Trade and GDP in World’s Top Economies: Panel Co-integration Analysis

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Abstract

This study investigated the impact of exports and imports per capita (EXPPCA and IMPPCA) on the nominal GDP per capita (GDPPCA) taken in natural logarithm in the top ten economies in the world (the list of countries: United States, China, Japan, Germany, United Kingdom, India, France, Brazil, Italy, Canada. This list is based on estimates for 2017 by IMF’s World Economic Outlook Database, April 2017). We performed a rich analysis of the panel unit root tests (PURT) using, firstly, the most six tests of the first generation assuming the independence of individual time series in panel and, secondly, dealing with cross-sectional dependence using the Sectionally Augmented Dickey-Fuller (CADF) test of the second generation. The findings revealed that all variables are integrated at order one. The test statistics for co-integration ended to reject the null hypothesis of no co-integration. Finally, two regressions were executed, so the group mean panel Fully Modified OLS (FMOLS) and group mean panel Dynamic OLS (DOLS) estimators. The estimation results associated with the long-run equilibrium are realized individually and aggregate according to the two methods FMOLS and DOLS. For the countries China, Japan, United Kingdom, Brazil, Italy, a positive impact of EXPPCA on GDPPCA is observed but EXPPCA do not have an impact on GDPPCA in the other countries, i.e., United States, Germany, India, France and Canada. The variable IMPPCA has a positive impact on GDPPCA for all countries (except China, Canada and Japan), but it has a negative impact both in China and Canada, and it hasn’t a significant effect on the Japanese GDPPCA. About forecasts for the year 2016, it seems that the FMOLS estimator (respectively DOLS estimator) shows an excellent forecast performance for the United States, China, France, Brazil and Canada (respectively for Japan, Germany, United Kingdom, India and Italy).

Keywords: Merchandise trade; GDP; Top economies; Co-integration analysis

Introduction

In 1960, the number of independent countries in the world reached sixty countries, but now it has reached 193 countries (members in the United Nations) and the future bodes for the emergence of new countries. As telecommunication technology has made the world a small village, competition among countries, particularly developed ones, has increased both the production of goods and the markets. The competition for the production of goods and services has become an essential feature of this era. The diversification of the wealth and production of countries necessitates the need for trade exchange between them. The industrialized countries were the most in need to sell their products to the developing countries, but they need the oil that is the lifeblood of many industrialized countries in the world. The 10 countries involved in our study are distinguished by abundant oil that is the lifeblood of many industrialized countries in the world. For the number of independent countries in the world reached sixty countries, but now it has reached 193 countries (members in the United Nations) and the future bodes for the emergence of new countries. As telecommunication technology has made the world a small village, competition among countries, particularly developed ones, has increased both the production of goods and the markets. The competition for the production of goods and services has become an essential feature of this era. The diversification of the wealth and production of countries necessitates the need for trade exchange between them. The industrialized countries were the most in need to sell their products to the developing countries, but they need the oil that is the lifeblood of many industrialized countries in the world. The 10 countries involved in our study are distinguished by abundant oil that is the lifeblood of many industrialized countries in the world.

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So, we have a panel data for ten countries involving measurements over 47 years. Our balanced panel data contain observations of each of the variables obtained over multiple time periods for the same individuals. The passage from univariate time series to panel series requires appropriate techniques for the panel unit root tests for cross-sectional data. Our first goal is to decide the order of the integrations of our series. During this stage, the literature of the analyses of the panel data allows us to take account of the dependence between the individual series and, consequently, we will resort to the tests adapted to this situation. Our second goal is to perform panel co-integration tests to examine the co-integrating relationship of the three variables taking $Y_t$ as the output variable. At this stage, we will limit ourselves to the situation. Our second goal is to perform panel co-integration tests to examine the co-integrating relationship of the three variables taking $Y_t$ as the output variable. At this stage, we will limit ourselves to the

Economic evolution of the top ten economies in the world

To appreciate the economy of each of these countries, it would be useful to take a look, on the one hand, on the FDI inflows and FDI outflows and on the other hand on the evolution of GDP per capita during the period 1990-2016. Indeed, the average of the FDI inflows as a percentage of gross fixed capital formation (respectively the FDI outflows) reached 6.2% (7.2%) in United States, 7.8% (1.6%) in China, 0.4% (5.0%) in Japan, 5.9% (9.9%) in Germany, 17.3% (19.0%) in United Kingdom, 4.1% (1.3%) in India, 6.0% (13.1%) in France, 12.6% (1.6%) in Brazil, 4.2% (5.9%) in Italy and 12.3% (14.3%) in Canada. If we compare these statistics to the world average evaluated at 7.9% (7.8%), we can divide the top ten economies in terms of GDP into two groups: The first group is China, India and Brazil each of which has an average of FDI inflows greater than the average of FDI outflows. It seems that each of these three countries favors the FDI inflows more than the FDI outflows. The second group consists of the other countries, each of which seeks to invest more in the rest of the world to stimulate its economic strength and encourage its international trade. If we investigate the GDP per capita (current US$) for each country (Figure 1) then we appreciate its rapid rise from the year 1970 to the year 2016. More precisely, we find around 11 times for United States, 71 times for China, 19 times for Japan, 15 times for Germany, 17 times for United Kingdom, 15 times for India, 13 times for France, 19 times for Brazil, 15 times for Italy and 10 times for Canada. China has managed to raise GDP per capita by more than 71 times from $113 per capita in 1970 to around $8123 in 2016 with an average annual growth rate at 10.15%. While EXPPCA has increased from $2.72 in 1970 to around $1522 in 2016 (around 540 times). Regarding the size of the population of these ten countries (Figure 2), it dropped from 55.3% in 1970 to 49.35% in 2016. The German economy benefits from a highly skilled labour force and a thriving industry (27.41% of GDP in 2016), which made it a leading exporter of chemicals, motor vehicles, iron and steel products, manufactured goods, electrical products and household equipment, while the imports focus on food, petroleum products, manufactured goods, electrical products, motor vehicles. The industry in Japan economy (28.63% of GDP in 2015) where robotics is one of the most promising areas for future economic growth, with Japanese technology outperforms the rest of the world. The commercial companies such as Toyota, Sony, Toshiba and Panasonic have an international reputation. Toyota especially benefited from increased sales in North America.
Manufacturing is one of the pillars of Japanese economic power, but Japan has few natural resources. Therefore, one of the methods followed by Japanese companies is to import raw materials and convert them to products sold locally or exported.

**Literature Review**

There is a rich literature in econometrics dealing with the panel unit root and estimating the long-run equilibrium relationships among the relevant variables using Pedroni’s panel co-integration approach. Mourad [17] has estimated a long-run equilibrium relationship between the real GDP in GCC countries [18] and six determinant variables such as the human development index, labor force, foreign direct investment, exports and imports as ratios of GDP and gross capital formation (% of GDP). Ahmed et al. [19] have considered the heterogeneity across the panel of eight economies in the ASEAN region to establish a long-run relationship between output, energy, trade, and emissions over a period of three decades. The log-linear Equation is used to investigate the relationship between the economic growth, CO2 emissions, total energy consumption in transportation of goods from air, rail and road, trade openness measured as (exports and imports scaled by GDP). Panel unit root tests are used and Pedroni’s panel co-integration test has been proposed for co-integration in panel data and the long-run elasticity (individual country and full panel) are estimated using the Fully Modified Ordinary Least Squares estimator (FMOLS) taking into account the heterogeneous co-integrated panel data. Jaunky and Lundmark [20] have employed a variety of univariate and panel data unit root tests to test the non-stationary process for paper publication for seventeen Organisations for Economic Co-Operation and Development (OECD) members over the period 1980-2012. Three generations of panel unit root tests are considered and cross-sectional dependence is detected. Saleh et al. [21] examine the contribution of tourism industry to the GDP of three countries: Bahrain, Jordan and Saudi Arabia. Their analysis is based on a comprehensive set of panel data (transformed to natural logarithms) of tourism receipts, education investment, foreign direct investment and fixed capital formation. The results show a long-run relationship between tourism growth and GDP. Using the DOLS panel co-integration estimation technique for long-run equilibrium analysis model, the estimated coefficient (elasticity) of gross fixed capital formation (GFCF) is positively related to GDP and highly significant but with the negative and positive FDI coefficients, the relationship between FDI and GDP is concave upwards in all proposed models. Aboubacar et al. [22] investigate whether foreign aid (AID) has a significant influence on economic growth in WAEMU’s (West African Economic and Monetary Union) countries (Benin, Niger, Burkina Faso, Senegal, Côte d’Ivoire, Togo, Mali, Guinea-Bissau). Using the group-mean panel FMOLS and DOLS estimators developed by Pedroni, their estimated models reveal that in the long-run, the effect of AID on economic growth is heterogeneous across sectors. Indeed, there exists a positive long-run impact of the aid in agriculture, aid in trade policies and regulations and aid in education on the economic growth. Oskooe and Akbari [23] have studied the stagnation per capita GDP of a panel of OPEC countries. The empirical results indicate that real GDP per capita series among OPEC countries are non-stationary. This means that oil price shocks would possibly permanently affect the real output levels of OPEC countries. Adeleye et al. [24] examine the impact of international trade on economic growth in Nigeria. In The Long-Run Model Equation, there is a negative impact of the total import on economic growth, while the total export will affect the economic growth positively. Firt [25] has dealt with the unit root hypothesis related to the real GDP for thirty-five advanced economies. The results obtained from the unit root tests in applied singular and panel structures suggest that the null hypothesis must not be rejected. In order to evaluate the effects of international trade on China’s economic growth, Sun and Heshmati [26] inform us that the international trade inspected in China’s thirty-one provinces for a period of six years, has made an increasingly significant contribution to economic growth. In the panel unit root context, Ozturk and Kalyoncu [27] have analysed the stationarity of real GDP per capita for 27 OECD countries using panel unit root tests. The results overwhelmingly indicate that real GDP per capita series among OECD countries are non-stationary. Ramirez [28] has utilized the FMOLS procedure developed by Pedroni to generate consistent estimates of panel co-integration for production and labor productivity function considering the stock of private capital and the public capital stock. The results suggest that, in the long-run, changes in the stocks of public and private capital and the economically active population have a positive and economically significant effect on Real GDP and labor productivity. Lee [29] has studied three annual time series (in natural logarithms), RGDP, energy use (EU) and real gross capital formation (GCF), for the eighteen developing countries. The used panel unit root tests confirm that three series have a panel unit root. Based on the tests for co-integration suggested by Pedroni, Lee concludes that the variables GDP, EC, and K move together in the long run. The FMOLS estimates of the elasticities of energy consumption and capital stock with respect to GDP are positive in most countries, that is, an increase in capital stock or energy consumption tends to promote RGDP. Keller [30] discussed that international trade which involves importing intermediate goods of a high quality contributed to the diffusion of technology.

**Methodology**

**Panel unit root tests (PURT)**

In terms of time, we have three generations of panel unit root tests (PURT). In the first generation, the literature assumed that the individual time series in the panel were cross-sectionally independently distributed. We quote the most used tests in practice, such as Levin and Lin [31,32], Levin, et al. (LLC) [33], Harris and Tzavalis (HT) [34] Breitung (λ) [35], Im, Pesaran and Shin (IPS) [36], Maddala and Wu (MW) [37], Hadri (LM) [38]. The null hypothesis of these tests is that all panels contain a unit root (except Hadri test in which the null is stationarity). The alternative designates that all panels are stationary for (LLC), (HT), (λ), but it designates that at least one panel is stationary for (IPS) and (MW). For Hadri test, the alternative designates that some panels contain unit roots. For (LLC), (λ), (IPS), the calculated values are compared to the 1%, 5%, and 10% significance levels with the one-tailed (negative) of a standard normal with the critical values of (-2.326), (-1.645), and (-1.282) correspondingly, however, for Hadri test, the critical values with the one-tailed (positive) of a standard Normal are (2.326), (1.645), and (1.282) respectively. For (HT) test, and for a panel data with N=10 and T=50, the critical values (trend included) are (-2.82), (-1.97) and (-1.54) at 1%, 5%, and 10% significance levels respectively. For (MW) test (non-parametric Fisher-type test), it is distributed as χ2 with (2N=24) degrees of freedom and the associated critical value is (36.41) to 5% significance level. In the second generation, these tests were based on the idea of abandoning the independence between panels and dealt with the problem of cross section dependence suggesting the advantage of the common individual movement of time series to obtain new test statistics for the panel unit root. We quote the most used tests in practice. Bai and Ng [39,40] used a method entitled “Panel Analysis of Non-stationarity in the Idiosyncratic and Common components” (PANIC), Chang [41,42]
adopted a nonlinear instrumental variable (IV) method to provide constant panel unit root test statistics that are not affected by the cross section dependence, Choi [43] modelled the cross dependence using a two-way error-component model which imposes the same pair-wise error covariances across the different cross section units, Phillips and Sul [44], unlike the PANIC technique proposed by Bai and Ng to test the unit root separately in the common and individual components of the time series, they test directly the panel unit root in the time series and not in its components, Pesaran [45] proposed a simple alternative where the standard ADF regressions are augmented with the cross section averages of lagged levels and first-differences of the individual series, he named his test "Cross Sectionally Augmented Dickey-Fuller (CADF)", Moon and Perron [46] suggested a procedure according to which the common factors have differential effects on different cross section units, Bai and Ng [47] used (PANIC) residuals to form two new tests estimating the pooled autoregressive coefficient, and using simply a sample moment. Among the tests of the third generation we mention Chang Q and Song [48] which developed a panel unit root test that is valid for very general panels. Below we will use the first-generation tests and the CADF test of the second generation and this is what we have been able to apply using the RATS software (version 9.2). For all used tests, we have the following: The average lags chosen from $p_{max}$ such that, following Schwert [49], Newey and West [50], Ng and Perron [51], the maximum lag is computed considering a bandwidth $(0.7)$, $(0.6)$] respectively. In Table 1 reported the results of PUR tests. All the variables are taken in natural logarithm. In fact, for purposes of economics analysis, the great advantage of the natural logarithm is that small changes in the natural log of a variable are directly interpretable as percentage changes, to a very close approximation. It seems that it is convenient to consider the variables in the first difference to reach stationarity. Before deciding whether or not panels are stationary, the degree of cross section dependence is tested estimating individual ADF (p=0,1,2,3) regressions included intercept but without cross section augmentations and computing pair-wise cross section correlation coefficients of the residuals from these regressions (namely $\hat{\rho}$). The simple average of these correlation coefficients across all the $((10 \times 9)/2=45$ pairs, together with the associated cross section dependence (CD) test statistics proposed in Pesaran [52] are given by:

$$\bar{\rho} = \frac{2}{N(N-1)} \sum_{i=1}^{N} \sum_{j=1}^{N} \hat{\rho}_{ij}$$

$$CD = \frac{TN(N-1)}{2}$$

Under the null hypothesis of zero, cross section dependence CD is asymptotically distributed as N(0,1). The results of (CD) test statistics are in the Table 2:

Inspecting results in Table 3, it seems that we reject strongly the null of zero cross section dependence for all the variables and by consequence the CD statistics leave little room for doubting that the errors associated of each from these variables are highly correlated across countries. As we have seen previously, the IPS technique proposes unit root tests for dynamic heterogeneous panels based on the mean of individual unit root statistics. Under the unit root hypothesis no cross section dependence IPS is asymptotically distributed as N(0,1). Pesaran proposes a cross-sectionally augmented version of the IPS (CIPS) that allows for cross section dependence. In fact the CIPS statistic is none other than CADF statistic based on the Augmented Dickey-Fuller statistics averaged across the group. In Table 3, all variables are I(1) for all values of (p). For this, there is a strong tendency to accept the null hypothesis (all panels contain unit roots). Finally, observing globally all the results offered by the panel unit root tests, we decide to consider all the variables as stationary in first differences thus I(1).

### Pedroni's methodology and panel co-integration test

The use of co-integration techniques to test for the presence of

<table>
<thead>
<tr>
<th>Tests</th>
<th>LLC</th>
<th>IPS $Z_{LC}$</th>
<th>Breitung (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>$\Delta X$</td>
<td>X</td>
</tr>
<tr>
<td>GDPACP</td>
<td>0.07</td>
<td>-4.61*</td>
<td>0.88</td>
</tr>
<tr>
<td>EXPPCA</td>
<td>-0.20</td>
<td>-3.88*</td>
<td>-1.09</td>
</tr>
<tr>
<td>IMPPCA</td>
<td>0.07</td>
<td>-4.55*</td>
<td>-2.03*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tests</th>
<th>MW</th>
<th>Hadri (LM)</th>
<th>HT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>$\Delta X$</td>
<td>X</td>
</tr>
<tr>
<td>GDPACP</td>
<td>61.29*</td>
<td>89.28*</td>
<td>281.61</td>
</tr>
<tr>
<td>EXPPCA</td>
<td>66.01*</td>
<td>76.28*</td>
<td>228.22</td>
</tr>
<tr>
<td>IMPPCA</td>
<td>82.01*</td>
<td>74.54*</td>
<td>174.05</td>
</tr>
</tbody>
</table>

*Rejection of the null hypothesis at the 1%, 5% and 10% significance levels respectively.

### Table 1: Panel unit root test (trend included).

<table>
<thead>
<tr>
<th>p</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDPACP</td>
<td>0.429</td>
<td>0.268</td>
<td>0.251</td>
<td>0.258</td>
</tr>
<tr>
<td>EXPPCA</td>
<td>0.418</td>
<td>0.650</td>
<td>0.658</td>
<td>0.665</td>
</tr>
<tr>
<td>IMPPCA</td>
<td>0.477</td>
<td>0.646</td>
<td>0.641</td>
<td>0.642</td>
</tr>
</tbody>
</table>

*Rejection of the null hypothesis at the 1%, significance level.

### Table 2: Cross section correlations of the errors in the ADF (p) regressions of variables (trend included).
long run relationships among integrated variables has enjoyed growing popularity in the empirical literature. McCoskey and Kao [53], Kao [16], Baltagi and Kao [54], Pedroni [8-13,55] proposes residual-based, while Groen and Kleibergen [15], Larsson and Lyhagen [56] and Larsson et al. [57] propose maximum-likelihood-based panel co-integration test statistics. Westerlund [58] proposes new error correction-based co-integration tests for panel data having good small-sample properties with small size distortions. In our case, we tested the long-run relationship between the (GDPPCA=Y) and the two variables (EXPPCA=X_1) and (IMPPCA=X_2) examining a panel spanning the years 1970 to 2016. The data are expressed in natural logarithms. It was expected that no series will diverge from all the remaining series and that co-integrating relationships exist. Therefore, the objective of this research is to construct a panel co-integration study using the Pedroni procedure which allows varying the degree of heterogeneity allowed among the members of the panel. Based on the co-integration tests and the unit root tests proposed by Engle and Granger [59] in the case of univariate time series [18], one might be tempted to think that the statistics of the panel unit root could be directly applicable to the tests of null of no co-integration, with perhaps some changes in critical values to reflect the use of estimated residues. Pedroni extends the procedure of residual-based panel co-integration tests for the models, where there is more than one independent variable. He proposes several residual-based null of no co-integration panel co-integration test statistics. Pedroni proposes seven statistics, four of which are based on the within-dimension and three on the between-dimension. For the steps to follow in this method [17] we considered the hypothesized long-run regression between the dependent variable GDPPCA and two other explanatory variables (M=2) as the following:

\[ y_{it} = \alpha_i + \beta_1 x_{1it} + \beta_2 x_{2it} + \epsilon_{it} \]  

(1)

Where, \( y_{it} \) represents \( \ln(y_{it}) \) over time periods (t=1,......, T) and countries (i=1,......, N). Likewise \( x_{1it} \) and \( x_{2it} \) represent \( \ln(x_{1it}) \) and \( \ln(x_{2it}) \) respectively. The \( \alpha_i \) represents the country-specific fixed effects, and \( \beta_1 \) and \( \beta_2 \) represents potentially heterogeneous country-specific deterministic trends. We used the estimate residuals \( \hat{\epsilon}_{it} \) in (1) to estimate the model:

\[ \hat{\epsilon}_{it} = \gamma \hat{\epsilon}_{it} + u_{it} \]  

(2)

Statistically speaking, the null hypothesis of no co-integration is:

\[ H_a: \gamma < 1 \quad \forall \ i = 1, \ldots, N. \]

Whereas, the alternative hypothesis changes according to the within (intra) or between (inter) dimension vision. In the within-dimension:

\[ H_a: \gamma = 1 \quad \forall \ i = 1, \ldots, N. \]

Where, \( \gamma \) is a common value. The alternate to no co-integration must be that if the individuals are co-integrated, then they will exhibit the same long run co-integrating relationships.

In the between-dimension:

\[ H_a: \gamma < 1 \quad \forall \ i = 1, \ldots, N. \]

Where, a common value \( \gamma \) is not required. Under this alternative hypothesis, the individual cross sections contain co-integrating relationships that are free to take on different values for different members of the panel, in other words, we allow the presence of heterogeneity between individuals. Since in practice, it is rare to find identical co-integration vectors for all individuals, we therefore assume that the heterogeneity through parameters will differ among individuals. Fixed effects and heterogeneous trends have been included for all tests. Using the software RATS (version 9.2), Table 4 reports both the within and between dimension panel co-integration test. We report results for the raw data as well as for data that have been demeaned with respect to the cross-sectional dimension for each time period, which serves to extract common time effects from the data. The test is done with raw data using the options (Det=trend, Lags=6) and relative to mean to remove the time effects using the options (Det=trend, Lags=6, TDUM: to subtract out common time effects). For the demeaned data, four among seven test statistics, Panel and group ADF-statistics (1% significance level), panel PP and Panel-\( \nu \) statistics (10% significance level successively) reject the null hypothesis of no co-integration.

**Table 3: CIPS test statistics for the panel data (trend included).**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level intercept and trend</th>
<th>First difference intercept</th>
</tr>
</thead>
<tbody>
<tr>
<td>P=0</td>
<td>P=1</td>
<td>P=2</td>
</tr>
<tr>
<td>GDPCAP</td>
<td>-1.55</td>
<td>-1.71</td>
</tr>
<tr>
<td>EXPPCA</td>
<td>-1.76</td>
<td>-1.95</td>
</tr>
<tr>
<td>IMPPCA</td>
<td>-1.75</td>
<td>-2.04</td>
</tr>
</tbody>
</table>

*Rejection of the null hypothesis at the 1%, significance level.
In Table 5, we present the estimation results associated with the long-run equilibrium individually and aggregate in line with both methods FMOLS and DOLS (between parentheses figure the t-statistics). For all of the group mean FMOLS estimates and standard errors in Table 5, we have considered the case in which the data have been demeaned over the cross-sectional dimension in order to account for some of the likely cross-sectional dependence through common time effects. The FMOLS group mean estimators for the panel as a whole provide credible estimates for the parameters.

The RATS option (AVERAGE=simple) is an equally weighted average. For the full sample, the group mean estimates associated with \( \hat{x}_{1it} \) and \( \hat{x}_{2it} \) are both positive.

### Conclusion and Discussion of the Results

If we closely investigate the long-term equilibrium relationship for each country, we find different results for both FMOLS and DOLS techniques. For the countries USA, China, Japan, Italy, and Canada (significant at around 12%), using FMOLS, we find a positive impact of EXPPCA on GDPPCA, so an increase in 1% in the variable EXPPCA leads to a large increase in GDPPCA of 0.47%, 2.18%, 1.85%, 1.38% and 0.71% respectively but using DOLS estimator, effects will be successively 0.47%, 2.47%, 1.83%, 1.40% and 1.06% and for Brazil, we observe a rate of 0.35%. For the rest of the countries, we did not see a significant effect of EXPPCA on GDPPCA. We also note that China has distinguished itself from other countries. China has managed to raise GDP per capita by more than 71 times from $113 per capita in 1970 to around $8123 in 2016 with an average annual growth rate at 10.15%. For the last year 2016 noting that the period data 1970-2015 have been successively 0.47%, 2.47%, 1.83%, 1.40% and 1.06%, and for Brazil, we find different results for both FMOLS and DOLS (significant at around 12%), using FMOLS, we find a positive impact of EXPPCA on GDPPCA, so an increase of 1% in the variable EXPPCA leads to a large increase in GDPPCA of 0.47%, 2.18%, 1.85%, 1.38% and 0.71% respectively but using DOLS estimator, effects will be successively 0.47%, 2.18%, 1.83%, 1.40% and 1.06% respectively. Positive effects have also been found with the DOLS procedure: 0.39%, 1.35%, 0.91%, 0.97% and 0.25% respectively. With regard to China and Japan, we see their differentiation from the rest of the countries as a 1% increase in IMPPCA leads successively to a 0.39%, 1.35%, 0.91%, 0.97% and 0.25% respectively. With regard to China and Japan, we see their differentiation from the rest of the countries as a 1% increase in IMPPCA leads successively to a 0.39%, 1.35%, 0.91%, 0.97% and 0.25% respectively.

After the global financial crisis that has spread rapidly since the fall of 2008, and by 2016, the shares of exports and imports reach 18.73% and 14.17% respectively. According the FMOLS and DOLS estimators, it is remarkable that EXPPCA do not have an impact on GDPPCA in the other countries. For the United States, Germany, United Kingdom, France, Brazil, using FMOLS estimator, we find a positive impact of IMPPCA on GDPPCA, so an increase of 1% in the variable IMPPCA leads to an increase in GDPPCA of 0.52%, 1.18%, 1.06%, 0.45%, 0.30% respectively. Positive effects have also been found with the DOLS procedure: 0.39%, 1.35%, 0.91%, 0.97% and 0.25% respectively. Positive effects have also been found with the DOLS procedure: 0.39%, 1.35%, 0.91%, 0.97% and 0.25% respectively. Positive effects have also been found with the DOLS procedure: 0.39%, 1.35%, 0.91%, 0.97% and 0.25% respectively.
used to estimate the two predictive models. In Table 6, for each country and for the group of 10 countries we have measured the forecast performance for the year 2016 using the Mean Absolute Percentage Error (MAPE). It seems clear that both FMOLS and DOLS estimators show good forecast performance for the year 2016 for all countries except for China and India. In fact, this finding may be understandable if we know that the GDP per capita in these two countries is the lowest in this group. The forecasts for the entire group seem to be excellent under both methods FMOLS and DOLS.

### References


