
# NON-LINEARITY BETWEEN EXPORT DIVERSIFICATION AND ECONOMIC GROWTH

**How Quality of Exports and Openness to Trade can influence the U-shaped Relationship**

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# ABSTRACT

The paper investigates on the non-linearity between export concentration and economic growth using dynamic panel estimation on a dataset from 1995 to 2010. The existing theory suggests how countries which diversify their export basket can boost their economic growth, thanks to both a portfolio and a dynamic effect, till a certain point on time where concentration again positively affects growth. The statistical significance of the squared term of concentration for all the different estimations carried out represents a first improvement with respect to the brief existing literature, which sometimes either did not obtain consistent results for the non-linearity or only checked for the negative effect of the linear term. Secondly, an almost total innovation brought by the research is the study of the effect that both *Quality of exports* and *Openness to trade* have on the position of the turning-point. The results suggest that those countries which look for quality upgrade or are heavily present in the international market scenario will firstly better reap the benefits coming from the first phase of diversification boosting all the process and, furthermore, obtaining higher final value of growth during the second phase characterized again by concentration.



**KEYWORDS:** EXPORT CONCENTRATION AND DIVERSIFICATION, NON-LINEARITY, DYNAMIC EFFECT, QUALITY-UPGRADE, OPENNESS.

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# 1. INTRODUCTION

Economic growth created by international trade has always been one of the main points of interests for governments due to the possibility to avoid both structural and political reforms, at least during the initial phase of the growing process. Nowadays, this topic has come back to the attention due to the negotiation on the TTIP (Transatlantic Trade and Investment Partnership) between political leaders of the European Union and United States; indeed, the two sides are arguing on how this agreement could help both areas to totally recover from the crisis started in 2007 (especially Europe where the majority of countries have not restarted to grow yet) without the need of new invasive and high demanding reforms for both citizens and government budgets. Hence, this example proves how even developed economies need and seek for international trade's facilitations simply because they are a powerful tool to start new growth's cycles. Indeed, when a country has the opportunity to kick-start his development without almost any collateral costs, then, in turn, it can faster the growing process through reinvesting the initial revenues coming from trade activities into public reforms aimed to strength both the overall social wellness (e.g. better education, health system and financial system) and his position in the international trade scenario (e.g. favorable context to doing business and trade-oriented infrastructure).

Nevertheless, the theory behind how economic growth is driven by trade is broad and contradictory, especially concerning on which type of trade should be undertaken and as a consequence what goods need to be produced.

The classical Ricardian theory as well as the Heckscher–Ohlin model supports the idea of comparative, competitive or relative advantage of a country, which means that economies should specialize following their endowment abundances that allow them to produce at a lower relative marginal cost. However, these theories, as well as all the economics concepts, are based on several assumptions that simply make impossible to have an "one-fit-all" solution for each country in every historical context; for instance, Ricardo himself highlighted the crucial importance of his immobility of capital assumption (which was not that implausible in 1817), without which his theory would not have had any sense. The evident problem is that times change and economics theory does with them.

The Asian-Tigers (Hong Kong, Singapore, South Korea and Taiwan) provide an effective example on how theories sometimes are made to be rejected by empirical evidence. In fact, even if these countries specialized in producing and then exporting high-quality products, such as financial services and information technology manufactures, their economic growth started thanks to a diversification process of their commodities' basket. For example, South Korea was able to move

from an agrarian based economy into a manufacturing one by mean of favorable reforms (i.e. agricultural, free trade enhancement and lowering public expenses) that made possible a structural transformation of its economy (IMF 2014). The key point, however, is the reinvestment of revenues coming from the growing agricultural sector towards the manufacturing sector, with, most importantly, the inclination to spread these gains into different sectors instead of focusing only on one specific product. Briefly, South Korea, as well as the others Asian-Tigers, had successfully diversified her production activities and projected her into the international trade panorama thanks to firstly a sophistication and quality upgrade of her resource-based sector, secondly to a reinvestment in new activities and, finally, to trade-liberalization reforms. Figure 1 clarifies the extraordinary development of the South Korea GDP which steadily increased from the early Sixties, when it was around only 30 Billions of US dollars (constant 2005), till it reached 195 Billion of US dollars in 1983 realizing a 550% increase in only 20 years. We can see that GDP growth clearly began when the Diversification Index (high values of the index mean a low level of diversification) dramatically dropped from 3.10 in 1962 to 2.11 in 1974, denoting a heavy diversification policy adopted by the Korean government. After 1974, the country steadily continued to diversified (the highest level of diversification was reached in 1992 at 1.89) till the begging of Nineties where the Diversification Index starts a new increasing phase defining a concentration and specialization period.

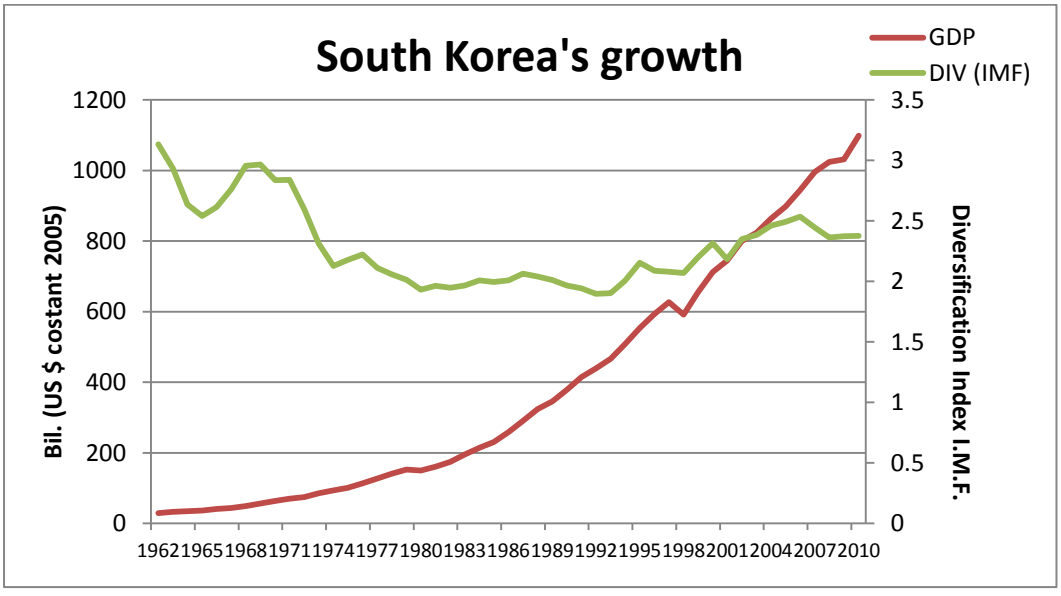



**Figure 1.** *Source: Author's calculations from World Bank and Diversification Toolkit of IMF.*

Figure 2 and 3 report other examples of the positive effect of diversification considering South Korea again and other 13 countries; as we can see Brazil, Kenia and above all Indonesia successfully moved towards the upper-left corner of the graph by mean of a consistent diversification process undertaken over the considered 40 years (for low level of the Index we have

higher diversification), Chile also moves to a better position reducing his diversification value from 4.7 to 3.7, while Central African Rep. (CAF) remain stuck in the down-right corner seeing that it even slightly increase his index by 0.1.

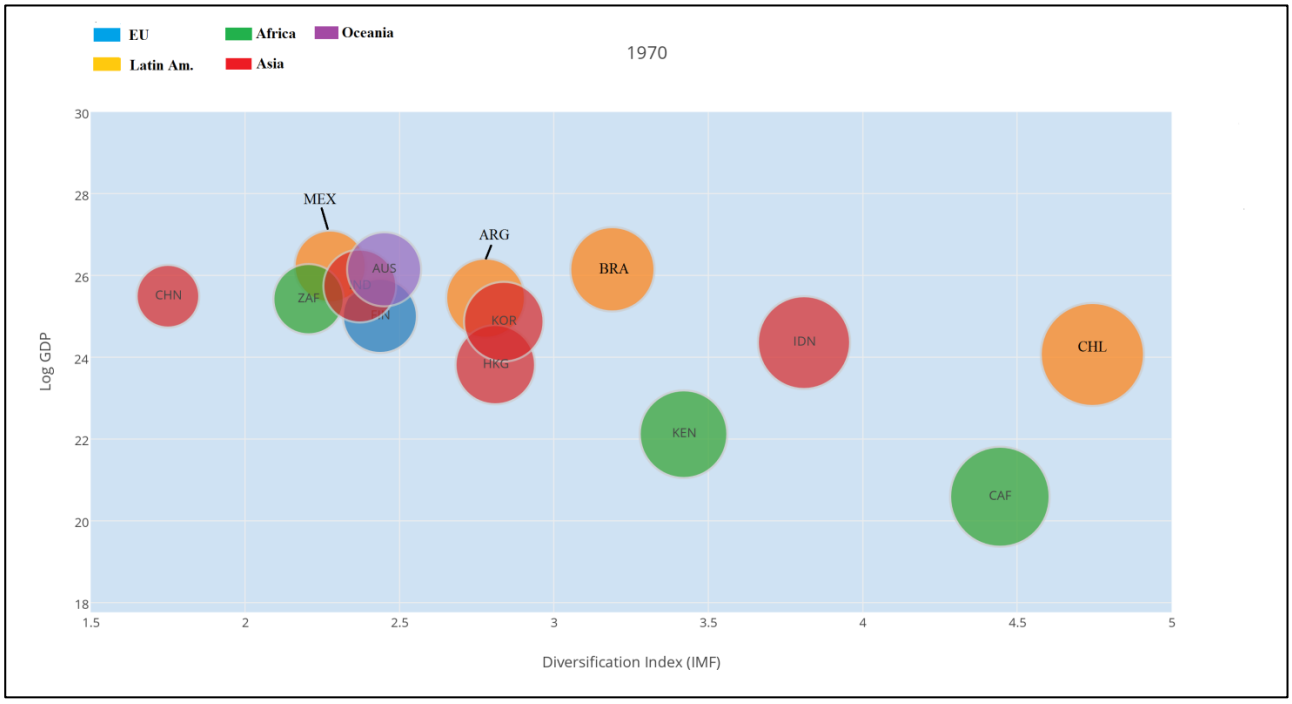



**Figure 2.** *Source: Author's calculation from World Bank and Diversification Toolkit of IMF.*

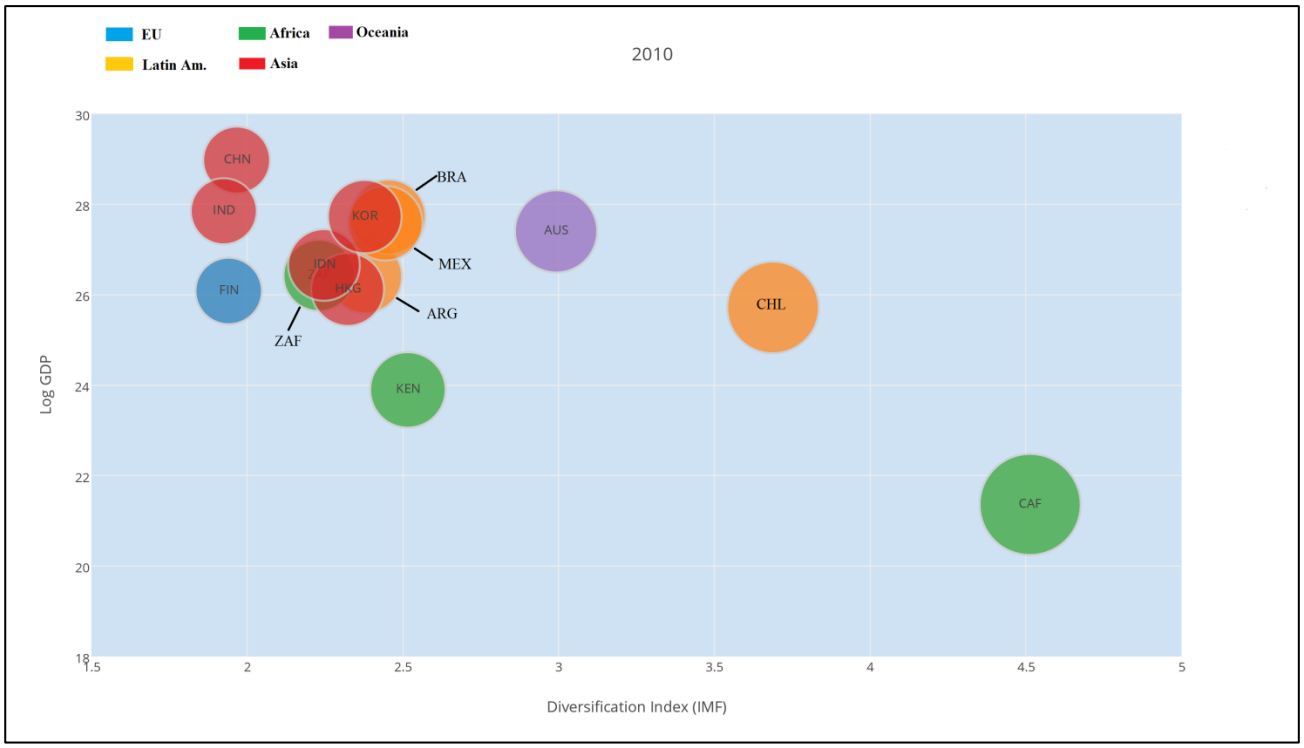



**Figure 3.** *Source: Author's calculation from World Bank and Diversification Toolkit of IMF.*

In this paper I want to analyse this export diversification process, which move against the classical trade related economic theories, in order to understand how much it could boost economic growth and how its duration is affected by policies aimed to quality-upgrade and openness to international trade.

Indeed, the existing theory and empirical evidence about export diversification had explained and demonstrated how every economy that diversify its export basket will benefit in term of GDP's growth till a turning point where, instead, specialization and sophistication of export will begin to positively affect GDP[1] (in Figure 1 this seems to happen in 1992 for South Korea). Moreover, governments can adopt different measures and reforms to get closer to this turning point basing their decision on the specific country economic context. For instance, natural resources might paralyse the growing process if economies heavily rely on them and, furthermore, if they are not able to reallocating the deriving revenues towards new sectors; especially for developing economies natural resources usually represent the first and, sometimes, the only source of revenue and export exposing them to a possible "Dutch disease" issue and price fluctuation.

The existing theory is based on two positive effects that a diversified export basket should generate: the portfolio effect and the dynamic effect; the former lowers the variances of price fluctuations' risks given that price fluctuations of different goods tend to offset each other, while the latter creates a favourable environment for knowledge spillovers, thanks to the birth of new markets, leading to an expansion of comparative advantages (i.e. countries learn by doing, and thus, obtain new skills and producing processes that will make easier the future specialization phase).

Furthermore, previous researches have investigated on the impact of several variables on this non-linear relationship which links economic growth to export diversification. Imbs and Wacziarg (2003) were among the firsts to describe how both the degree of diversification and the point in time when the turn-around towards concentration arises are different among countries due to differences in trade policies. For instance, they found that level of openness, transport costs and tariffs influence the turning point position through the concept of intensity of trade by the Ricardian theory: the more a country is willing to trade, the faster the diversification phase will be. Other elements such as lack of an efficient financial market and adequate infrastructures as well as barriers to entry and human capital have a substantial effect on the country's road towards export diversification and economic growth.

Using a more recent dataset going from 1995 to 2010, this paper has the intention to first of all check for both the negative effect of concentration on economic growth (i.e. first phase of the

[1] Imbs and Wacziarg (2003), Lederman and Maloney (2003, 2012), Agosin (2007) and Hesse (2008)

process) and for the non-linearity which sometimes was either not tested or led to not significant results (Hesse 2008, Aditya and Roy 2010). Secondly, the main step forward of the research is the study on the influence of both quality upgrade of exports and level of openness on the diversification process as they should boost it improving the first phase by amplifying the *dynamic effect*. The paper begins with the literature review and theoretical background on both export diversification and quality upgrade in section 2; in section 3 I will explain the adopted methodology, derive my hypotheses and briefly mention the data sources; section 4 firstly provides the empirical results for the non-linearity's hypothesis for both the entire dataset and the three sub-panels (1995-1999, 2000-2004 and 2005-2010), secondly it deals with the analysis of the effect of *Quality* and *Openness* on the U-shaped relationship with the help of both empirical results and graphic representations; finally the conclusions are reported in section 5 and the additional tables and figures are in the Appendix.

## 2. LITERATURE REVIEW AND THEORETICAL BACKGROUND

The economic diversification topic has not been broadly investigated yet, and, furthermore, has produced counteractive results due to estimation problems linked to endogeneity and autoregressive features of the variable involved.

### 2.1. The U-shaped relationship

Among the initial researchers on the topic, Imbs and Wacziarg (2003) were those who firstly provide a clear investigation on the non-linearity relationship between export diversification and GDP growth using several diversification index and data sources as robustness checks[2]. Indeed, using a nonparametric methodology based on robust locally weighted scatterplot smoothing (*lowess)*[3], the authors obtained significant results on the nonlinearity shape they were looking for in each of their specification. The two main results Imbs and Wacziarg came up with are, firstly, the non-symmetry of the U-shaped pattern seeing that the initial level of sectoral concentration is not reached again, in any of the estimations, during the concentration phase (i.e. the upward phase after the income's *turning point*), and, secondly, that the *turning point* usually occurs very late during the economic growing path implying high level of yearly income[4]. Furthermore, the authors performed several estimations with different subsamples in order to investigate on the robustness of their results obtaining always the non-linearity; for instance they analysed both within- and between-country data variance, performed country- and period-specific regressions and checked for biasing effect coming from country size and region. An interesting result achieved through the country-specific analysis was that those economies that had a high level of trade openness had started the re-concentration phase definitively earlier than the average estimate (e.g. Singapore at $2,500, Cyprus at $5,800 and Ireland at $7,000).

Finally, Imbs and Wacziarg provide some theoretical interpretations for their empirical findings on both diversification and specialization as well as on the heterogeneity of the duration of the two different stages of this U-shaped path. In addition to the portfolio effect that I explained above in the Introduction, the authors explain the willingness of countries and, especially, citizens to seek for new markets (i.e. diversify) through the idea of non-homothetic preferences that, clearly, will influence the consumption pattern of individuals across the economic growth process.

[2] The authors utilized ILO, UNIDO (where also the Value Added per sector is used as concentration variable) and OECD as data sources, while the Gini Coefficient, the Herfindahl Index, the Coefficient of variation of sector shares, the Max-min spread and the Log-variance of sector shares as sectoral concentration proxies.

[3] This estimation procedure does not impose a specific functional form, but instead it uses a weighted regression of Y (measure of export concentration) on X (income level) using a small amount of data around each observation. Hence, the estimated fitted values will represent the smoothed value in constructing the nonparametric curve.

[4] Imbs and Wacziarg estimated $9,575 and $8,675 for the period 1969-1997 and 1963-1996 for ILO and UNIDO data source respectively.

Concerning specialization, instead, they consider the concepts of intensity of trade, from the Ricardian theory, and of demand externalities, from the economic geography theory. The former straightforwardly justifies how lower trading costs (arising from a higher trade intensity) will make easier the imports of goods that would have been produced domestically otherwise, thus allowing each country to focus and specialize in those sector where it has a comparative advantage; while the latter illustrates the clustering process of monopolists firms, which continues till profits are increasing in local expenditures, deriving from both transport costs decreasing in technological upgrades and firms' desire to stay close to demand. Lastly, level of openness and income are claimed to be *substitutes* in determining the length of the two phases, in fact the higher a country's openness is (as well as the lower transport costs are) the shorter the diversification phase will be and, as a consequence, the lower the income level is.

The non-linear relationship finds confirmation also when it is checked on different countries subsamples with different crucial levels (i.e. turning point) of concentration; nevertheless, the squared term of export concentration is not always significant even if it always reports a positive sign. Indeed, the same happened in Hesse (2008) where even the significance of the linear term dropped from 1% level to 10% when the squared term is included; in Aditya and Roy (2010) the coefficient is significant for some countries sub groups only. Finally, some research totally left behind the squared term focusing only on the positive effect of export diversification (Agosin, 2007).

Therefore, the first intent of this paper is to provide a stronger evidence of this non-linearity with a more recent data set.

#### 2.1.1. *Natural resources dilemma*

Lederman and Maloney (2003) included export concentration as one of their trade structure variables explaining economic growth, but omitting the square term and so the study about the non-linearity. As expected, their Herfindahl index has been found to impede and slower growth (first phase of the U-shaped relationship), and, moreover, the authors also use the share of natural resources exports in total export as alternative measure of export concentration in a particular sector. This choice has been made to further investigate on the natural resources abundance's impact on economic growth using the ratio of natural resources' exports on GDP (Sachs and Warner, 1999). In contrast to the theory about natural resources abundance, the share of GDP surprisingly drives income growth instead of pushing it down; while as mentioned above the share of total export confirms the negative expectation of concentration.

This interesting results has of course been pursued by the authors in other research, and they also provide a final sum in 2012 (WB) on the topic and even extend it considering its impact on macroeconomic volatility; the two authors' assumptions basically state that, firstly, a strong dependence on natural resources amplifies volatility as it strongly restricts the other exporting sectors (i.e. Dutch Disease), and secondly the weakness of governments and public institutions might be a crucial impulse for the negative impact of primary commodities. However, neither export of energy and mining nor of agriculture showed a direct impact on volatility of both trade and GDP growth in Lederman and Maloney results, but they do significantly influencing export concentration, where energy and mining exports increase concentration while agriculture exports decreases. In sum, Lederman and Maloney say that is more a matter of diversification-aimed industrial policies which should effectively readdress the revenues from resources rather than the abundance of them per se.

This dilemma raised by Lederman and Maloney definitely caught my attention, and I will use the share of natural resources' export on total exports as proxy for concentration for my robustness check as the authors did.

2.1.2. *Patent rights' implications for policy choices*

A step forward towards a clearer interpretation of export diversification, her determinants and consequences on GDP growth has been made by Agosin (2007) who realize an empirical model hypothesizing that countries with a broader exports basket register greater growth's rates than countries which start to concentrate since the beginning of their growing pathway. First of all, Agosin is one of the first to mention the dynamic effect of diversifying exports, explaining how developing countries can widen their comparative advantages by mean of exporting sectors which are definitively not new worldwide, but they are for these growing economies and thus work as sources of technological discoveries and knowledge spillovers. Moreover, the author defines and investigates on depth the implications of discoveries, which are divided in cost and demand discovery, and, most importantly, he specifies that they are not patentable in developing countries due to concept expressed above of "new exporting sectors". Hence, this feature of the new sectors' innovation imposes the impossibility for the first mover to catch all the benefits of the discovery.

In the model designed by the author, when an entrepreneur comes up with a new discovery he has to borrow a first amount in t=0 to acquire information about the new market and its possibility of growth, and a second amount in t=1 to start his business in order to finally enjoy profits in t=2. Instead another entrepreneur can easily skip the information process due to the possibility to copy the first mover's experience, so enjoying a second mover advantage. Therefore,

indifferently from the kind of discovery, the profit of the first mover will be lower, but the cause why may be either an increase in factor rewards or a decrease of product price for cost and demand discovery respectively[5].

The idea behind Agosin's reasoning is that the impossibility for developing countries' entrepreneurs to obtain a patent for their discoveries will boost the diversification of output and export by mean of copycats and, most importantly, it will make possible and faster the creation of technological and knowledge intra-industry spillovers. Hence, the author explains why growing economies should not merely pass from an agricultural to a manufacturing system without any intermediate steps, because it would dramatically penalize farmers' economic stability and, furthermore, it would give the start to a new sector without a sufficient percentage of skilled-workers (i.e. Human Capital) that would make the transaction profitable (Sheridan, 2014). Therefore, when a country start his growing process, the government should move towards an implementation of his classical sector (e.g. usually agriculture) by mean of favourable reforms, enlarging thus the tax burden and make possible investment in better infrastructure for the future.

Summing up, the easier starting new business is (i.e. sectoral reforms, facility to copy precedent discovery and better infrastructure) the more probable investment and new discoveries will be, and, above all, the easier will be to broaden the comparative advantages set of developing countries. This argument opens a new door for economic policies' decisions, in fact governments can base their actions on the level of output and export diversification obtained till a specific point of time; for example, they may favour the copycats till when a proper average yearly income is reached or as well as a sufficient spectrum of comparative advantages and information externalities is obtained in order to switch to the re-concentration phase. After that, a patent law should be introduced in order to boost the concentration process in high challenging sectors (especially high value-added sector such as technology-related productions) making possible for pioneers to reap all the benefits from a first-move and, thus, climbing up the value-chain rapidly and in a more efficient way.

It is in this reasoning that the concept of quality upgrade (i.e. sophistication) comes in as the increasing probability of knowledge externalities could make easier to enhance it. However, as I explained before, it is crucial that governments improve pioneers' protection and patents' facilities in order to enlarge the value-added on country's exports when the right moment to specialize has come. Country-specific examples show, indeed, different stories with different speeds of GDP growth and export diversification. For instance, Latin American Countries and Asian Tigers; while

[5] **Cost discovery**: investments by copycats will push up skilled-labor wages lowering the first mover's profit. **Demand discovery**: product price falls due to raise of skilled-labor wages as consequence of enters of new entrepreneurs into the market.

the latter were able to encourage and protect new discoveries particularly in the high-tech sector, countries such as Brazil and Mexico went too further in an expansion of their main exporting sector in terms of merely quantity, without looking forward for considerable innovations[6].

## 2.2. Quality-upgrade and Structural Transformation

Lederman and Maloney (2012) engage this topic focusing on "How" the goods are produced and how much this matter for the final growth of developing economies, in other words, "*countries do not automatically become the best of what they produce*". Indeed, they report several country specific examples on the transformation process and reallocation of knowledge across industries in order to highlight how human-capital and technological spillovers heavily matter. Scandinavian countries provide the best lesson on broadening comparative advantages and productive sectors by mean of high targeted researches on their natural resources: Finland provided a suitable scenario to make possible a transformation of a cellulose mill into Nokia, absolute market leader in telecommunications till few years ago. Therefore, it seems clear that a massive diversification alone is not enough to maximize economic growth, but it must be sustained by a combination of investment, research and trained human capital; moreover, it is of primary importance to understand that diversify towards high-tech production is not always synonymous of quality upgrade, because, quite often, developing country undertake only the last stages of these productions (generally the assembling stage) which do not provide a consistent value-added.

Hence, from the reasoning outlined by Lederman and Maloney appears evident that the portfolio effect play his main role during the initial phase of the diversification process, principally for least developing countries, because protects economies from prices fluctuation risks and thus creates the environment to start the GDP growth; but it is only with a proper dynamic effect that a country can really make the most from diversification and prepare itself for the re-concentration phase.

Nevertheless, the relationship between quality upgrade of export and economic growth has not been largely investigated; in fact, some studies focused on its impact on the direction of trade (Hallak, 2006), while others on how does it differently affects the social welfare and the rate of innovation respect to an horizontal differentiation (more varieties) (Grossman and Helpman, 1989).

[6] Lederman and Maloney (2012) used the Index of Revealed Comparative Advantage (IRCAI), which should be larger than 1 if the country has an innovation comparative advantage (i.e. the country produce more patents than the world average for that specific sector), of both Mexico and Brazil to show their failure in pushing up the value-added of their principal high-tech exporting sectors (computer for Mexico and aircraft for Brazil) over a 20 years period. In fact they both have an IRCAI<1, while the Republic of Korea's IRCAI has moved from a position below that of Mexico to a value larger than 3.

2.2.1. *R&D trade from North to South*

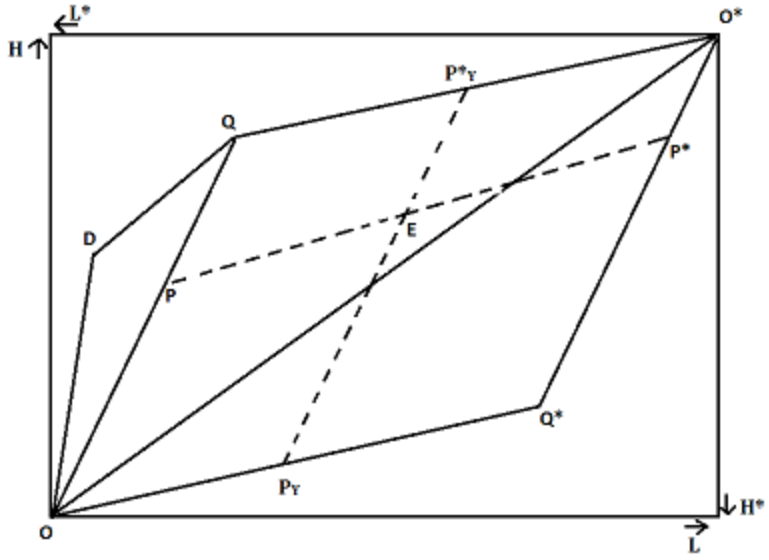
Among the pioneers were Grossman and Helpman (1989) who developed a model on product improvements, adopting a continuum of goods bounded in the interval [0,1], where firms are pushed to look for profitable innovations, which proportionally depend on related R&D investments, in order to increase market power and earn profits. One of the comparative analyses carried on by the authors, compares the quality improvement (i.e. vertical) to the variety improvements (i.e. horizontal) with a long-run target, findings that while for the latter the *equilibrium rate of innovation* is always really slow, for quality improvement it might be either slower or faster than its optimal. The reason behind is based on three effects, identified by the authors, that arise after an innovation: the *business-stealing effect* (i.e. the aggregate decrease in profits due to a marginal innovating entrant), the *consumer-surplus effect* (i.e. due to market distortion, consumers temporarily enjoy higher quality products at the same price as before) and the *intertemporal spillover effect* (i.e. the opportunity for all the other firms to use that innovation for their product's upgrade in the future). Hence, when the variety-based growth model is considered, the first two effects offset each other leaving only the *intertemporal spillover effect* as positive externality; while when there is a quality-upgrade, the *business-stealing effect* dominates the others two only for low or high values of the product quality level $\lambda$[7], creating a negative externality and pushing other firms to seek for new innovation in order to re-gain profits and market power[8]. In sum, Grossman and Helpman distinguish the two externality in *explicit* when a variety-progress is made because it decreases the cost of future R&D investment, and *implicit* for the quality-based growth model seeing that a successful discover forces the other firms to stop looking for that innovation, and instead, move towards the quality-step above which will generate profits and market share for them.

Finally, the authors test their model in an international trade set-up and explain how the prediction from the H-O model of complete specialization toward the country-specific comparative advantage falls when they relax their previous assumption of absence of MNEs (i.e. it imposes that product innovation and manufacturing take place in the same country). Indeed, using the Graph 1 they illustrates that when the endowment point E falls in the region OQO*Q* there will be no

[7] The authors defined product quality as a countable number such that the lowest quality of good ω is equal to 1. Hence, $Q_j(\omega) = \lambda^j$ where $\lambda>1$ is the same for every ω. This implies that in order to reach quality **j**, a product must be improved **j** times.

[8] In the variety-case the dixit-stiglitz preferences arise, and thus the consumer utility function changes. In fact in the quality-case $\boldsymbol{\log u(t)} = \int_0^1 \boldsymbol{\log}\left(\sum_j \boldsymbol{q_{j,t}}(\boldsymbol{\omega})\, \boldsymbol{d_{j,t}}(\boldsymbol{\omega})\right)\boldsymbol{d_\omega}$ while for the variety-case $\log u(t) = logE + log \propto + \gamma t\left(\frac{1}{\propto -1}\right)$, and thus $\boldsymbol{u(t)} = \left[\int_0^{n(t)} \boldsymbol{d_t}(\boldsymbol{\omega})^{\propto} \boldsymbol{d\omega}\right]^{\frac{1}{\propto}}$ where α (0< α <1) represents *the rate of substitution between varieties*. Therefore, also the welfare functions and the consequent maximization problem (respect to labor market equilibrium) of the *rate of innovation* will lead to diverse results. In fact, the welfare equation is $\rho U = logE - log\lambda + \frac{i}{\lambda}(log\lambda)$ and $\rho U = logE + log\alpha + \frac{\gamma}{\rho}\left(\frac{1}{\alpha -1}\right)$ for quality and variety respectively; where $\boldsymbol{i}$ and $\boldsymbol{\gamma}$ are the two innovation rates, $\rho$ is the consumer discount rate and E the flow of spending at time t.

incentive to split the two production processes due to factor prize equalization among the two economy. Instead, when E lies somewhere in the triangle ODQ, multinational enterprise start producing R&D activities (OD and DQ represent the two R&D employment vectors) in the relative skilled endowed home country (i.e. North) while they carry on the unskilled abundant manufacturing process abroad (i.e. South) making possible factor price equalization again and the consequent world integrated equilibrium.




**Graph 1**. *R&D Trade from North to South by mean of MNEs*

Their intuition has changed the concept of total and continuous specialization pursued by countries and driven by comparative advantages which should persist in each moment of the country development according to the H-O model. In Grossman and Helpman model, the production point of a specific product **moves** between the two countries following the discovery evolution path, as it starts from the home country when a R&D investment turns to be successful, consequently increases the region market share, and, thanks to MNEs, it then moves toward the foreign country to start the imitation process.

The clear lesson we learn from this is developing country can improve their production basket benefiting from knowledge spillovers from more skilled-endowed country and multinational activity.

However, as well as Agosin idea of copycats firm, this model does not directly discusses how developing country can undertake quality-upgrading process and R&D investment on their own, and, above all, whether this can really accelerate the development course. Furthermore, a reasonable question is whether each country can produce every type of new products which might need specific input as raw materials, infrastructures, intermediates and knowledge.

In fact, climbing the value-chain of two distinct products may occur at different innovation rates depending on both country and product specific characteristics. This aspect has not been defined and investigated in Grossman and Helpman (1989) as the authors used a continuum of products in a homogenous space where possible discoveries are driven only by fixed research costs, which means that the distance between the existing quality and the next discovery is always the same regardless of the level of sophistication already achieved and, most importantly, of the specialization path the country previously undertook. Indeed, supposing Brazil is seriously investing in R&D for medical related products, it would be really demanding for the country to reap all the benefits coming from a US innovation in the aerospace sector, but it would have been clearly easier if Brazil would have had focused on aircrafts for example.

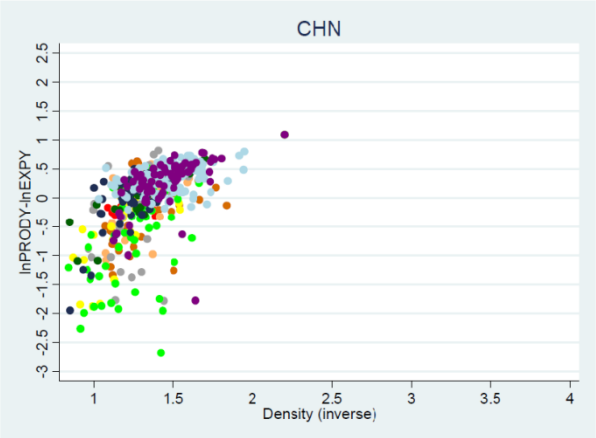
2.2.2. *The products' space*

Hausmann and Klinger (2006) investigates on whether the product space is homogenous for each economy, as all the precedent theory affirms, adopting a model of overlapping firms that lives for two periods and can either produce the standard goods (for which no additional investments and costs are needed due to the complete assimilation of the production process) and earn 1, or investing in the new product which has never been produced in the country before (e.g. it could be a quality upgraded goods coming from abroad as discussed before). However, the new production implies sustaining a cost to create new capabilities or adapt the existing ones for the new good, and moreover, this cost is increasing in the *distance* between the two products in terms of sector and capability affinity between them. This *distance* represents the substantial divergence from the Grossman and Helpman model and it is based on the concept that if two goods need similar capability and the country has already a revealed comparative advantage in the old goods, then it will be absolutely simple for firms to "jump" towards the new production and for the country to broaden its comparative advantages. The last element which together with the *cost of jumping* and *distance* plays a role in the likelihood for the country to concretely obtain a new comparative advantage is the *appeal* of the new product in terms of its future productivity and income growth[9]. The crucial conclusion from Hausmann and Klinger estimation is that the more a new product is close to the pre-existing path of goods undertook by the imitating country the easier would be for the latter to sophisticates in that production and generates inter and intra sector externalities.

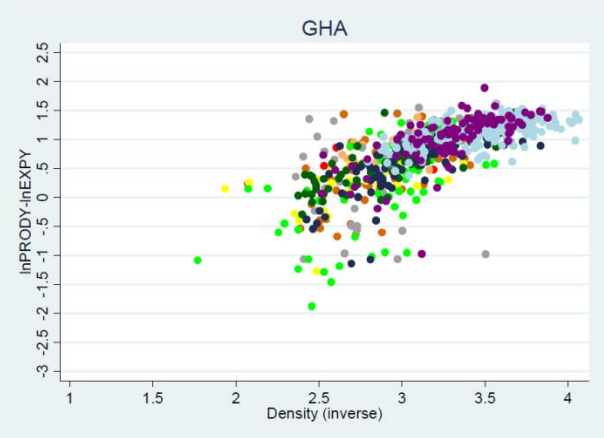
Therefore, a policy recommendation for developing countries would be to expand those sectors that make use of skills and resources effortlessly transferable to other goods, such as the light manufactures sector.

[9] The proxy used is PRODY from Hausmann, Hwang and Rodrik (2006) which is a weighted average of per capita GDP of each country where comparative advantages are the weights.

A clear explanation is given by the product space graphs 2 and 3 below provided by the authors, who plotted the difference between the income level of the new product (PRODY) and the level of sophistication of the country's export basket (EXPY) against the inverse of *density* of the country's product space for China and Ghana. Indeed, we can see how China has many products with a positive difference between PRODY and EXPY starting from a density of 1 (which reflects a really crowed product space seeing that its inverse is considered), while the first product for Ghana with a possibility of upgrade is at a level density of 2.4 with animal products and labor intensive manufactures.




**Graph 2.** *Product space China*




**Graph 3.** *Product space Ghana*

Hence, from Hausmann and Klinger it appears that quality enhancement can not be pursued at the same rate of innovation for all different kind of goods, but it deeply depends on the pre-existing country's comparative advantage path which determines whether the product space is really *dense* and thus favourable for create positive externalities, knowledge spillovers and human capital shifts within and across sectors.

Nevertheless, the product space could not be the only determinant for products quality-upgrade, because otherwise least developing countries should trade with totally developed countries at the same intensity of all the others. This actually does not happen due to remarkable gap in income per capita among countries which in turns determine differences in consumers' preferences regarding level of quality[10]. Therefore, quality can also influence the direction of trade itself splitting countries trading activities according to their income level: country has to increase their product quality at a certain point in time in order to further boost their GDP.

[10] Linder (1961) "An essay on trade and transformation" from Hallak (2006)

2.2.3. *Income and quality*

Hallak (2006) investigated on how the demand for quality is influenced by income using a theoretical model based on the Dixit-Stiglitz structure of preferences where the main variable of interest is the *intensity of preference* for quality of a country. In fact, while Dixit-Stiglitz structure imposes equality of *intensity of preference* across countries, Hesse removes this strong assumption postulating this relationship:

$$\gamma_z^k = \gamma_z + \mu_z ln y^k$$

where $\gamma$ is the intensity of preference, $z$ is the sector, $k$ the country and $y$ the importer's income. Therefore, the author tested the null hypothesis that reflects the Dixit-Stiglitz assumption (i.e. $\mu_z = 0$) against his alternative where importer's income positively impact demand for quality imports (i.e. $\mu_z > 0$). The empirical results confirmed his assumption seeing that the estimations of $\gamma_z^k$, which represents the coefficient of the interaction terms between *importer per capita income* and *exporter quality*, is positive for at least 2/3 of the analysed economies. Moreover, his results are confirmed even when the strict assumption of export prices as only determinant of quality is relaxed, allowing other variables such as exporter per capita income to play their role. The great feature of Hesse's work is the index of export prices he estimated as proxy for quality in each country and sector using cross-country differences in unit values for US imports at 10digit level, obtaining an elevated variation in his data and allowing him to precisely categorize products in differentiated, reference priced and homogenous for each economy.

This finding is the most interest in my opinion because clearly explains how quality and income are strongly correlated and together influence the path of trade. Therefore, developing country must improve their production quality at a certain period in order to enhance their development at the maximum growing rate possible.

# 3. METHODOLOGY

## 3.1. Econometric theory

The existing literature has been driven by the particular feature of both the research topic and of the macroeconomic variables involved towards dynamic panel estimation of growth rather than classic cross-sectional. The first problem arises with endogeneity as macro-level variables tend to influence each other in a cross-sectional analysis[11], and variables which commonly are used to explain growth such as gross capital formation, population growth or inflows of FDI can also be easily correlated with past values of the errors. Moreover, countries have different characteristics and may experience particular and unexpected periods of crisis or growth, and this moves against the cross-sectional hypothesis of absolute absence of fixed effects.

*Endogeneity* and *country-specific fixed effects* can be effectively solved using the two dynamic GMM estimators, first-difference (Arellano and Bond, 1991) and system (Arellano and Bover, 1995; Blundell and Bond, 1998), keeping in mind that fixed effect are supposed to be independently distributed across countries. In fact, while the first-difference GMM estimator solve the mentioned problems by mean of only differences equations with lagged values of the independent variables used as instruments, system GMM estimator additionally uses equation in levels with lagged first-differences. Hence, these techniques allow, firstly, for explanatory variables which are influenced by either their past realizations or other variables (i.e. endogeneity), and secondly for the time invariant country-specific effects that just disappear thanks to the first differences.

However, there are specific characteristics involved on growth models that usually make the system GMM more suitable than the difference GMM, as well as there are others that weaken the former favouring the latter.

Above all, a great part of macroeconomics variables associated with GDP and its growth are not simply relying on their past realization, but they are commonly *high persistent*[12]; this means that first-differences equations have not a great margin of variation to successful perform, while the system GMM avoid this problem by further using the lagged difference of the endogenous variables as instruments. Following the same reasoning, if the dependent variable is close to a *random walk* (i.e. when coefficient of the lag of the dependent variable approaches to 1) then just taking the first-difference equation could not be enough, and this definitively depends on whether past levels

[11] Caselli et al. (1996) from Hesse (2008)
[12] Blundell and Bond (1998), Lederman and Maloney (2003), Aditya and Roy (2010), Hesse (2008).

incorporate sufficient information on future realization[13]. Roodman (2009) clarifies the diversity between the two estimators as he says that while first-difference GMM tackles the problem by mean of past levels to explain current changes, the system GMM uses past changes to explain current levels[14]. In sum, when either the lagged dependent variable's coefficient α is close to 1 (random walk) and/or when the ratio of the variances of the unobserved time-invariant country-specific fixed effects to that of the residual error component ($\sigma_\eta^2 \,/\, \sigma_\upsilon^2$ where $\eta_i$ represent the time-invariant fixed effect, while $\upsilon_{i,t}$ is subjected to variation in time) is high, then system GMM will be preferred to first difference GMM (Blundell and Bond, 1998).

Other important considerations to keep in mind are that both first-difference and system GMM performs better when the dataset is characterized by *small T and big N*, especially the system GMM; *time dummies* must be included to ensure the no correlation assumption across individual, and that system GMM is based on the assumption about the proximity of variables to their *steady state* values.

#### 3.1.1. *Over identification and autocorrelation*

Last but not least, one should always checks for *over identification* problem arising from the use of too many instruments, and *autocorrelation of the idiosyncratic disturbance terms*; while I could not test them for the preliminary estimations on the entire dataset obtained with both a Linear Panel estimation with AR(1) disturbance and a difference-GMM, I did it for each of the system-GMM exercises I performed thanks to the awesome feature of the **xtabond2** Stata function which always reports both tests after each regression.

The Sargan/Hansan test for over identification is generally used for GMM estimations and checks for the exogeneity of instruments utilised, then it turns to be really important for difference and system GMM because they are both based on the use of dependent variable lags as instruments. Roodman, who developed the **xtabond2** function, explains that these two peculiar econometrics techniques likely generate a large amount of instruments that "count quadratic in the time dimensions of the panel T, and will enlarge the variances matrix till a certain point where it becomes singular and the use of a generalize inverse is needed". This does not impact the consistency of results, but the more T increases the less reliable the Hansen test becomes, reporting suspicious "positive" p-value of 1.000, and the less it will converge to the asymptotic result. Nevertheless, there is not a general rule on how many instruments are "too much" and Roodman

[13] Blundell and Bond (1998), Roodman (2009)

[14] **First-difference**: $\Delta y_t = y_{t-1}$, while **System**: $y_t = \Delta y_{t-1}$

suggests to keep an eye on the Hansen test values which should not be lower than 0.1, to be sure about the joint validity, and not larger than 0.25 only for asymptotic problems.

While the over identification problem does not impact the consistency of the estimation, an eventual autocorrelation of the idiosyncratic parts of the errors terms would force to apply further and longer lags to solve the inconsistency. The test developed by Arellano and Bond investigates on the residual in differences "checking for serial correlation of order $l$ in levels by looking for correlation of order $l$+1 in differences" (Roodman, 2009). However, the interest must focus on the second-order serial correlation and not on the first-order which is expected by construction and is never taken into account for difference and system GMM[15].

## 3.2. The model

The model applied for the research is kept as easier as possible firstly because the more variables are included, the more likely an over identification problem will arise, and secondly the previous literature has always followed this way including classical growth related variables in a first instance such as investment as share of GDP and population growth, and then checking the consistency of others like level of openness or average of year of school. Moreover, in this way it is possible to understand the extent to which the hypothesis on the non-linearity between export diversification and economic growth is valid and continues to hold.

The dependent variable used as proxy for economic growth is the natural log of GDP (constant 2005 US$) which expresses the percentage change in the main variable of interest; the choice has been made mainly because it allowed to easily and efficiently normalize the data, while using the GDP growth (annual percentage) would have meant dealing with negative values normalization problems[16].

Therefore the final estimated equation looks like:

$$logGDP_{i,t} = \alpha + \beta_1 logGDP_{i,t-1} + \beta_2 X_{i,t} + \beta_3 HHI_{i,t} + \beta_4 HHI_{i,t}^2 + \eta_i + \upsilon_{i,t} \qquad (1)$$

where $X_{i,t}$ is a vector of explanatory variables which always includes the natural log of gross capital formation, the log growth of population, the inflation deflator of GDP and, depending on the specific estimation pursued, the level of openness and the level of exports' quality; $HHI_{i,t}$ is the Herfindahl index of export concentration and is included both alone and with its squared term to

[15] In fact, the difference of the idiosyncratic disturbances in time **t** is mathematically related to that in **t-1** by mean of the shared past value **t-1**. ( $\Delta v_{i,t} = v_{i,t} - v_{i,t-1}$ and $\Delta v_{i,t-1} = v_{i,t-1} - v_{i,t-2}$) (Roodman, 2009)

[16] A first attempt was made with the log of GDP growth, but, even if the results were statistical significant, several negative observations were lost and this would have seriously biased the results towards "well-performing" countries only. In other words, it would have made not that much of a sense, in my opinion, to analyse a development topic focusing only on rich countries.

detect the non-linearity; $\eta_i$ is the country-specific time invariant effect and $\upsilon_{i,t}$ is the residual part of the error terms, and, of course, the subscripts *i* and *t* refers to country and time respectively; finally, years dummies are included being of crucial importance for dynamic panel to avoid contemporaneous correlation (Roodman, 2009).

Therefore, the main two expectations from equation (1) are that $\beta_3$ and $\beta_4$ have a **negative** and **positive** sign respectively, which would indeed reflect a non-linearity going from export concentration to economic growth; this is the main hypothesis I will go to check and it represents already a step forward respect part of the previous literature where only the sing of export concentration (or diversification) was tested (Lederman and Maloney, 2003; Agosin, 2007). Other attempts was made including also the squared term, but first of all *large T*[17] dataset were used adopting average values over five-year periods (Aditya and Roy, 2010; Hesse, 2008) instead of testing the different panels separately which, as I will show later in the results' description, could dramatically biased the estimation due to over identification problem (i.e. p-value of the Hansen test become "too reassuring" converging to 1,000); or again the non-linearity was founded to be significant only by mean of an interaction between HHI and GDP per capita used, indeed, as a proxy for $HHI^2$, meaning that while rich countries benefit from concentration (i.e. elevate level of GDP per capita), poor countries grow thanks to diversification (Hesse, 2008).

3.2.1. *Interactions hypothesis*

Nevertheless, the interaction interpretation as well as the inclusion of their main effect could be very tricky when two continuous variables are taken into account, and, moreover, the previous literature has barely investigated this field. Indeed, when Hesse (2008) included both the interaction with GDP per capita and the main effect, the coefficient of HHI dramatically increased from -0.482 (estimated together with $HHI^2$ which was founded positive but statistical insignificant) to -1.474, and secondly the p-value of the Hansen test was in both case surprisingly high around 0.990. The other only two interaction terms I found were instead included alone, and they focused on the exports' growth rate (Agosin, 2007) and on the country's exports volume with respect to the world average (Aditya and Roy, 2010). Both terms were significant meaning that the positive effect of export diversification on economic growth is stronger when countries' exports are either growing at high rates or their volume is larger than the world average capturing a kind of comparative advantage.

[17] As I explained, these estimation techniques are suitable for panel with *small T* and *big N*, otherwise both autocorrelation of idiosyncratic residuals and over identification problem can easily arise.

I based my interactions terms with Quality of exports and Openness on this idea, and my reasoning linking the interaction effect on the position of the "turning point" follows this line: if countries with higher level of Quality exports or Openness can better reap the benefits of diversification respect those with low level of both variables, then the possibility of technological and knowledge spillovers, both inter- and intra-industry, increases, and the concentration phase will come closer. Equation (2) reproduces the idea:

$$logGDP_{i,t} = \alpha + \beta_1 logGDP_{i,t-1} + \beta_2 X_{i,t} + \beta_3 HHI_{i,t} * Quality_{i,t} + \eta_i + \upsilon_{i,t} \qquad (2)$$

The expectation is that $\beta_3$ of equation (2) is **negative** meaning that the positive effect of diversification is stronger and amplified when Quality of export is higher[18] (same reasoning holds for Openness and its interaction I will check), and this should boost the dynamic effect and enhance a more suitable and sustainable economic growth. Indeed, one can expect that higher quality means more R&D investments as higher Openness could imply more stable and favourable trading relationships between countries and both these two factors definitively favours knowledge spillovers.

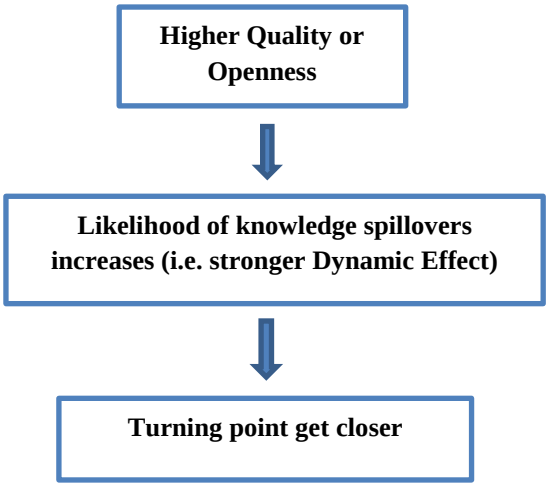



**Figure 4.** *Interactions mechanism*

## 3.3. Data sources and computation

First of all, my definitive sample is composed by 95 countries that I choose among 174 of the initial sample following the definition of *large* country from Hallak (2006), who pick those countries with a population larger than 3 million and with more than US$ 2 billion of imports; being my research based on exports instead of imports, my choosing criteria relies on export values larger than US$ 2 billion (the entire list of countries is reported in the Appendix).

[18] Aditya and Roy (2010), Agosin (2007)

A consistent part of the explanatory variables come from World Bank Database as well as the dependent variable, while the Herfindahl index and total population size are taken from UNCTAD. Starting from the main variable, I used GDP in constant US$ 2005 from World Bank and as I explained before, I took the logarithm to express the growth from one year to the other. For the *gross capital formation as share of GDP*, I always used that from World Bank and I took the logarithm following all the literature on economic growth and export concentration; however, due to lack of data for the first 5 year panel going from 1995 to 1999, I conducted another estimation with gross capital formation from World Trade Integrated System (WITS) improving the validity of the model[19]. The other main variable is represented by *population size* from UNCTAD and I simply consider her *percentage growth* per each period adding a value of 0.05 (Hesse, 2008; Caselli et al., 1996; Hoeffler, 2002) which represents the sum of constant rate of technological process and depreciation rate also because they are not taken into account by my dependent variable. In the classic Solow Model where the dependent variable is real GDP per capita growth, *population growth with the technology parameter* is expected to negative affect economic growth per capita, however it is always positive and strongly significant in my estimations meaning that a larger workforce might enlarge total GDP and boosts economic growth at country level, but not be enough to register growth per capita.

The last main variable I added is *Inflation (as GDP deflator)* also from World Bank; I decided to include it first because I imagine it could slow down growth especially in an export context where trading activities are strongly impacted by price fluctuation, and secondly because it was never considered before (at least in the encountered literature).

Regarding Quality of export and Openness, which are entered in the equations both as independent variable and mainly as interaction with the main variable HHI, while the latter is also from World Bank, the former is an index making part of the Diversification Toolkit from the International Monetary Fund; I have calculated the average of Quality at 3-digit level seeing that also the HHI provided by UNCTAD is constructed on the same digit level. Openness instead is simply the share of Trade on GDP.

Furthermore, I also managed to download from WITS (World Integrated Trade System) the EXPY index developed by Hausmann et al. (2006) which captures the sophistication of a country's export basket; even if the bulk downloads was not available for guest users, I decided anyway to invest time and energy in downloading 5 countries and 5 years files (the maximum extent allowed) only because I retain it could have an excellent explanatory power for quality upgrade and

[19] Indeed, as it is showed in the Appendix Table. 1, this issue creates an over identification problem seeing that the reported p-values of Hansen test are too high to be not suspicious and, moreover, ln GCF is not significant, while it is always for the other two panels.

favourable-growth product space. Indeed, it is the sum of each sector's PRODY weighted by the share of that sector in the export basket of the country, where PRODY represents the average of the income per capita of a country weighted for the Relative Compared Advantage of each country on a specific good (McCann 2007)

$$EXPY_j = \sum_k \frac{x_{jk}}{X_j} PRODY_k \text{ , and } PRODY_k = \sum_j \frac{x_{jk}/X_j}{\sum_j (x_{jk}/X_j)} Y_j$$

where $Y_j$ is the per-capita GDP of country $j$, $x_{jk}$ are the export of country $j$ for the specific sector $k$ and $X_j$ are total exports of country $j$. Moreover, EXPY has a satisfactory coverage for my dataset especially for the period from 2000 to 2010, and I used its logarithm to better catch a percentage shift in quality.

Finally, the proxy for the main variable of interest is the Herfindahl Index from UNCTAD constructed at 3-digit level, which has been broadly used in the past research and, moreover, it covers all the countries for the time period analysed. As every Herfindahl Index it has a range values from 0 to 1 where concentration is maximum.

3.3.1. *Summary Statistics*

The summary statistics' Table 1 below gives some preliminary interesting numbers for the next Results section; the reported values are the means for the main variables of interests and are braked down for the different country's areas on the whole sample 1995-2010. As we can see, the areas with the highest concentration values are Western Asia, Africa and North Africa followed by Latin America and East and South Asia which still have a value above the World average of 0.274. Looking at Western Asia, it is interesting that even if this area reports the highest HHI on average, the values of Quality of Exports and Openness are both above the world average where the latter is even the second after only East and South Asia; this could be interpreted as a consequence of a strong dependence for these countries on commodities exports, which indeed are part of an high quality sector. Nevertheless, the value of log EXPY is below the average meaning that commodities could not be a good comparative advantages path where technological and knowledge spillovers may arise, even if the quality needed is elevated. Rapidly looking at the other values, the Inflation deflator's mean for Africa leaps out being tremendously high (82.2) respect all the others even compared to North Africa which instead registers only 7.55; therefore this leads to think that the elevated HHI for Africa (which is the second highest) might be driven also from a serious financial instability and lack of operating financial system (IMF, 2014). Concluding, Latin America seems to be the most "stuck" area seeing that has the lowest values for both Quality of Exports and log of EXPY and the second lowest for Openness after only North America (which, however, has the most

performing HHI, Quality and EXPY); this finding has already been reported by Agosin (2007) who stressed how Latin American countries were not as able as East Asian countries to efficiently readdress resources from primary sector towards the manufacturing one (e.g. Chilean wines).

**Table 1.** *Means of the main variables for the different geographic areas*

| Area | Number | log GDP | log GCF | Pop. Size (mil) | Pop. Growth | Inflation | HHI | Quality Ind. | log EXPY | Openness |
|---|---|---|---|---|---|---|---|---|---|---|
| TOT | 95 | 25.185 | 2.06 | 59.33 | 3.425 | 20.57 | 0.274 | 0.828 | 9.712 | 83.195 |
| EU | 29 | 26.093 | 1.852 | 26.651 | 0.073 | 14.15 | 0.134 | 0.916 | 9.915 | 86.306 |
| East and South Asia | 21 | 25.24 | 2.107 | 166.93 | 14.646 | 19.52 | 0.289 | 0.783 | 9.716 | 105.4 |
| Western Asia | 8 | 24.457 | 2.265 | 11.839 | 0.106 | 12.22 | 0.521 | 0.841 | 9.677 | 90.42 |
| Africa | 9 | 23.66 | 2.395 | 35.6 | 0.668 | 82.2 | 0.458 | 0.682 | 9.317 | 78.75 |
| North Africa | 5 | 24.74 | 2.041 | 29.33 | 0.261 | 7.55 | 0.353 | 0.819 | 9.626 | 67.737 |
| Latin America | 10 | 24.903 | 2.461 | 35.82 | 0.514 | 10.947 | 0.291 | 0.792 | 9.503 | 50.11 |
| Central America and Caribbean | 8 | 24.15 | 2.132 | 19.9 | 0.257 | 7.532 | 0.237 | 0.819 | 9.542 | 79.72 |
| North America | 2 | 28.9 | 1.564 | 163.19 | 4.41 | 2.102 | 0.105 | 0.944 | 9.993 | 48.016 |
| Oceania | 3 | 24.895 | 1.554 | 9.72 | 0.072 | 4.466 | 0.211 | 0.827 | 9.742 | 65.952 |

In the next section I provide my results explaining also why I adopted different estimator for different panel dataset by mean of all the considerations stated in the Methodology. I will mainly focus on the time size of my dataset, the autoregressive degree of the dependent variable (Arellano and Bond test for AR of the second order) and the over identification issue (Hansen test) in order to obtain the most reliable results.

# 4. RESULTS

## 4.1. Entire dataset 1995-2010

A first attempt has been carried out on the entire dataset to have both a first check of the non-linearity and also to show how system-GMM could be tricky with *large T* dataset reporting a more than suspicious Hansen test's p-value converging to 1.000. In addition, I decided to adopt both a Fixed Effect Linear Panel with an AR(1) disturbance (which should be then more suitable than a normal linear panel seeing that goes closer to the idea of dynamic estimation) and the difference-GMM which performs better than system-GMM as the time dimension increases[20].

Table 2 shows the results for the Linear Panel. In column 1 the non-linear relationship seems to be the reverse of what the theory suggest, but only HHI results positive and significant; this weird result leads me thinking about a possible delayed effect of HHI which could be better caught by the classic linear estimation, and, moreover, the lag of HHI may get closer to the first difference applied by dynamic panel. Indeed, when the first lags of both HHI and $HHI^2$ are used (column 2), the relationship comes back to have the expected sign, where concentration positively affects GDP growth only after a certain point on time; however only in column 3, when also Openness and Quality are included, the variables of interest become statistically significant. Interesting, also Openness appears to have a significant effect only when her lag is entered (column 4) increasing also the significance and magnitude of concentration. Nevertheless, the results are really far to be satisfying and reliable seeing that all estimations report dubious elevated R squared.

The difference-GMM estimation dramatically improve the overall significance of the model as well as of the two main variable of interest HHI and $HHI^2$ denoting the superior explicative power respect the linear panel of Table 2; in fact, the non-linear relationship is immediately observed with the structural equation in column 1 of Table 3, where all the variables are significant and with the expected sign. In addition, column 2 and column 3 repeat the tests pursued with the linear panel including Openness and Quality, and as before both significance and magnitude of HHI are pushed up and also the delayed effect of Openness is confirmed (column 3).

[20] Due to an issue of not positive definite matrix of covariance, in both the Linear Panel and Difference-GMM the normal share of gross capital formation is entered instead of his logarithm. I suspect this problem derives from a large lack of data when all the dataset is considered, and furthermore, this problem will in part arise also for the panel 1995-1999.

**Table 2.** Fixed Effect Linear Panel with AR(1) disturbance 1995-2010

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| *VARIABLES* | 1 | 2 | 3 | 4 |
| *ln GDP$_{T-1}$* | 0.997*** | 1.004*** | 0.815*** | 0.865*** |
| | (0.00686) | (0.00608) | (0.0169) | (0.0149) |
| *HHI* | 0.123* | | | |
| | (0.0701) | | | |
| *HHI $^{2}$* | -0.123 | | | |
| | (0.0765) | | | |
| *HHI$_{T-1}$* | | -0.0282 | -0.126* | -0.146** |
| | | (0.0685) | (0.0662) | (0.0668) |
| *HHI $^{2}_{T-1}$* | | 0.00840 | 0.150** | 0.153** |
| | | (0.0769) | (0.0748) | (0.0752) |
| *Inflation* | -0.000233*** | -0.000238*** | -0.000224*** | -0.000233*** |
| | (4.24e-05) | (4.22e-05) | (3.94e-05) | (3.93e-05) |
| *Pop. Growth* | 0.00138 | 0.00131 | 0.00397*** | 0.00296** |
| | (0.00139) | (0.00140) | (0.00144) | (0.00143) |
| *GCF* | 9.23e-05*** | 9.40e-05*** | 8.95e-05*** | 8.95e-05*** |
| | (1.64e-05) | (1.63e-05) | (1.51e-05) | (1.51e-05) |
| *Openness* | | | 0.000129 | |
| | | | (9.22e-05) | |
| *Openness$_{T-1}$* | | | | 0.000405*** |
| | | | | (9.67e-05) |
| *Quality* | | | 1.070*** | 1.026*** |
| | | | (0.117) | (0.116) |
| *Ys** | Yes | Yes | Yes | Yes |
| *Constant* | -0.0518 | -0.0154 | -0.384*** | -0.149* |
| | (0.0957) | (0.0948) | (0.0913) | (0.0890) |
| *Observations* | 1,164 | 1,164 | 1,160 | 1,160 |
| *Number of number* | 89 | 89 | 89 | 89 |
| *R-sq (with-in)* | 0.9765 | 0.9761 | 0.9774 | 0.9772 |

Adjusted Durbin-Watson Standard errors in parentheses
***p<0.1, **p<0.05, *p<0.1

**Table 3.** Difference-GMM Dynamic Panel 1995-2010

| | (1) | (2) | (3) |
|---|---|---|---|
| VARIABLES | 1 | 2 | 3 |
| *ln GDP$_{T-1}$* | 0.920*** | 0.828*** | 0.830*** |
| | (0.0429) | (0.0488) | (0.0490) |
| *HHI* | -0.759** | -0.802*** | -0.882*** |
| | (0.326) | (0.293) | (0.317) |
| *HHI $^{2}$* | 0.545** | 0.660** | 0.731** |
| | (0.260) | (0.270) | (0.288) |
| *Pop. Growth* | 0.00638*** | 0.00354* | 0.00352* |
| | (0.00181) | (0.00201) | (0.00213) |
| *Inflation* | -0.000395* | -0.000381* | -0.000385* |
| | (0.000223) | (0.000222) | (0.000223) |
| *GCF* | 0.000161** | 0.000160** | 0.000159** |
| | (7.16e-05) | (7.49e-05) | (7.46e-05) |
| *Quality* | | 1.993*** | 1.987*** |
| | | (0.490) | (0.498) |
| *Openness* | | 0.000138 | |
| | | (0.000167) | |
| *Openness$_{T-1}$* | | | 0.000420** |
| | | | (0.000183) |
| *Ys** | Yes | Yes | Yes |
| *Constant* | 2.147** | 2.803*** | 2.743*** |
| | (1.093) | (1.027) | (1.041) |
| *Observations* | 1,163 | 1,159 | 1,159 |
| *Number of number* | 89 | 89 | 89 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The computation of the partial derivative of Equation 1 with respect HHI has been of fundamental importance for me to better understand the "movements" of the turning point on the non-linear relationship, and to interpret my results. Indeed, equating the derivative to zero, the critical value of concentration HHI* is easily calculated as:

$$\frac{\partial logGDP}{\partial HHI} : \beta_3 + 2\beta_4 HHI = 0 \quad \boldsymbol{HHI}^* = -\frac{\beta_3}{2\beta_4} > 0$$

Being $\beta_3$ the negative coefficient of HHI, the critical value *HHI** will indeed be positive; calculating it for the three difference-GMM estimations we have 0.696 $(0.759/2 * 0.544)$, 0.607 $(0.802/2 * 0.66)$ and 0.603 $(0.882/2 * 0.731)$ for column 1, 2 and 3 respectively[21]. This decreasing trend of *HHI** has been the strong hint that heads me towards the interactions between HHI and both Quality of Exports and Openness; in fact the critical value, where the turn-around arises, drops by almost 0.1 as both the two mediating variables are included, and this clearly suggests a sort of influence by the latter on the "concentration path". Moreover, the correlation matrix (Appendix) shows as both *Quality* and *Openness* are negatively correlated with concentration.

The last estimation with the system-GMM is reported in Table 4 and basically illustrates how, with this technique, the number of instruments tends to explode as the time dimension increases, showed by Hansen's p-values of 1.000, and strongly biases the results. However, also in this case the hypothesis on the non-linearity seems to be confirmed with an apparent strong significance, as well as the decreasing trend of *HHI** when Quality and Openness are included; in fact the turning point falls from 0.467 (column 1) to 0.438 when Quality is added (column 2) and even till 0.408 with also Openness (column 3). Two more notations must be made, first that the matrix of covariance is now positive definitive also with the log of capital formation, and secondly the constant term is omitted because, using system-GMM, it would have the same effect as introduce the *time* as regressor and arise inconsistency[22].

[21] Moreover, the **second order condition** $\frac{\partial^2 logGDP}{\partial HHI^2} : 2\beta_4 > 0$ satisfies the positivity constraint ($\beta_4$ is the positive coefficient of $HHI^2$), meaning the HHI* is, indeed, a minimum.

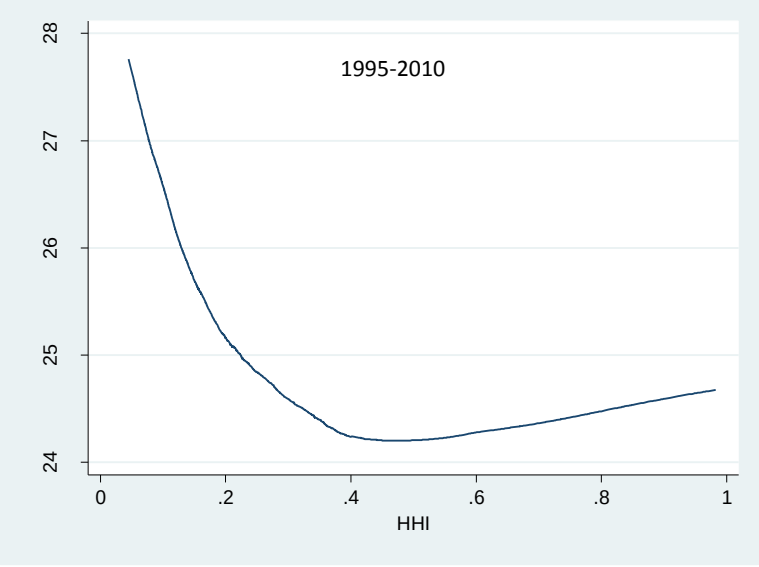
[22] Even if the effect is mitigated by a proper set of dummy variables as Roodman (2009) says, I notice that all of them become strongly significant when the constant term is omitted.

**Table 4.** System-GMM Dynamic Panel 1995-2010

| | (1) | (2) | (3) |
|---|---|---|---|
| VARIABLES | 1 | 2 | 3 |
| *ln GDP$_{T-1}$* | 0.968*** | 0.961*** | 0.979*** |
| | (0.00514) | (0.00783) | (0.00425) |
| *HHI* | -0.464*** | -0.363*** | -0.194*** |
| | (0.101) | (0.0945) | (0.0566) |
| *HHI* $^2$ | 0.497*** | 0.414*** | 0.238*** |
| | (0.108) | (0.101) | (0.0622) |
| *Pop. Growth* | 0.000604*** | 0.00102*** | 0.000630*** |
| | (0.000205) | (0.000322) | (0.000202) |
| *Inflation* | -0.000144*** | -0.000171*** | -0.000135*** |
| | (4.60e-05) | (5.91e-05) | (2.74e-05) |
| *ln GCF* | 0.00858*** | 0.0105*** | 0.0111*** |
| | (0.00162) | (0.00184) | (0.00140) |
| *Quality* | | 0.333*** | 0.153*** |
| | | (0.0916) | (0.0509) |
| *Openness* | | | 3.36e-05 |
| | | | (3.00e-05) |
| *Ys** | Yes | Yes | Yes |
| *AR(2) Test* | (0.823) | (0.638) | (0.808) |
| *Hansen Test* | (1.000) | (1.000) | (1.000) |
| *Observations* | 844 | 841 | 841 |
| *Number of number* | 90 | 90 | 90 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Finally, following Imbs and Wacziarg (2003) who were among the firsts to understand the phenomenon and plot it, I used a lowess line[23] to illustrate the non-linear relationship with Graph 4.




**Graph 4.** *Author's calculation using STATA software*

As the two authors found with several specifications of export concentration, the relationship is clearly non-symmetric as the concentration phase is not extended enough to reach back the initial level of log GDP. Nevertheless, the main result is confirmed, and the turning point seems to be much more closed to the System estimate (0.467, Col.1 Tab.4) than to the Difference one (0.696, Col.1 Tab.3).

[23] See Footnote 3 Page 9

## 4.2. System-GMM on *small T* panels

When the dataset is broken down into three different panels, the consistency and reliability of the estimation dramatically increases as the p-values of the Hansen test are now far from being too high and generate suspects on a "too easy" solution of the over-identification problem. Table 5 reports the results for the panels 1995-1999[24], 2000-2004 and 2005-2010 where the odd columns shows only the negative effect of concentration on GDP growth (i.e. first phase), while the even ones test for the non-linearity. As we can see, there is a certain trade-off between validity of the estimation (Hansen test) and statistical significance as the latter declines for the main variable of interest respect to the estimation on the whole panel, but still the two main hypotheses on the effect of export concentration on economic growth are confirmed on all three period.

Indeed, HHI has always a **negative impact** on the dependent variable, but his magnitude is found to be consistently different between the period 1995-1999 and the other two; I address this discrepancy to a possible paucity of gross capital formation data which somehow distorts the estimation. Though, all three exercises follow a common path as both the magnitude and the significance of HHI raise when $HHI^2$ is taken into account, probably meaning that the two effects can not be split without allowing for an incomplete estimation; this particular result move against the previous literature where the opposite trend was found. In fact, I consider that omitting the squared term of concentration means leaving out the effect of those countries that successfully undertook and completed their export diversification process, showing how the latter is decisive to boost growth as much as possible (and on the contrary how bad concentration might be at the dawn of the path).

The most performing panel is also the most recent one, and this could probably come from either a year more in the time dimension or a superior accuracy of the data; in fact, here the non-linearity is strongly supported as well as the single negative effect of HHI in column 5. The critical values where the relationship turns around (*HHI*)* are 0.523, 0.491 and 0.495 for 1995-1999, 2000-2004 and 2005-2010 respectively, displaying a sort of stability across the different periods around the middle value of the HHI's range. Finally, deserve a word of attention the coefficient of *Inflation,* which now is not significant anymore (compared to the exercises pursued on the entire dataset) for five estimation out of six, and, above all, is always positive; so there might be either some kind of counteractive effect or, more likely, price's instability has a significant impact only in the long-run.

[24] As explained before, logGCF from WITS is used for 95-99 due to lack of data, anyway the estimation with GCF from WB is also provided in the **Appendix Table 1**

**Table 5.** System-GMM Dynamic Panel

| | 1995-1999 | | 2000-2004 | | 2005-2010 | |
|---|---|---|---|---|---|---|
| VARIABLES | 1 | 2 | 3 | 4 | 5 | 6 |
| *ln* $GDP_{T-1}$ | 0.896*** | 0.893*** | 0.985*** | 0.980*** | 0.969*** | 0.963*** |
| | (0.0433) | (0.0448) | (0.00783) | (0.00825) | (0.00790) | (0.00856) |
| *HHI* | -0.427* | -1.656* | -0.0597* | -0.345** | -0.0634** | -0.463*** |
| | (0.226) | (0.883) | (0.0318) | (0.164) | (0.0301) | (0.111) |
| $HHI^2$ | | 1.584* | | 0.351* | | 0.468*** |
| | | (0.879) | | (0.187) | | (0.118) |
| *Pop. Growth* | 0.00156** | 0.00109* | 0.000381** | 0.000393** | 0.000891*** | 0.000922*** |
| | (0.000753) | (0.000603) | (0.000191) | (0.000183) | (0.000302) | (0.000290) |
| *Inflation* | 2.11e-05 | 3.03e-05 | 0.00230 | 0.00220* | 0.00148 | 0.000701 |
| | (1.95e-05) | (4.72e-05) | (0.00149) | (0.00127) | (0.00127) | (0.00120) |
| *ln GCF (wits)* | 0.124** | 0.258* | | | | |
| | (0.0560) | (0.131) | | | | |
| *ln GCF* | | | 0.0108*** | 0.0104*** | 0.00860*** | 0.00749** |
| | | | (0.00281) | (0.00293) | (0.00299) | (0.00297) |
| *Ys** | Yes | Yes | Yes | Yes | Yes | Yes |
| *AR(2) Test* | (0.385) | (0.522) | (0.177) | (0.105) | (0.620) | (0.948) |
| *Hansen Test* | (0.285) | (0.160) | (0.112) | (0.136) | (0.124) | (0.342) |
| *Observations* | 267 | 267 | 190 | 190 | 228 | 228 |
| *Number of number* | 89 | 89 | 85 | 85 | 87 | 87 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

### 4.2.1. *Interactions: empirical analysis*

The second part of the empirical analysis focus on the influence of the mediating variables that proxy for *quality of exports* and *level of openness* towards international trade; as I explained before in the Methodology, the past literature has not focused too much on this topic and the only attempts I encountered are related to either the exports' growth rate (Agosin, 2007) or to the volume of exports of a country respect to the world average (Aditya and Roy, 2010). Nevertheless, the importance of both products' quality as well as inclination to trade as tools to speed up the U-shaped process have been emphasised by past research; for example, Imbs and Wacziarg (2003) had already understood how countries with an high level of openness had turn-around towards the second phase earlier in comparison to more trade-closed economies[25]. Hence, this scarcity of bids, and, most importantly, the downward trend of *HHI** detected on the entire dataset with both difference and system GMM, really pushed me to further investigate in this direction; thus, Table 6 and 7 reports the results for Quality and Openness respectively.

[25] See Page 10

First of all, I would remind that the expectation for $\beta_3$ of equation 2 is a **negative sign**[26] meaning that the positive effect of diversification is intensified for countries that tend to boost either exports' quality or openness. Secondly, as far as I understood from the literature on both interactions by itself and in the specific topic of this research, it is arduous to give a real and specific number which expresses the additional effect when both non-linear estimations and interactions of continuous variables are simultaneously involved. This is why I will combine the classic empirical estimation with the graphic analysis in the *sub section 4.2.2*.

- *Quality*

Said that, I tested the possible favourable effect of exports' quality on the diversification phase through both the *Quality Index* I have already used for the entire dataset's estimations, and the *EXPY Index* which not only proxies for quality but also combines that with the concept of product space's density analysed by Hausmann and Klinger (2006). The results for *Quality* are all with the expected negative sign and statistical significant, but, as happened before with the main effect alone (HHI), the magnitude for the period 1995-1999 (column 1) is much stronger in comparison with that of 2000-2004 (column 3) and 2005-2010 (column 5) that instead are much more closer to each other. Nevertheless, again all the results are significant, with two out of three at 5% level, supporting the idea that an higher level of *Quality* implies a stronger effect of Diversification on economic growth. When instead the *EXPY Index* is entered as a proxy of exports' basket quality (column 2, 4 and 6), the results still go towards the expected direction but they are significant for only 2000-2004 and 2005-2010 periods and, as I mentioned in the methodology, this is probably due to lack of observations for the first dataset. Looking at the level of significance, while for the period 2000-2004 there is not an improvement compared to *Quality*, we can find it for the panel 2005-2010 where *EXPY* is instead significant at 1% level. Moreover, the *EXPY Index* is entered with his logarithm (as the data source provided it), then his magnitude is not comparable to that of Quality as here we are speaking about a percentage shift in quality (*EXPY*) instead of the simple level (*Quality Index*); thus, column 5 and 6 show how an increase on the sophistication level of the export basket of a country is more significant than the actual level of quality for the period 2005-2010. Hence, the results of column 2, 4 and 6 not only confirm those with the *Quality Index*, but also show that economies who are active in R&D, and then tend to sophisticate their products as much as possible, are also those who can make the most from Export Diversification benefits, maybe by mean of more likely technological and knowledge spillovers both intra- and inter-industries.

[26] The tricky part here is that I used the Concentration indicator over my research instead than its inverse which clearly proxies for Diversification (i.e. 1-HHI), but I indeed had validation of my hypothesis in Aditya and Roy (2010) who also adopted HHI and successfully found a negative sign for their interaction with export volume respect to the world average.

**Table 6.** Quality and EXPY interaction System-GMM

| | 1995-1999 | | 2000-2004 | | 2005-2010 | |
|---|---|---|---|---|---|---|
| VARIABLES | 1 | 2 | 3 | 4 | 5 | 6 |
| *ln GDP$_{T-1}$* | 0.951*** | 0.973*** | 0.983*** | 0.982*** | 0.972*** | 0.977*** |
| | (0.0143) | (0.0122) | (0.00754) | (0.00890) | (0.00717) | (0.00706) |
| *HHI * Quality* | -0.258** | | -0.0769* | | -0.0708** | |
| | (0.129) | | (0.0405) | | (0.0344) | |
| *HHI * ln EXPY* | | -0.00637 | | -0.00561* | | -0.0103*** |
| | | (0.00930) | | (0.00316) | | (0.00388) |
| *Pop. Growth* | 0.000698*** | 0.000461** | 0.000380** | 0.000421* | 0.000805*** | 0.000663*** |
| | (0.000260) | (0.000183) | (0.000190) | (0.000213) | (0.000280) | (0.000247) |
| *Inflation* | 7.19e-06 | -3.96e-05 | 0.00169 | 0.00189 | 0.00146 | 0.00364*** |
| | (1.57e-05) | (6.05e-05) | (0.00128) | (0.00149) | (0.00109) | (0.00138) |
| *ln GCF (wits)* | 0.130*** | 0.149*** | | | | |
| | (0.0405) | (0.0528) | | | | |
| *ln GCF* | | | 0.0116*** | 0.00915*** | 0.00894*** | 0.0101** |
| | | | (0.00331) | (0.00303) | (0.00262) | (0.00410) |
| *Ys** | Yes | Yes | Yes | Yes | Yes | Yes |
| *AR(2) Test* | (0.312) | (0.773) | (0.118) | (0.100) | (0.732) | (0.304) |
| *Hansen Test* | (0.185) | (0.199) | (0.171) | (0.159) | (0.151) | (0.122) |
| *Observations* | 264 | 211 | 190 | 170 | 228 | 202 |
| *Number of number* | 88 | 76 | 85 | 77 | 87 | 78 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

- *Openness*

The second variable I tried to interact together with HHI has been *Openness* as percentage of GDP (Table 7) in order to see whether countries that are more expose to trade are also those who better succeed in their diversification process and are able to reach the turning point faster. This idea is based on both the *new trade theory* and the *new economic geography*, developed by Krugman, which are based on mainly three new factors respect the old theories: economies of scales, love of varieties and trade costs. The principal innovation of this new theory is the *home market effect* which explains how countries with a consistent internal demand for a particular good will produce more of that good that what is needed, and then exports it; this happens because industries can reap the benefit of arising economies of scale, which means producing more by saving in relative marginal cost. The second step of the theory implies that industries will more easily produce different varieties of that good thanks to economies of scales, increase the sector profitability as consumers have Dixit-Stiglitz preferences, and clearly tend to agglomerate in that specific area where indeed the phenomenon arises. Finally, low trade costs, which might derive from either trade agreements or lower tariffs or again geographic proximity, enhance the mechanism and makes easier agglomeration of production among neighbour countries. Once again the classical example are the Asian-Tigers that were able to create a kind of trading area for the

entire technologic sector broadening it as much as possible towards different "varieties" such as for instance computer, mobile phone and videogames.

**Table 7.** Openness interaction System-GMM

| | 1995-1999 | | 2000-2004 | | 2005-2010 | |
|---|---|---|---|---|---|---|
| VARIABLES | 1 | 2 | 3 | 4 | 5 | 6 |
| *ln GDP$_{T-1}$* | 0.961*** | 0.941*** | 0.976*** | 0.972*** | 0.974*** | 0.973*** |
| | (0.0124) | (0.0173) | (0.00915) | (0.0102) | (0.00666) | (0.00665) |
| *HHI * Openness* | -0.00154* | | -0.000947* | | -0.000222 | |
| | (0.000789) | | (0.000516) | | (0.000266) | |
| *HHI * Openness$_{T-1}$* | | -0.00249** | | -0.00127** | | -0.000316 |
| | | (0.00117) | | (0.000617) | | (0.000303) |
| *Pop. Growth* | 0.000642** | 0.000831** | 0.000452* | 0.000496* | 0.000797*** | 0.000802*** |
| | (0.000258) | (0.000353) | (0.000232) | (0.000257) | (0.000262) | (0.000264) |
| *Inflation* | 8.32e-06 | -4.68e-05 | 0.00128 | 0.00169 | 0.000421 | 0.000747 |
| | (7.76e-06) | (0.000108) | (0.00139) | (0.00162) | (0.000879) | (0.000939) |
| *ln GCF (wits)* | 0.106** | 0.131*** | | | | |
| | (0.0415) | (0.0455) | | | | |
| *ln GCF* | | | 0.0108*** | 0.00867*** | 0.0118*** | 0.0112*** |
| | | | (0.00278) | (0.00293) | (0.00274) | (0.00277) |
| *Ys** | Yes | Yes | Yes | Yes | Yes | Yes |
| *AR(2) Test* | (0.341) | (0.164) | (0.163) | (0.115) | (0.813) | (0.954) |
| *Hansen Test* | (0.133) | (0.122) | (0.153) | (0.305) | (0.104) | (0.131) |
| *Observations* | 267 | 267 | 190 | 190 | 228 | 228 |
| *Number of number* | 89 | 89 | 85 | 85 | 87 | 87 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The experiment considers both the value of *Openness* in *T* (column 1, 3 and 5) and *T-1* (column 2, 4 and 6) first because I have already detected a kind of delayed effect when the entire dataset was tested, and second the past realization might even catch the idea of arising trade relationships between countries. In fact, it is reasonable to think that what does matter more is building durable partnerships in the international trade scenario which can better prompt exchanges of specific know-how. Surprisingly, in this case the panel 2005-2010, which always performed better compared to the other two in all the previous estimations, does not report significant results even if they have the expected negative sign. Nevertheless, columns 1 to 4 confer some significant evidence in support of the theory implications expressed above for the two older panels; moreover all the coefficients for the six different estimations have more or less the same magnitude even for the panel 1995-1999 that, instead, has previously reported remarkably higher results compared to the other sub-samples. When we compare the lagged realisation with that at time *T* both significance (only for column 2 and 4) and magnitude increase meaning that not only higher openness improves the positive diversification effect, but a more durable presence on the

international trade has even a stronger and more serious impact on the phenomenon.

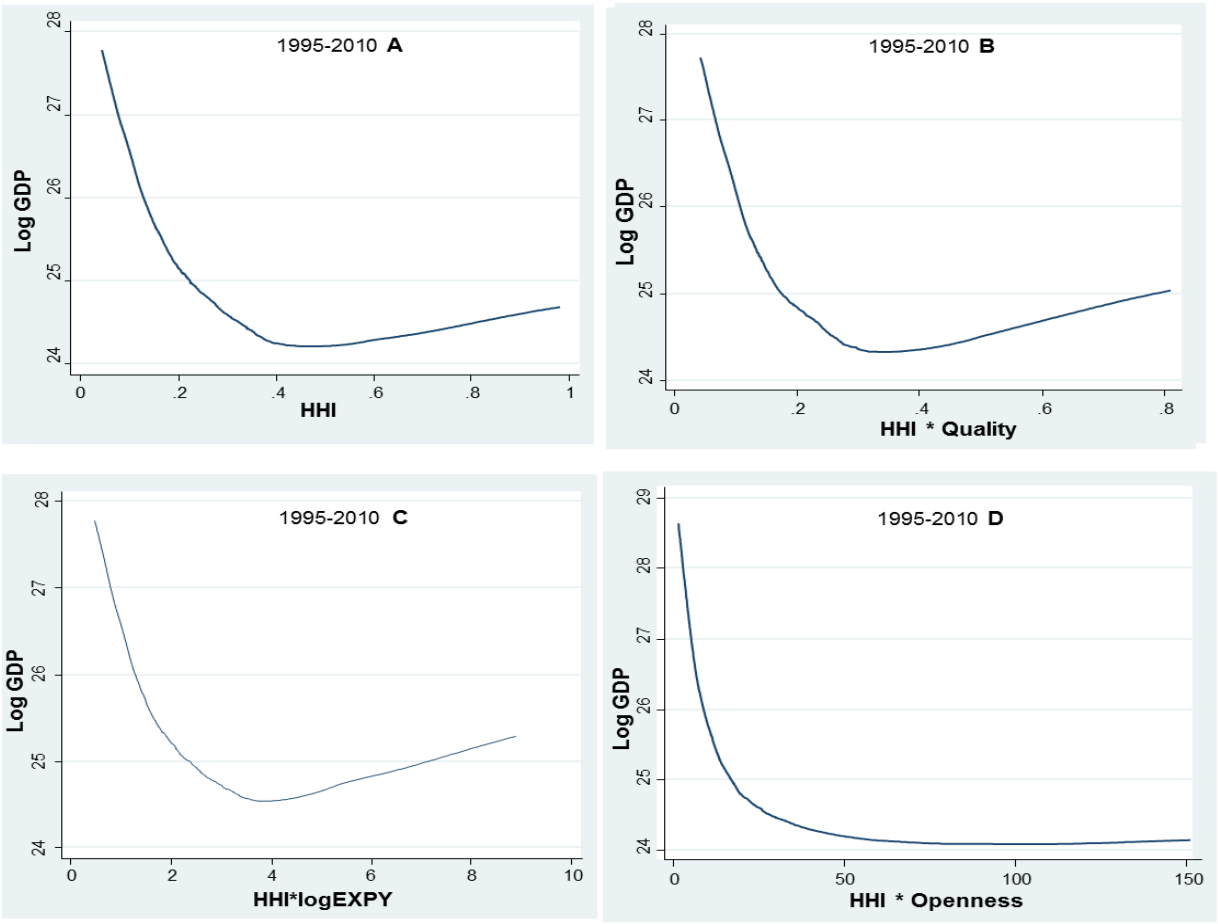
4.2.2. *Interactions: graphic analysis*

In support to the empirical estimations I also conducted two graphic exercises to better understand the interaction effects on the U-shaped relationship between export concentration and economic growth; they are both based on the entire period 1995-2010 as I thought it might better capture the incidence (the same are reported also for the small panels in the Appendix Figure 1, 2 and 3).

The first attempt is a further estimation with the lowess line technique that I have already applied in Graph 4 to show the non-linearity, and that now is used also with the interactions studied above; panel **A** of Graph 5 is just a copy of Graph 4 and it is reported only for an easier comparison with the interaction with *Quality*, *log EXPY* and *Openness* in panel **B, C** and **D** respectively. The main drawback I encountered for this estimation has been the difference in measure scale of the x-axis where for the normal case with HHI (panel **A**) it clearly goes from 0 to 1, while for the others it changes depending on the mediating variable's values; yet this does not mean that some clearer conclusion with respect the empirical analysis can not be draw.

Indeed, both panel **B** and **C** show how the line is in an higher position in the graph compared to that in **A** meaning that when quality plays her role in the diversification process the level of GDP growth will be overall higher than in the case where quality-upgrade is not pursued by countries. This finding is perfectly in line with Hallak (2006) where quality and income has been found to be complementary in determining the direction of trade among countries; so the more quality of a country's exports increases, the more likely this country will engage new trade relationship with richer countries where households have higher quality preferences.

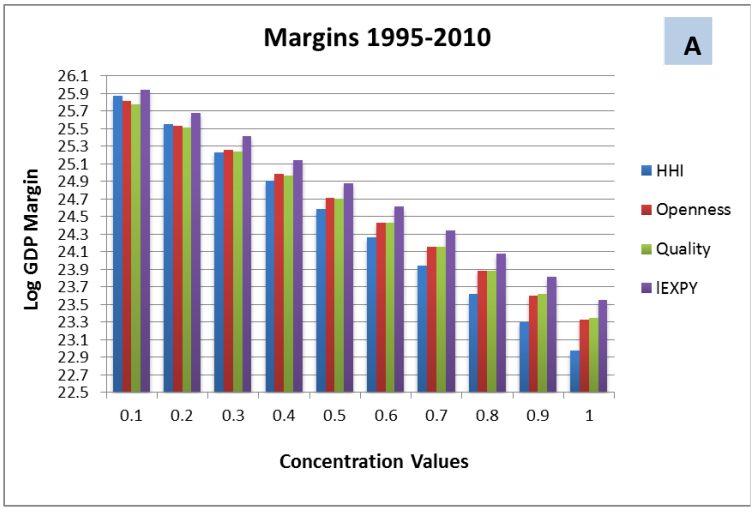
Secondly, both lines seem to be more convex respect to the normal case and, in fact, while the line in panel **A** clearly end below the 25 log value of GDP, **B** and particularly **C** exceed this threshold. The interpretation I come with is that not only quality-upgrade can speed up the all diversification process, but it will also positively impact the second phase of concentration allowing countries to reach higher final value of GDP; moreover, with this idea it also make sense why the interaction with *log EXPY* outperforms that with *Quality* as not only the mere sophistication of products matter but also the density of the product space has a clear effect on final value of GDP because it enlarges the range of new possible arising markets. Unlike the other two interactions, panel **D** does not provide any kind of evidence that *Openness* improves the relationship's shape probably because the x-axis range is too biased respect that of HHI.




**Graph 5**. *Author's calculation using STATA software*

Nevertheless, when I performed the second graphic exercise also *Openness* appears to have a positive effect on GDP value; these results are based on margin effects' estimation for which, however, I could only use a normal OLS regression seeing that it was not possible to perform it with the system-GMM. In sum, I estimated the predictive margins for the log of GDP at the ten intermediate values of concentration's range (i.e. from 0.1 to 1) with both HHI alone and interacted with the three mediating variables already mentioned; Figure 5 reports the results for the entire dataset.

In panel **A** I plot the predicted average values for the log of GDP for all the four different specifications, while in panel **B** I only report the differences between the predicted value using the interaction term and that when HHI is taken alone (blue columns in panel **A**). The interest should focus on the high value of HHI as it reflects how much either *Quality* or *Openness* can boost the growth respect to diversification by itself; indeed, as we can see from both panels, the more extended gaps are concentrated over the HHI values going from 0.4 to extreme concentration of 1.



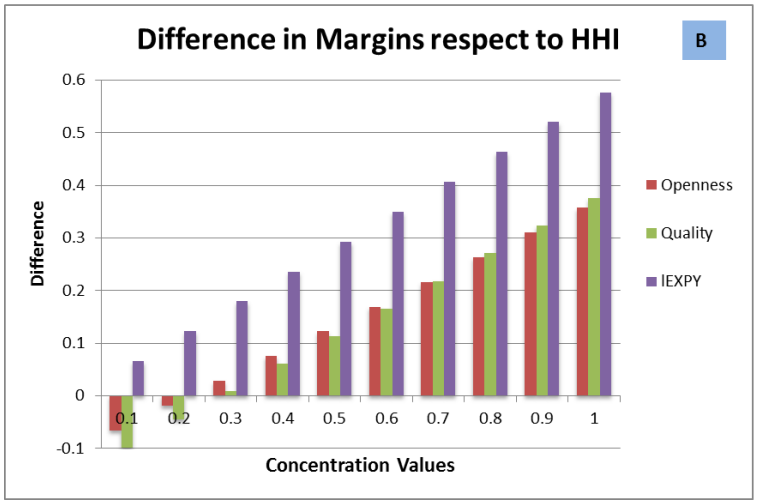




**Figure 5.** *Author's calculation using STATA margin function*

Moreover, there is a clear predominance of the positive effect of *log EXPY* over the other two interactions as it never show a negative difference respect the average prediction with only the main effect of HHI; this finding is totally in line with what we saw in the other graphic exercise, where the lowess line for *log EXPY* was above both that with *Quality* and that with HHI alone. Instead, the decreasing "power" of both *Quality* and *Openness* seems to indicate that they surely are of crucial importance for the first phases of the diversification process (HHI values between 0.5 and 1), but their impact decrease as far as the country goes toward the complete economic growth.

I would address the outperforming result of *EXPY* to the fact that, as I said several times already, it also captures the product space effect, which appears to favour economic expansions at every level of concentration. In fact, it could be argued that when a country enjoys a dense product space, and so it has already undertaken a suitable comparative advantage path, it will be always easier for that specific country starting new producing process, enlarge the varieties' supply of the existing products, and thus cover all the different stages of the value chain.

However, the results slightly change for the three different sub-panels (Appendix Figure 4) where *Quality's* impact appears stronger than that of *EXPY* for the panels 2000-2004 and 2005-2010 with both the lowess and margins exercise[27], while *Openness* registers a surprisingly higher difference in average expectation of *log GDP* with respect to the other two variables for the period 1995-1999.

[27] But still *EXPY* is the only interaction which keeps a positive difference in expected average value of *log GDP* respect to the main effect case

In sum, it is clear from both the empirical and graphic analysis that both *Quality* and *Openness* have a positive influence on the diversification process as they determine higher level of GDP growth compared to the normal situation for the critical values' range of HHI where the turning-point should arise (i.e. the previous estimations gave *HHI** of 0.696 and 0.467 for Difference and System on the entire dataset and 0.523, 0.491 and 0.495 for three sub-panels) accelerating the all process.

## 4.3. Robustness check

In order to analyse a particular topic which I came across to during my research, I decided to perform a robustness check by mean of the share of natural resources' exports on total exports (i.e. *NRX)*; indeed, Lederman and Maloney deeply investigated on the effect of natural resources on economic growth concluding that their negative impact, sustained by the past literature for a long time, it is more a matter of inefficient industrial policies which are not aimed to a reallocation among new sectors of the revenues deriving from natural resources' activities. Hence, following the previous attempt of Lederman and Maloney, I construct the share of natural resources export considering it as a specific proxy of concentration in one sector[28]; Table 8 reports the result for the negative impact of concentration and his non-linearity, while Table 9 and 10 report the interactions exercises.

The first hypothesis is successfully confirmed by the columns 1, 3 and 5 of Table 8 where *NRX* enters in the equation with a negative and statistical significant sign for all the three sub-panels even with an improvement with respect to *HHI* in Table 5; nevertheless, while for the *HHI* example the non-linearity always registered significant results and even led to an increase in significance for the linear term of concentration, here we see the exact opposite effect where only for the panel 2000-2004 the hypothesis holds. Still, the negative and positive signs are present in all three sub-panels confirm the non-linearity where *NRX** is indeed a minimum of the function going from concentration to economic growth. Finally, I compared the three values of *NRX** to those of *HHI** and they are all three way higher as we have 0.83 (0.523), 0.674 (0.491) and 0.792 (0.495); even if only the value for the period 2000-2004 is statistical significant, there still a kind of evidence supporting the idea of countries "stuck" in their diversification path by natural resources dependence, and this should definitively be a direction for further researches.

[28] The primary exports include the SITC sections 0,1,2,3,4 and 68.

**Table 8.** Robustness check *NRX*

| | 1995-1999 | | 2000-2004 | | 2005-2010 | |
|---|---|---|---|---|---|---|
| VARIABLES | 1 | 2 | 3 | 4 | 5 | 6 |
| *ln* $GDP_{T-1}$ | 0.937*** | 0.937*** | 0.983*** | 0.983*** | 0.968*** | 0.969*** |
| | (0.0175) | (0.0194) | (0.00637) | (0.00660) | (0.0107) | (0.0102) |
| *NRX* | -0.163** | -0.395 | -0.0407** | -0.151** | -0.0687*** | -0.179* |
| | (0.0700) | (0.269) | (0.0176) | (0.0611) | (0.0251) | (0.0952) |
| $NRX^2$ | | 0.238 | | 0.112** | | 0.113 |
| | | (0.222) | | (0.0551) | | (0.0801) |
| *Pop. Growth* | 0.000931*** | 0.000903*** | 0.000391** | 0.000387** | 0.000832*** | 0.000809*** |
| | (0.000350) | (0.000337) | (0.000182) | (0.000161) | (0.000294) | (0.000252) |
| *Inflation* | -7.26e-06 | -5.19e-06 | 0.00210** | 0.00213** | 0.00135 | 0.00123 |
| | (1.04e-05) | (1.11e-05) | (0.00105) | (0.00102) | (0.000849) | (0.000907) |
| *ln GCF (wits)* | 0.113** | 0.117** | | | | |
| | (0.0548) | (0.0585) | | | | |
| *ln GCF* | | | 0.0104*** | 0.0101*** | 0.0109*** | 0.0108*** |
| | | | (0.00293) | (0.00287) | (0.00377) | (0.00362) |
| *Ys** | Yes | Yes | Yes | Yes | Yes | Yes |
| *AR(2) Test* | (0.240) | (0.238) | (0.125) | (0.118) | (0.737) | (0.795) |
| *Hansen Test* | (0.108) | (0.107) | (0.218) | (0.166) | (0.201) | (0.234) |
| *Observations* | 267 | 267 | 190 | 190 | 228 | 228 |
| *Number of number* | 89 | 89 | 85 | 85 | 87 | 87 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Also for the interactions the overall significance increases compared to the normal case, but still it is important to remind that, as Lederman and Maloney affirmed, *NRX* is just a proxy of concentration in a particular sector, so it only catches a partial and smaller effect than *HHI*. Once again, *Quality* is always significant and the magnitude for the first panel is larger than the others two (column 1, 3 and 5 Table 9); *ln EXPY* is still not significant for the period 1995-1999, but it gain statistical power in comparison to the normal case for the second panel (column 2, 4 and 6 Table 9); finally, now *Openness* is significant already with the current realization in *T* (Table 10).

The apparent stronger effect of the three mediating variables suggests that much more efforts are requested to a country with an export concentration biased toward natural resources in order to increment and improve his diversification process; this other evidence supports the high levels of the turning-point (*NRX**) found before and again arises some question on which extent natural resources can slow economic growth.

**Table 9.** *Quality* and *ln EXPY* Robustness check *NRX*

| | 1995-1999 | | 2000-2004 | | 2005-2010 | |
|---|---|---|---|---|---|---|
| VARIABLES | 1 | 2 | 3 | 4 | 5 | 6 |
| *ln GDP$_{T-1}$* | 0.898*** | 0.975*** | 0.986*** | 0.981*** | 0.986*** | 0.984*** |
| | (0.0375) | (0.0110) | (0.00601) | (0.00910) | (0.00634) | (0.00568) |
| *NRX * Quality* | -0.392** | | -0.0443** | | -0.0571*** | |
| | (0.180) | | (0.0207) | | (0.0154) | |
| *NRX * ln EXPY* | | -0.00327 | | -0.00453** | | -0.00514*** |
| | | (0.00471) | | (0.00195) | | (0.00162) |
| *Pop. Growth* | 0.00134** | 0.000427*** | 0.000350** | 0.000424** | 0.000496*** | 0.000533*** |
| | (0.000621) | (0.000153) | (0.000174) | (0.000205) | (0.000171) | (0.000180) |
| *Inflation* | 1.30e-06 | -4.02e-05 | 0.00198** | 0.00171 | 0.00210*** | 0.00225*** |
| | (1.87e-05) | (5.92e-05) | (0.000837) | (0.00145) | (0.000734) | (0.000652) |
| *ln GCF (wits)* | 0.0764 | 0.147*** | | | | |
| | (0.0680) | (0.0520) | | | | |
| *ln GCF* | | | 0.0116*** | 0.00855*** | 0.0140*** | 0.0146*** |
| | | | (0.00309) | (0.00290) | (0.00275) | (0.00369) |
| *Ys** | Yes | Yes | Yes | Yes | Yes | Yes |
| *AR(2) Test* | (0.253) | (0.746) | (0.105) | (0.122) | (0.853) | (0.254) |
| *Hansen Test* | (0.100) | (0.164) | (0.405) | (0.110) | (0.242) | (0.495) |
| *Observations* | 264 | 211 | 190 | 170 | 228 | 202 |
| *Number of number* | 88 | 76 | 85 | 77 | 87 | 78 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

**Table 10.** *Openness* Robustness check *NRX*

| | 1995-1999 | 2000-2004 | 2005-2010 |
|---|---|---|---|
| VARIABLES | 1 | 2 | 3 |
| *ln GDP$_{T-1}$* | 0.950*** | 0.983*** | 0.976*** |
| | (0.0163) | (0.00655) | (0.00702) |
| *NRX * Openness* | -0.00173** | -0.000517* | -0.000653** |
| | (0.000787) | (0.000264) | (0.000256) |
| *Pop. Growth* | 0.000654** | 0.000381** | 0.000645*** |
| | (0.000253) | (0.000189) | (0.000221) |
| *Inflation* | 1.47e-06 | 0.00190** | 0.00111 |
| | (7.29e-06) | (0.000827) | (0.000794) |
| *ln GCF (wits)* | 0.120** | | |
| | (0.0479) | | |
| *ln GCF* | | 0.01022*** | 0.01517*** |
| | | (0.0028) | (0.00327) |
| *Ys** | Yes | Yes | Yes |
| *AR(2) Test* | (0.265) | (0.139) | (0.777) |
| *Hansen Test* | (0.174) | (0.277) | (0.205) |
| *Observations* | 267 | 190 | 228 |
| *Number of number* | 89 | 85 | 87 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

# 5. CONCLUSIONS

This research has firstly tested to which extent the two hypotheses on both the negative impact of export concentration on growth and on the non-linear relationship between the two variables hold with respect to different estimation techniques and time dimensions; secondly, it investigates on the possible positive influence, by mean of an enhancement of the dynamic effect, by *Quality of Exports* and *Openness to Trade* on the diversification process. In fact, through both an empirical and graphic analysis, it has been shown how the mediating variables taken into consideration strength the diversification's benefits and, overall, raise the average realization of GDP; this part of the study is certainly innovative for the existing literature, as the only interactions encountered so far were based on either exports' volume or growth, but it certainly must be further analysed accounting for both better proxies of the considered variables and more elevated graphic estimations. For instance, it would be interesting to consider as alternative definition of Openness either tariff exemptions on both imports of intermediate goods (that might be crucial for domestic production of the future export) and exports, or government policy aimed to implement EPZs (export processing zones) or TPOs (trade promotion organizations), or again trade agreements' participation by economies.

Moreover, the research succeeded in testing the non-linearity, which was sometimes left behind by other authors who only checked for the linear effect of *HHI*, obtaining significant results for each estimations and a partial confirmation by the robustness check performed by mean of the share of natural resources' exports on the total. Unlike the past literature, here it appears that the linear term of concentration grows in both significance and magnitude when also his squared term is entered in the equation. Finally, the study extended the time coverage for which this theory has been already tested using a more recent dataset going from 1995 to 2010.

Nevertheless, it must be stress that firstly the research adopts a different dependent variable compared to the majority of the past literature, focusing more on the overall state of country economy (GDP) instead of looking at the individual income (GDP per capita), and secondly it suffers from some lack of data for the oldest sub-panel (1995-1999) which somehow biased upward the magnitude of both *HHI* and $HHI^2$ with respect the other two periods.

Said that, the main value added has been the interaction study which definitively opens different ways where future researches should investigate on to advice better government policies aimed to limit both waste of economic resources and costs deriving from structural transformation process which, inevitably, negatively impact some sectors and households over the enitre process.

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# APPENDIX

## List of Countries

| EU | | East and South Asia | | Latin America | | Africa | |
|---|---|---|---|---|---|---|---|
| Austria | AUT | Bangladesh | BGD | Argentina | ARG | Angola | AGO |
| Belgium | BEL | China | CHN | Bolivia | BOL | Côte d'Ivoire | CIV |
| Bulgaria | BGR | Hong Kong | HKG | Brazil | BRA | Cameroon | CMR |
| Bosnia and Herz. | BIH | Indonesia | IDN | Chile | CHL | Dem. Rep. of Congo | DRC |
| Belarus | BLR | India | IND | Colombia | COL | Ghana | GHA |
| Switzerland | CHE | Iran | IRN | Ecuador | ECU | Kenya | KEN |
| Czech Republic | CZE | Japan | JPN | Peru | PER | Nigeria | NGA |
| Germany | DEU | Kazakhstan | KAZ | Paraguay | PRY | South Africa | ZAF |
| Denmark | DNK | Cambodia | KHM | Uruguay | URY | Zambia | ZMB |
| Spain | ESP | South Korea | KOR | Venezuela | VEN | Zimbabwe | ZWE |
| Finland | FIN | Sri Lanka | LKA | **Central America & Caribbean** | | **North Africa** | |
| France | FRA | Myanmar | MMR | Costa Rica | CRI | Algeria | DZA |
| United Kingdom | GBR | Malaysia | MYS | Cuba | CUB | Egypt | EGY |
| Greece | GRC | Pakistan | PAK | Dominican Rep. | DOM | Libya | LBY |
| Croatia | HRV | Philippines | PHL | Guatemala | GTM | Morocco | MAR |
| Hungary | HUN | Singapore | SGP | Honduras | HND | Tunisia | TUN |
| Ireland | IRL | Thailand | THA | Mexico | MEX | **Oceania** | |
| Italy | ITA | Tajikistan | TJK | Panama | PAN | Australia | AUS |
| Lithuania | LTU | Turkmenistan | TKM | El Salvador | SLV | New Zealand | NZL |
| Netherlands | NLD | Uzbekistan | UZB | **North America** | | Papua New Guinea | PNG |
| Norway | NOR | Viet Nam | VNM | United States | USA | | |
| Poland | POL | **Western Asia** | | Canada | CAN | | |
| Portugal | PRT | Azerbaijan | AZE | | | | |
| Romania | ROU | Iraq | IRQ | | | | |
| Russia | RUS | Israel | ISR | | | | |
| Slovakia | SVK | Jordan | JOR | | | | |
| Sweden | SWE | Lebanon | LBN | | | | |
| Turkey | TUR | Saudi Arabia | SAU | | | | |
| Ukraine | UKR | Yemen | YEM | | | | |

**APPENDIX. CORRELATION MATRIX.** 1995-2010

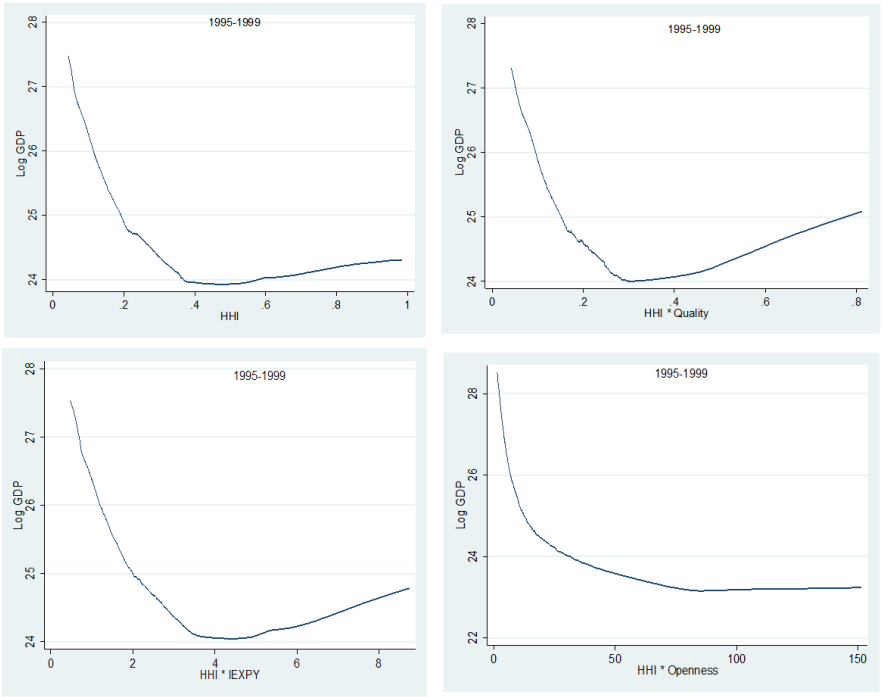
| | ln GDP | ln GCF | HHI | Pop Growth | Inflation | Quality | Openness | ln EXPY |
|---|---|---|---|---|---|---|---|---|
| **ln GDP** | 1.00 | | | | | | | |
| **ln GCF** | -0.25 | 1.00 | | | | | | |
| **HHI** | -0.35 | 0.21 | 1.00 | | | | | |
| **Pop Growth** | 0.24 | 0.06 | -0.11 | 1.00 | | | | |
| **Inflation** | -0.08 | 0.22 | 0.04 | -0.02 | 1.00 | | | |
| **Quality** | 0.52 | -0.29 | -0.36 | -0.36 | -0.05 | 1.00 | | |
| **Openness** | -0.21 | 0.06 | -0.04 | -0.14 | -0.01 | 0.20 | 1.00 | |
| **ln EXPY** | 0.70 | -0.26 | -0.42 | 0.01 | 0.77 | 0.77 | 0.14 | 1.00 |

**APPENDIX. Table 1.** Panel 1995-1999 with *ln GCF (WB)*

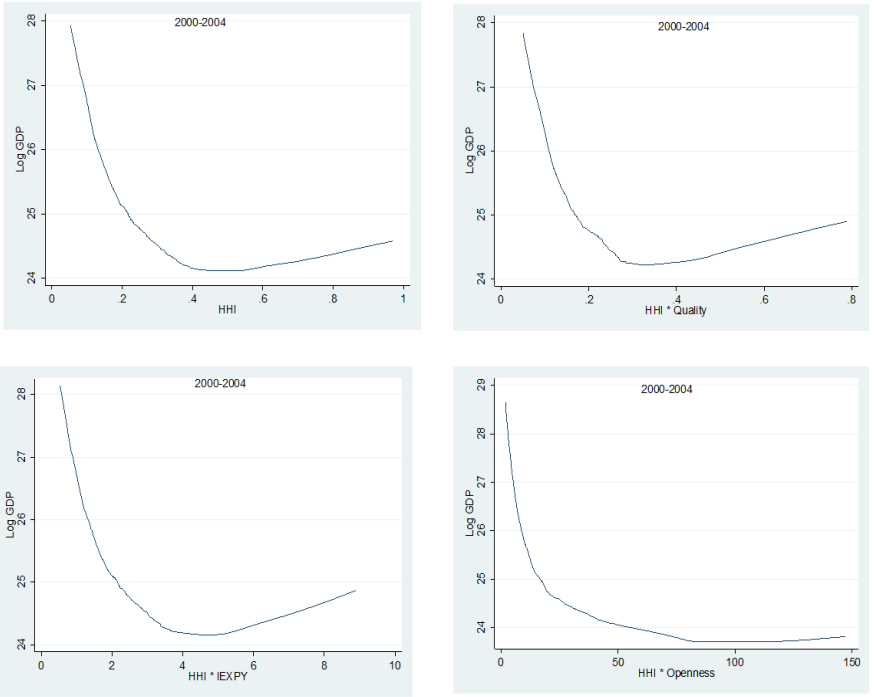
| | (1) | (2) |
|---|---|---|
| VARIABLES | 1 | 2 |
| *ln* $GDP_{T-1}$ | 0.960*** | 0.945*** |
| | (0.0152) | (0.0338) |
| *ln GCF* | 0.00897 | 0.0133 |
| | (0.00885) | (0.0124) |
| *HHI* | -0.228** | -1.084 |
| | (0.107) | (0.775) |
| $HHI^2$ | | 1.144 |
| | | (0.875) |
| *Pop. Growth* | 0.000644** | 0.000691* |
| | (0.000304) | (0.000374) |
| *Inflation* | -0.000140** | -0.000194** |
| | (6.48e-05) | (8.21e-05) |
| *Ys** | Yes | Yes |
| *AR(2) Test* | (0.400) | (0.798) |
| *Hansen Test* | (0.719) | (0.618) |
| *Observations* | 171 | 171 |
| *Number of number* | 79 | 79 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

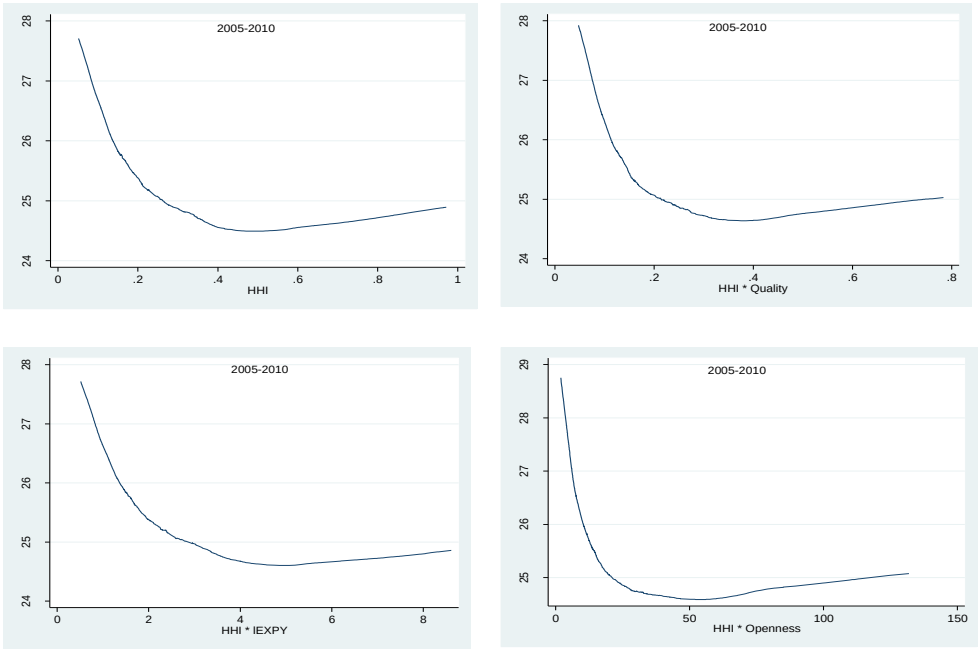
**APPENDIX. Figure 1.** *Lowess exercise 1995-1999*




**APPENDIX. Figure 2.** *Lowess exercise 2000-2004*



**APPENDIX. Figure 3.** *Lowess exercise 2005-2010*




**Appendix. Table 2.** *Turning points on entire dataset*

| **HHI*** | HHI only | Quality | Openness |
|---|---|---|---|
| Difference GMM | 0.696 | 0.607 | 0.603 |
| System GMM | 0.467 | 0.438 | 0.408 |

**Appendix. Table 3.** *Turning points sub-panels*

| **HHI*** | 1995-1999 | 2000-2004 | 2005-2010 |
|---|---|---|---|
| HHI | 0.523 | 0.491 | 0.495 |
| NRX | 0.83* | 0.674 | 0.792* |

***** *The non-linearity is not statistical significant for the two sub-panels.*

**APPENDIX. Figure 4.** *Margins exercise for the three sub-panels*