective.

[3] Because Ecuador recorded very high RER values during the period of macroeconomic instability 1995-1999, we have excluded this MIC from our figures.

GDP-weighted average HHI was relatively low in Asia compared to Latin America, suggesting a higher diversification in export products while the GDP-weighted RER was more stable and competitive. We observe also that, on average, exports tended to become less diversified in Latin America even though both regions experienced an increase in the real exchange rate, *i.e.* a real depreciation against the US dollar within the same period.

(Insert Figure 2 here)

Figure 2 plots the unconditional correlation between the average change in the RER and the level of HHI in three sub-periods: 1996-1999, 2000-2007, 2008-2015. We investigate this relationship graphically for the whole sample and by region. Interestingly, we observe a negative correlation but with flatter lines for the Asian region, meaning that great changes in the RER could drive export diversification, or *vice-versa*. This is probably because individual HHI and RER data are weighted and averaged over sub-periods.

To get a deeper insight, we tried to take into account measures of GVC participation. Unfortunately, existing indices of GVC are constrained by data availability for our whole country sample over the period under consideration. This means that their inclusion in our empirics would come at the cost of reducing our sample size. Therefore, we chose to consider GVC-related foreign factors or events that could influence the causal link. Firstly, international investment flow is a prominent feature of global production and trading systems, allowing us to measure here GVC participation by FDI as a ratio of GDP. Also extracted from WDI, our FDI-to-GDP ratio is in log and lagged one period.

Secondly, we 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. The intuition behind the link is that external conditions in time of financial crises (with tightening global markets) affect

not only the volume and structure of trade, but also the macroeconomic interactions. For example, one might argue that the East Asian MICs have come out of the 1997 financial crisis determined to improve export performance through greater participation in GVCs. On the other hand, the global financial turmoil of 2008 resulted in a global recession with a decline in international trade. This might have played a role in the dynamics of exchange rates and the associated expenditure-switching effects (a change in demand composition in response to relative prices). Accordingly, the Granger causality will be tested in a panel context given cross-sectional dependencies and heterogeneity across countries by using dummy variables for financial crises.

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 the RER may exist in panels. Thus a causality analysis using panel data 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:

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

We assume the lag orders K are identical for all cross-section units of the panel (i=1,…,N) observed at time period t (t=1,…,T), while the autoregressive parameters $\gamma_i^{(k)}$ and the regression

slopes $\beta_i^{(k)}$ differ across countries. Similarly, α_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.

$$H_0 : \beta_i = 0 \; \forall i = 1,...,N$$

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

Our two variables are expressed in logarithms in order to include the proliferative effect of time series. In addition, the empirical investigation will be conducted separately for Asia and Latin America because an important issue to consider in interpreting this heterogeneous panel test is the potential for the causal relationships to differ across country groups.

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 in order to determine whether the global null hypothesis can be rejected.

3.3. Preliminary tests

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, the stationarity of the variables and selection of optimal lag length.

(Insert Table 2 here)

The cross-sectional dependence test is performed following the Pesaran (2004) approach under the null hypothesis of cross-sectional independence. The statistics in *Table 2* show clearly that the null hypothesis 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.

(Insert Table 3 here)

We need to take into account cross-sectional and slope heterogeneity features when verifying the stationarity of our panel data sets. The results of the unit root tests are reported in *Table 3*. Taking our three country samples, the statistics indicate a rejection of the null hypothesis and suggest stationarity at the level for HHI whereas RER is I(1). It should be noted that the Granger causality test for panel data proposed by Dumitrescu and Hurlin (2012) is built under the assumption that the variables are stationary. Therefore, while performing the causality test, we use the first difference for the I(1) variable.

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 while testing our Granger causality.

4. Empirical results

The preliminary analysis having been completed, we now turn to the Granger causality test. First, we examine the causality between HHI and ΔRER because HHI is stationary and RER is I(1). Second, we define a benchmark model in which 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:

$$\begin{cases} HHI_{it} = \alpha_{HHI,i} + \sum_k \gamma_{HHI,i}^{(k)} HHI_{i,t-k} + \sum_k \beta_{HHI,i}^{(k)} \Delta RER_{i,t-k} + \sum_k \lambda_{HHI,i}^{(k)} FDI_{i,t-k} + \theta_{HHI,i} Z_{i,t} + \epsilon_{it} \\ \Delta RER_{it} = \alpha_{\Delta RER,i} + \sum_k \gamma_{\Delta RER,i}^{(k)} \Delta RER_{i,t-k} + \sum_k \beta_{\Delta RER,i}^{(k)} \mathrm{HHI}_{i,t-k} + \sum_k \lambda_{\Delta RER,i}^{(k)} FDI_{i,t-k} + \theta_{\Delta RER,i} Z_{i,t} + \epsilon_{it} \end{cases}$$

where $FDI_{i,t-k}$ denotes the lagged FDI-to-GDP ratio and $Z_{i,t}$ consists of two dummy variables.

In the benchmark model, the null hypothesis of HNC $H_0 : \beta_{HHI,i} = 0$ with $\forall i = 1,2,...,N$ means that changes in RER do not Granger cause HHI and $H_0 : \gamma_{RER,i} = 0, \forall i = 1,2,...,N$ means that HHI does not Granger cause changes in 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 for the financial crises: they take a value of one for 1997-1998 (or 2008–2009) and zero otherwise.

(Insert Table 4 here)

The upper part of *Table 4* provides the Granger causality results following the Dumitrescu and Hurlin (2012) methodology without taking into account the financial crises. Firstly, the null hypothesis is not rejected at the 1% level of significance in both directions regardless of the country group. The results reported here provide strong evidence that no causality running from RER to HHI is observed in our model specification. The results change when we capture the effects of financial crises (the lower part of *Table 4*). Indeed, we observe that the HHI level Granger causes changes in the RER for the whole sample if we introduce the dummy variables. In this case, we find a positive causality, which means that the higher degree of export diversification (lower HHI) could predict a stable RER (less change in the currency). Secondly,

we do not find any evidence of the reverse causation for the two sub-samples, which suggests that it is global macroeconomic interactions that are the issue here. In other words, our findings seem to reveal divergent effects of the financial crises across countries in the two regions, which calls for more detailed investigation.

(Insert Table 5 here)

One may suspect that the inherent differences in country size and the composition of export goods covered by our sample are driving the impact of shocks and the empirical results. Therefore, Granger causality tests are conducted without small islands and the results are displayed in *Table 5*. As before, there is no evidence of the causality running from RER to HHI for all samples. Interestingly, the reverse causation with an estimated positive sign is present for the whole sample and the Asian sub-sample when we account for the financial crises. For Latin American countries, we do not find any causal relationship between these variables.

To sum up, the role of the RER as a conventional determinant of export diversification, whatever the model, is not systematic at all when we consider a broader global scenario as the backdrop. The statistics on the Granger causality test show some interesting results on the impact of financial crises, even though one weakness of this kind of heterogeneous causality tests is the difficulty in interpreting significant statistics. All things considered, a unidirectional positive causality suggests that a higher diversification helps in stabilising the RER level. One intuition behind this result is the way global macro-economic developments work to capture the benefits of export diversification. In Asia specifically, HHI causes changes in RER and this link was highlighted by the financial crises. There is a clear consensus on the channels through which the competitive level of RER has determined the successful export-led growth in the Asian MICs. But our findings suggest that the subsequent export diversification has in turn caused a decrease

in the rate of RER change, lowering the countries' vulnerability to external shocks. In other words, we argue here that in time of financial crises, diversifying exports has played an important role in Asian macro resilience.

5. Conclusion

Achieving export diversification is one of the greatest challenges in developing countries nowadays. Whereas much of the existing literature has demonstrated that the RER has a robust positive impact on export diversification, the proposition we develop in this paper claims that export diversification can also exert an influence on the RER. One prominent feature of trade integration has been the rise of GVCs. By supporting access to foreign markets through reduced trade barriers, higher capital mobility and ICT development, the formation of global and regional production processes allows developing countries to embrace a wide range of activities at various stages of the production chains. However, they are also exposed to evolving global conditions stemming from higher dependence. In particular, financial crises may disrupt previous efforts at economic development and the role of exchange rates in promoting exports and in the macroeconomic adjustment process needs to be carefully re-assessed.

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. We investigated the relationship by controlling for FDI, which is a key driver of GVC formation. Secondly, we attempted to identify the contribution of financial crises to the causality between the two variables.

Our empirical results reveal a reverse direction where export diversification might help to consolidate a stable and competitive exchange rate. This causation is neglected in the existing literature and our study attempts to bridge the gap. First, we show that the two financial crises of 1997 and 2008 disrupted the causal link. More precisely, it appears that the countries under consideration have overcome the impact of financial crises by allowing diversification to become an alternative tool in reducing exchange rate volatility. Second, we observe no causality between the two variables at the regional level, meaning that it is global interactions that are the issue here. Because the findings might be truncated by the country sample, we rule out small islands. Again, our empirical findings show that the financial crises have affected the causation but export diversification now causes the RER changes in the Asian sub-sample.

Overall, there is clear evidence that during financial crises export diversification has helped to reduce RER fluctuations, corroborating recent development studies that make a case for diversification to build macro resilience. Although more theoretical work is needed, our findings focus attention on a missing link (*i.e.* diversification in exported products and in destinations is likely to be an important determinant of RER stability) that the Asian emerging economies have successfully experienced.

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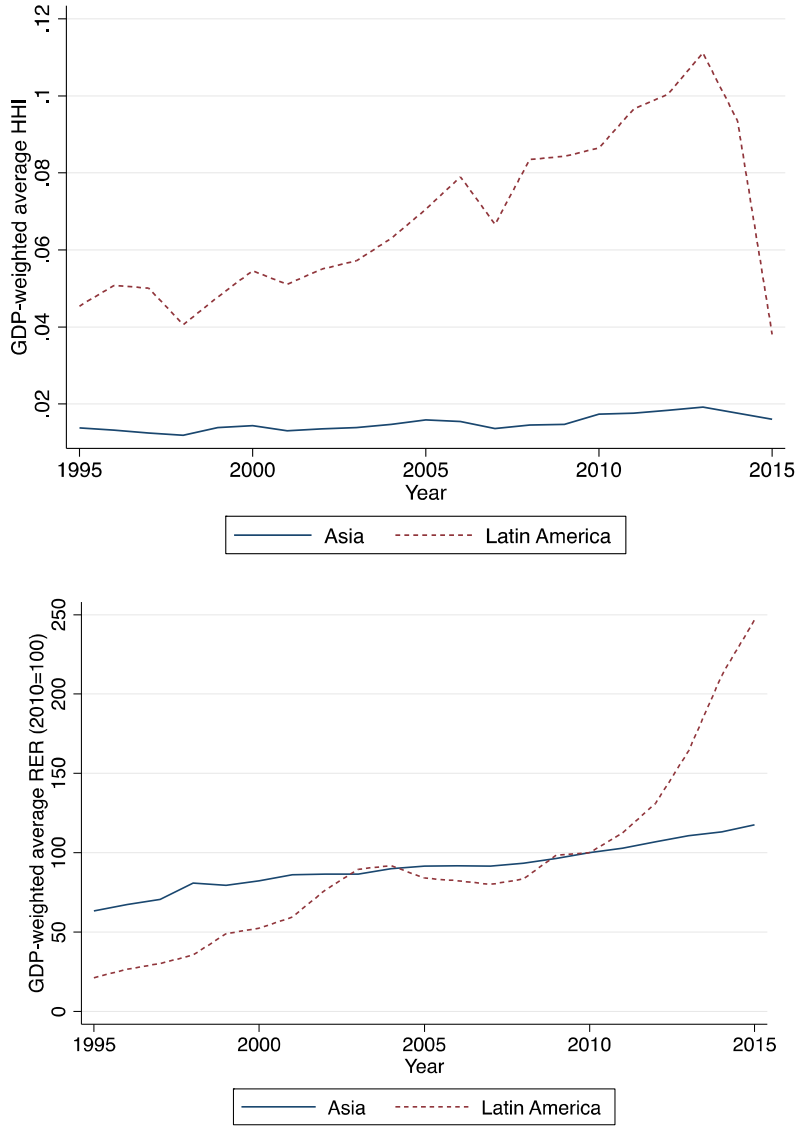
Annex: Country sample

Asia:	
East Asia and Pacific *(17)*	Cambodia, China, *Fiji*, Indonesia, *Kiribati*, Lao PDR, Malaysia, Mongolia, Myanmar, *Papua New Guinea*, Philippines, *Samoa, Solomon Islands*, Thailand, *Tonga*, *Vanuatu*, Viet Nam
South Asia *(6)*	Bangladesh, Bhutan, India, *Maldives*, Pakistan, Sri Lanka
Latin America and the Caribbean *(24)*	Argentina, *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

Note: Small islands developing states (SIDS) defined by UNCTAD are in *italics*.
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 47 countries over a 21-year period.

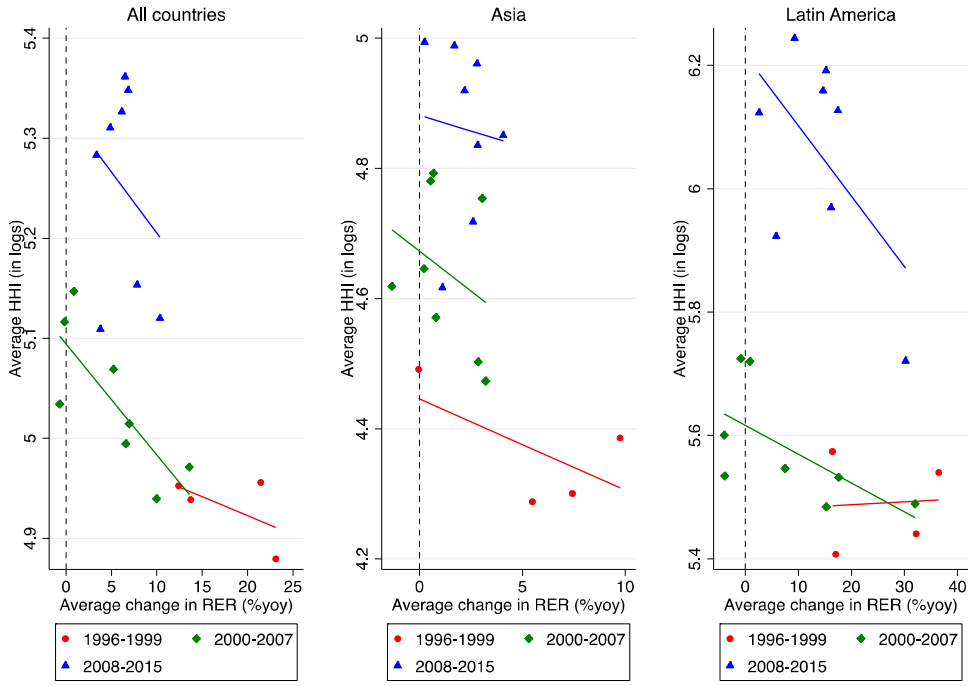
Figures and Tables

Figure 1: HHI and RER in the middle income countries of Asia and Latin America (1995-2015)



Source: Authors' calculations.
Note: Individual HHI and RER are weighted by the share of each country in the regional GDP

Figure 2. Relationship between HHI (BACI) and RER by sub-period



Source: Authors' calculations.

Table 1. Summary statistics of HHIs and RER indices (1995-2015)

Variable		Obs.	Mean	Std. Dev.	Min	Max
WHOLE	HHI	987	0.114	0.122	0.003	0.796
	RER	987	1963.533	27587.2	0.174	633762.3
Asia	HHI	483	0.113	0.126	0.003	0.682
	RER	483	85.037	35.423	0.843	194.491
Latin America	HHI	504	0.115	0.118	0.011	0.796
	RER	504	97.436	123.525	0.174	1755.503

Table 2. Cross-sectional dependence test

Lags	Pesaran CD statistics					
	WHOLE		Asia		Latin America	
	HHI	RER	HHI	RER	HHI	RER
1	7.373***	14.298***	4.690***	13.459***	3.047**	7.990***
2	6.774***	16.346***	3.892***	13.228***	3.160***	10.095***

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

Table 3. Unit root test

		Pesaran (2007)	Breitung and Das (2005)	Chang (2001)		
	Variable	CIPS	??	Pm	Z	L*
WHOLE	HHI	-3.923***	-2.095**	9.283***	-6.770***	-7.237***
	RER	-0.030	11.297	-0.454	4.762	5.858
Asia	HHI	-3.018***	-0.916	3.681***	-3.548***	-3.508***
	RER	3.658	7.873	-0.246	3.797	4.925
Latin America	HHI	-2.898***	-2.081**	9.108***	-6.001***	-6.693***
	RER	-2.424***	8.108	-0.394	2.946	3.376

Note: Pesaran (2007), Breitung and Das (2002) and Choi (2001) test the null hypothesis of unit root test. *, **, *** stand for significance at 10%, 5% and 1% respectively.

Table 4. Granger causality test for panel data with various lags

Without dummy variables		Statistics $\bar{W}_{HNC}$	$\bar{Z}_{HNC}$	$\tilde{\bar{Z}}_{HNC}$	$\bar{W}_{HNC}$	$\bar{Z}_{HNC}$	$\tilde{\bar{Z}}_{HNC}$
	Lags	From HHI to ΔRER			From ΔRER to HHI		
Whole	1	***1.452***	***2.191****	***1.110***	***1.365***	***1.768****	***0.785***
	2	3.290	4.420***	1.891*	2.793	2.720***	0.781
Asia	1	***1.176***	***0.598***	***0.059***	***1.083***	***0.281***	***-0.185***
	2	3.343	3.220***	1.406	2.429	1.028	-0.024
L. America	1	***1.716***	***2.480****	***1.496***	***1.635***	***2.199****	***1.280***
	2	3.239	3.034***	1.270	3.143	2.799***	1.116
With dummy variables		From HHI to ΔRER			From ΔRER to HHI		
Whole	1	***1.668***	***3.237*** (positive)***	***1.726****	***1.067***	***0.324***	***-0.409***
	2	3.479	5.069***	1.803*	2.776	2.659***	0.406
Asia	1	***1.527***	***1.786****	***0.857***	***2.661***	***1.586***	***0.125***
	2	3.170	2.807***	0.833	0.822	-0.605	-0.895
L. America	1	***1.803***	***2.782****	***1.577***	***1.302***	***1.046***	***0.305***
	2	3.774	4.347***	1.708*	2.885	2.169**	0.446

Note: The null hypothesis is the homogeneous non causality (HNC) from X to Y. The optimal lags, that are chosen following the methodology of Han et al. (2012), are indicated in italic bold. The sign of causality is reported in the model with optimal lag. *, **, *** stand for significance at 10%, 5% and 1% respectively.

Table 5. Granger causality test for panel data without small islands

Without dummy variables		Statistics $\bar{W}_{HNC}$	$\bar{Z}_{HNC}$	$\tilde{\bar{Z}}_{HNC}$	$\bar{W}_{HNC}$	$\bar{Z}_{HNC}$	$\tilde{\bar{Z}}_{HNC}$
	Lags	From HHI to ΔRER			From ΔRER to HHI		
Whole	1	***1.280***	***1.136***	***0.392***	***1.580***	***2.354****	***1.329***
	2	3.591	4.570***	2.150**	3.209	3.473***	1.433
Asia	1	***1.216***	***0.590***	***0.130***	***1.329***	***0.901***	***0.368***
	2	4.338	4.527***	2.393**	2.863	1.672*	0.529
L. America	1	***1.333***	***0.999***	***0.413***	***1.788***	***2.365****	***1.462***
	2	2.969	2.056**	0.726	3.497	3.176***	1.457
With dummy variables		From HHI to ΔRER			From ΔRER to HHI		
Whole	1	***1.891***	***3.619*** (positive)***	***2.111****	***1.251***	***1.020***	***0.206***
	2	4.156	6.193***	2.639***	3.229	3.530***	1.095
Asia	1	***2.088***	***2.980*** (positive)***	***1.819****	***1.013***	***0.037***	***-0.338***
	2	4.403	4.654***	2.057**	3.360	2.635**	0.886
L. America	1	***1.727***	***2.180****	***1.198***	***1.449***	***1.347***	***0.588***
	2	3.950	4.137***	1.696*	3.120	2.375**	0.674

Note: The null hypothesis is the homogeneous non causality (HNC) from X to Y. The optimal lags, that are chosen following the methodology of Han et al. (2012), are indicated in italic bold. The sign of causality is reported in the model with optimal lag. *, **, *** stand for significance at 10%, 5% and 1% respectively.