GROWING REGIONAL SCIENTIFIC MIGRATION AND MOBILITY: THE EUROPEAN UNION AND THE EASTERN PARTNERSHIP

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Abstract: *The article contributes to the growing strand of the literature on the scientific mobility and migration in the European Union (EU) and the Eastern Partnership. The paper provides the quantitative assessment of the costs and benefits of 'smart' labour migration in the Eastern Partnership (EaP) countries (particularly, Ukraine), explores the potential of future new rules for the mobility within the EU-EaP, and proposes some policy recommendations to enhance the benefits stemming from such flows. One of the rigorous idea – to provide an explanation whether the scientific migration and mobility, and remittances impact on economic development in the donor and recipient states, and, in particular, how important it is as a resource for the EaP enhancing. The convergence effect of scientific migration in the EU and the Eastern Partnership region is considered by means of calculative assessment.*

Keywords: *Eastern Partnership; scientific migration; European Union; mobility; assessment; convergence; Ukraine*

Introduction

There are a number of shortcomings in the current migration policy framework between the European Union and the countries of the Eastern Partnership (EaP). The process is far from satisfactory and leads to reduced benefits for both sending and receiving countries (and the migrants themselves). Migration's significance is increasing, especially in the European countries, being fostered and reinforced by the economic integration between the European countries through the emergence of supranational institutions such as the European Union (EU).

Note, that the migration is a complex phenomenon, involving clear economic dimensions (e.g., through the effects of remittances on consumption and

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investment patterns, the changes in the labour markets that are the result of the outflow of workers, the changes in relative prices of tradable goods and non-tradable) as well as non-economic ones (such as the resulting consequences on the social fabric of sending countries, the deadweight losses possibly caused by the underemployment of skills). The remark, that the migration has an important role in the EaP countries in facilitating the economic restructuring, whereby "old" jobs are eliminated, and the labour surplus is reduced, allowing for greater productivity of those workers remaining in the country, and, consequently, resulted in higher wages over time. Approach to the migration is changing over the world. These trends are clearly claimed in the UNESCO Science Report, "Towards 2030", launched 10 November 2015. The report says that the science will play a key role in realizing Agenda 2030, and the main body of the report is particularly about the scientific migration and mobility. The world in search of effective growth strategy will consider the science as a new framework for sustainable growth. The realization of this note is seen in considering universities as increasingly global players, a developing science - policy interface. In the nutshell, tracking trends in the scientific migration and mobility could support the assessment of the EU-EaP policy success and future sustainable development.

The EU could consider, in the context of the Scientific Mobility Partnerships, encouraging member countries to start pilot programs specifically targeted for the EaP nationals to access to the EU labour market. The EU while managing the migration situation should concentrate on the alternative group of potential migrants (in the aspect of their terms of staying (long term mobility) and the level of their human capital).

Quite obvious, that the migration has various impacts on the society as it creates flows of people, money, and knowledge between countries. The Bilateral Remittance Matrix 2012 (World Bank, 2012), for instance, displays such financial impact and exhibits that the total amount of the worldwide inwards and outwards remittance in 2012 was approximately 529 billion USD. Such a monetary flow is an important financial source for the country with the weak economic power. The mobile scientist/student is successful one even from a formal point of view as for the donor-country, as for the recipient-country: because of knowledge and innovation diffusion, remittances, skilful human capital inwards in the labour market etc.

Nevertheless, the mobility of scientists is a social and anthropological phenomenon. This phenomenon is as old as the science itself. There is the observed evidence of local scientists' movements in ancient periods. For example, in ancient Greece, many scientists have left their homes in the search of wisdom. Some returned home later, while others - such as Pythagoras (570 BC) (Boyer, 1968) - continued to move, and they based their schools in new territories. In the Middle Ages, the scientists' move was considered as the "brain benefit ", since scientists returned to their hometowns. The mobility is the condition of scientific growth and spread of knowledge. At any rate, it supports further technical and innovative

development of the state. The challenge is only in creating an optimal balance between emigration and immigration of scientists in the EU-EaP economies: for the EaP not having the 'brain drain', for the EU - to launch an effective policy to absorb the potential of the scientific migrants' capacity ('brain gain').

This paper touches the relationship between highly skilled (educated) scientific migration and the transfer of knowledge within the European Union (EU). To understand these processes, we need to conceptualize the phenomenon and then develop appropriate operational tools. Scientific migration engages two key concepts: (1) the concept of skill or knowledge; and (2) the concept of migration itself. Analysing the impact of scientific migration/mobility requires an understanding of who is moving (and the quality of their skills) and the nature of their migration. This might include consideration of the direction of flows; their frequency, duration, and permanency; and the propensity to return. In order to evaluate the impact of these processes on the regions concerned and develop appropriate policy responses, we need to examine the relationship between the scientific mobility (the transfer of knowledge) and the regional development indicators. The question remains open: what are variables to use for the scientific migration/mobility assessment and its impact.

1. Literature review

There is quite a large body of literature that tackles the complex encompassing such issues as international (scientific) migration, capital transfer (remittances), and economic development. However, just a few papers on the topic of "scientific migration and mobility" (exactly) could be found in the research space of the EaP, but nothing that focuses on the link to the EU trends (Zhylinska, 2012). The notorious "brain drain/gain" (or the external scientific migration) is only part of the processes that relate to the scientific mobility. The titles given to the international scientific movement with the expertise and aptitudes are highly regarded and in demand around the world (Fahey and Kenway, 2010). Research into the policy and statistics concerned with the movement of educated people has quite a long and differentiated history. The base is mostly in the work on the international mobility of university academics and students. However, since the rise of notion of the knowledge economy (the force of the innovations in the skilled hands of educated human capital) many states as well as the EU have developed policies that suit their specific geopolitical situation (EPAM - European NGO Platform for Asylum and Migration; The Eastern Partnership Panel on Migration and Asylum; the European Commission's flagship scientific mobility scheme (the Marie Curie Fellowship Scheme etc.). Much the EU-EaP government policy on the international mobility of the highly skilled arises from the research on migration, labour mobility, remittances. The entry point is a national economic growth, competitiveness, growing regional interdependence and convergence.

Thus, we consider four-dimensional literature material:

1) scientific labour migration/mobility: Dobson (2009) deeply analysed the scale, direction and structure of labour mobility within the EU and the EaP, however, having a general approach to the educated segment of migrants. Kale *et al*. (2008) presented important insights regarding the issues affecting the diffusion of knowledge through the migration of scientific labour in India (particularly, pharmaceutical sector). They proved that the reverse "brain drain" of engineers and scientists educated and trained in the US or Europe can accelerate technological upgrading in the Indian economy by providing the skill and know-how needed to help local firms shift to higher value-added activities. Bauder (2012) provided very sound theoretical analyses of a labour market perspective when examining the transnational academic mobility. In his article, he assumed political-economy and segmentation-theory perspectives of such labour mobility. Ackers (2005) considered the relationship between highly skilled scientific migration and the transfer of knowledge within the EU. She came up with the conclusion of the urgent necessity to analyse the migration flows. In her previous works, she contributed to the concept of "tied migration" throughout the deep qualitative analysis of the experiences of highly skilled scientists that were moving within the EU (Ackers, 2004). In her papers, Ackers proves the importance of considering the impact of mobility on the progression of trailing partners as opposed to simply engagement or salary. Her findings are firmly grounded in the experiences of scientists, recent trends in European labour markets and suggest that the pressure to attain international experience is beginning to shape career trajectories in many other employment sectors. Extremely appealing research was done by Moed *et al.* (2013) on the exploration of Scopus as a data source for the study of international scientific migration or mobility of five analysed countries: Germany, Italy, the Netherlands, the UK and the USA. Authors argued that Scopus author-affiliation linking and author profiling are valuable, crucial tools in the study of this phenomenon. Moed and his co-authors found that the UK has the largest degree of outward international migration, followed by the Netherlands, and the USA the lowest. Language similarity between countries is a more important factor in international migration than it is in international co-authorship. During 1999–2010 the Netherlands showed a positive "migration balance" with the UK and a negative one with Germany, suggesting that in the Netherlands there were more Ph.D. students from Germany than there were from the UK, or that for Dutch post docs stage periods in the UK were more attractive than those in Germany. Comparison of bibliometric indicators with OECD statistics provided the researchers be the evidence that differences exist in the way the various study countries measured their number of researchers. The authors concluded that a bibliometric study of scientific migration using Scopus is feasible and provides significant outcomes.

The challenges on the way of widely spread scientific mobility are straightforwardly highlighted by Jacob and Meek (2013). They argue that the mobility of scientific labour is an indispensable prerequisite for building capacity and world-class excellence. A lot of the newly emerging economies have been able

to leverage themselves to advantageous positions in the global scientific economy through the skilful deployment of international research networks. The mobility is still a mixed blessing since scientific labour, like other scarce resources, has a tendency to cluster towards the centre. Also, the authors grounded the statement that the given advances in communication technology and the presence of high-quality research infrastructure, a core group of networked researchers can go a long way towards helping a country with modest scientific resources achieve world-class excellence.

The majority of papers on the topic use not open-statistic data, but survey data (mostly in the form of semi-structured interviews). For example, the questioning of former visiting researchers in Germany examined to what extent the participation of researchers in transnational academic mobility, their experiences and perceived outcomes vary by gender (Jöns, 2011). The paper stated that the academic world of female researchers tends to be less international than that of their male colleagues, particularly in the natural sciences.

2) remittances and labour migration: Hundreds of papers examined the facets of migration and remittances and explore the role of migrants as actors in development and partnership over the world (i.e., Doorn and Date, 2002; Adams and Page, 2005; Kharlamova and Taran, 2010; Kharlamova and Naumova, 2010). There are quite few researches that indicated negative connotation of remittances in the sense of migration spillover (Chami *et al.*, 2003; Jawaid and Raza, 2016). Thus, Ustubici *et al.*, 2012) contributed to the discussions on the nexus between migration and development by assessing the effects of remittances on human development. They concluded that remittances have the most positive effect in terms of boosting human development in the countries where the state perceives migration as an effective labour export strategy.

3) the impact of migration on the economic development of the EU as the recipient part: there is the sound evidence in the literature that (i) the balance of costs and benefits is positive for both sending and receiving countries; (ii) costs can be reduced, and benefits maximized, by the use of appropriate policies that facilitate mobility and integration of migrants and their families, and that help manage the economic consequences of large remittance flows; (iii) labour migrants from the EaP countries could help the member states of the European Union to fill skills gaps at all levels in the next few years, as the demographic transition intensifies in Europe (Barbone *et al.*, 2013; Delcour, 2013; Kharlamova, 2015). Coupé, Vakhitova (2013) and Mincu, Cantarji (2013) conducted a research in the field of costs and benefits of labour mobility between the EU and the Eastern Partnership Partner Countries. For Moldova, authors argue that migration to the EU of workers with low and mid-level skills would have a greater impact on poverty reduction because unskilled workers come from lower income families and villages and tend to send home a larger proportion of their income. A major concern regarding the social costs of migration is the lack of structures and expertise at the community level to tackle the problems of migrant families. Given that migrants

are part of family systems, it is recommended that a family perspective is used when developing policies regulating international migration and the migration concerns need to be mainstreamed into national development policies. At the same time, Mincu and Cantarji (2013) also recommended that the EU and Moldova develop programs targeting migrants with low and mid-level skills to fill labour shortages in specific sectors of the economy, in which natives are more reluctant to work.

A bit different situation is observed for Ukraine. Coupe and Vakhitova (2013) assessed how liberalisation of the EU visa regime, something that the EU is currently negotiating with Ukraine, will affect the stream of Ukrainian labour migrants to EU countries. Their study suggests that the number of tourists will increase substantially, whereas the increase in the number of labour migrants is unlikely to be very large. They also suggested that the number of legal migrants is likely to increase, but at the same time the number of illegal migrants will decline because currently only a third of migrants from Ukraine have both residence and work permits in the EU, while about a quarter of them stay there illegally.

Ruiz-Arranz and Giuliano (2005) and Aggarwal *et al.* (2011) carry out an exploration of the remittances impact on financial development. They explored the various aspects of mobility requirements and the relationship between competitiveness, excellence, and mobility in the scientific research in the EU. The "expectation of mobility" in science plays an important role in shaping the European Research Area (Morano-Foadi, 2005). Researchers argue that better economic opportunities and advanced migration policy in destination countries promote highly skilled migration. Despite the actions and measures taken in the context of the EC Mobility Strategy, unbalanced flows are still a weakness of the European Research Area, especially from the EaP. There is a need in Europe to coordinate science and migration policies at the European and Member States level to enhance the attractiveness of European receiving countries and facilitate the return of scientists to their sending nations. Moving people and knowledge across the EU is not broadly explored for the EaP, and even as to all EU states (Ackers and Gill, 2008), and especially addressing the effects of highly skilled, scientific migration and the transfer of knowledge on the individual concerns, and in terms of sustainable scientific development and capacity.

4) the impact of migration on the economic development of the EaP as the donor: Despite the growing interest of scholars and policymakers to better understand the determinants for researchers in public science to transfer knowledge and technology to firms, little is known how temporary international mobility of scientists affects both their propensity to engage in knowledge and technology transfer (KTT) as well as the locus of such transfer (Edler *et al.*, 2011). Prominent results of Edler *et al.* (2011) affirm how the duration and the frequency of scientists' visits at research institutions outside their home country can affect KTT activities. Proving the benefit for host and home country, authors found out that the longer research visits abroad are, the higher the likelihood that scientists engage in

KTT to firms, again both in the host and the home country. Same could be said about the frequency of scientists' visits institutions abroad. In the long run, the results, therefore, provide evidence for the possibility of the benefits of "brain circulation".

Ground research of Cajka *et al.* (2014) on the base of econometric model forecasted the stocks of migrants from the Eastern European states (EES) in the Visegrad group (V4) countries and the European Union Member States (EU MS) in the case of visa abolition. Visa abolition is not going to dramatically increase migration from the EES in the EU MS. Even though, the immediate effect of visa abolition would probably result in the slight increase of migration stocks in the V4 and EU countries, the annual migration stocks comprised of residents of Belarus, Moldova and Ukraine in the EU MS in a long term might be around for one and a half to just above three – three and a half million people.

Iankova and Turner (2004) focused on the struggle for a social Europe by examining social partnership developments in two western countries, Germany and Britain, and two eastern countries, Bulgaria and Poland: the coming or deepening of labour markets has therefore surprisingly promoted or reinforced relations of social partnership throughout Europe. Marin (2012) offered a collective assessment of the development and impact of the European Neighbourhood Policy and the Eastern Partnership Initiative on its eastern neighbours - Belarus, Ukraine and Moldova in particular, with Russia's added perspective. Most authors considered the scientific migration as a new alternative and new bring for the European partnership states.

Nevertheless, the current migration policy framework between the European Union and the countries of the Eastern Partnership is far from satisfactory and leads to reduced benefits for both sending and receiving countries (and the migrants themselves).

Both the relevant literature and also various political trends – as well as this very topic – suggest that there is a distinct need for the EU to determine the conditions necessary for the successful implementation of agreements and other measures that would regulate the relevant ever-spreading phenomenon of inter-European migration currently blocked. In this regard, it should be noted that several Eastern Partnership countries have been successful in concluding bilateral agreements with individual EU countries, while others seem to be still lagging behind. Fine examples for such agreement can be seen in the case of Belarus which has concluded agreements on the social security of migrants with Latvia and Lithuania or the significant bilateral treaties signed by Ukraine and Moldova with individual EU countries on matters such as labour conditions, social security payments and benefits, migrants' welfare and other matters. However, there is no single permit directive that could simplify negotiations between the EaP countries and the EU, which can provide a common platform for discussions and resolutions pertaining to social security and other working conditions for migrants. It might result from the under-appreciation of the significance of the potential that might be

offered by the migration from the Eastern Partnership Countries to the EU and the impact therein. One such impact is the potentially high benefits (also in terms of minimising costs) that the scientific migration and exchange can bring with it.

Indeed, scientific activities of migrants have a colossal potential for the development of economic, political and social processes of the modern EU and, of course, in the states of their origin. The research plans to examine the capacity of the scientific cooperation / mobility of researchers to contribute to an increased understanding between the EU and the countries of the Eastern Partnership (EaP) (particularly, the case of Ukraine) in addressing social and macroeconomic challenges.
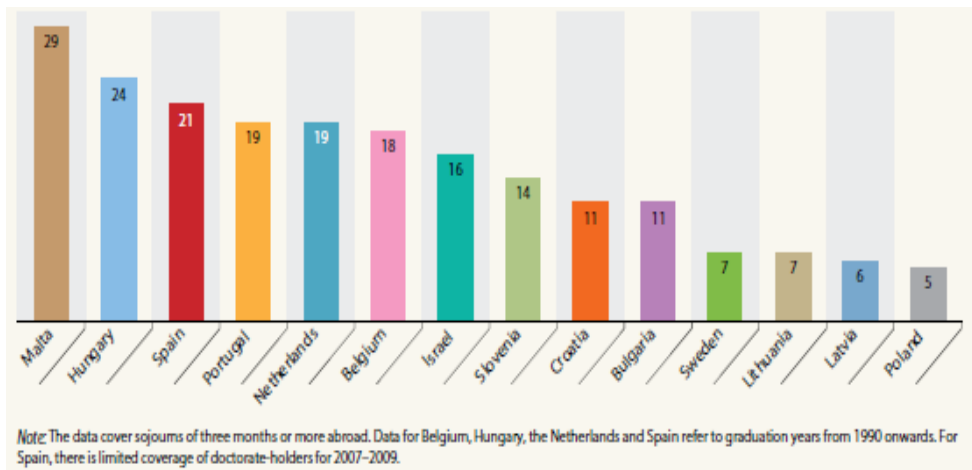
2. Methodology

Before coming to the methodology the obvious issue is to settle definitions and determinants. The scientific migration is something conceptually different from the scientific knowledge transfer and diffusion of science. It is mostly a movement of scientists from the peripheries towards scientific centres for conducting research and any other scientific activity. Mainly it is initiated not by the migrants itself, but by available abilities, programmes in the recipient state. The following factors and determinants of scientific migration could be considered: scientific knowledge of particular migrant (remains as internal, implicit factor); collaboration network; co-authorship; remittances received. Thus, scientific migration and mobility should be distinguished as not-spontaneous, mostly forced, regulated. However, there is still no universal term for the scientific mobility and its exact determinants. In the EU states it is common for scientists being participants of scientific migration: the careers of doctorate-holders survey reveals that, on average, between 5% and 29% of citizens with a doctorate have gained research experience abroad for three months or longer in the past 10 years (Figures 1 and 2). However, most scientific migrants from the Eastern Partnership countries are temporary migrants in the sense that they continue to belong to a household in their home country, even if they work abroad for a long time (CASE project entitled "Costs and Benefits of Labour Mobility between the EU and the Eastern Partner Partnership Countries" for the European Commission (Contract No. 2011/270-312, tender procedure EuropeAid/130215/C/SER/Multi).

When we talk about the scientific mobility, mostly we mean academic mobility referring to students and teachers in higher education moving to another institution inside or outside their own country to study or teach for a limited time. According to the UNESCO Institute for Statistics (June 2015), the outbound mobility ratio counted 1.7 (2000) and 2.0 (2013) for the CEE and 3.1 (2000) vs 3.3 (2013) for the Western Europe. Keep in mind, that the world average rate is 1.8 for the period, demonstrating the number of students from a given region enrolled in tertiary programmes abroad expressed as a percentage of total tertiary enrolment in the region. If to come to the means for scientific mobility, then for the period of 2007-

2013, cooperation in higher education between the EU and the EaP mostly took place in the framework of Erasmus Mundus and Tempus supporting the scientific mobility with further migration. While the Erasmus Mundus programme focused on mobility actions and on encouraging partnerships between institutions from the EU and from the partner countries, Tempus IV focused on the reform and modernisation of higher education systems in the Neighbourhood region.

Figure 1. Percentage of national citizens with a doctorate who lived abroad in the past 10 years, 2009

Note: The data cover sojourns of three months or more abroad. Data for Belgium, Hungary, the Netherlands and Spain refer to graduation years from 1990 onwards. For Spain, there is limited coverage of doctorate-holders for 2007–2009.

Source: UNESCO Institute for statistic / OECD /EUROSTAT

Figure 2. Percentage of foreign doctorate holders in selected states, 2009
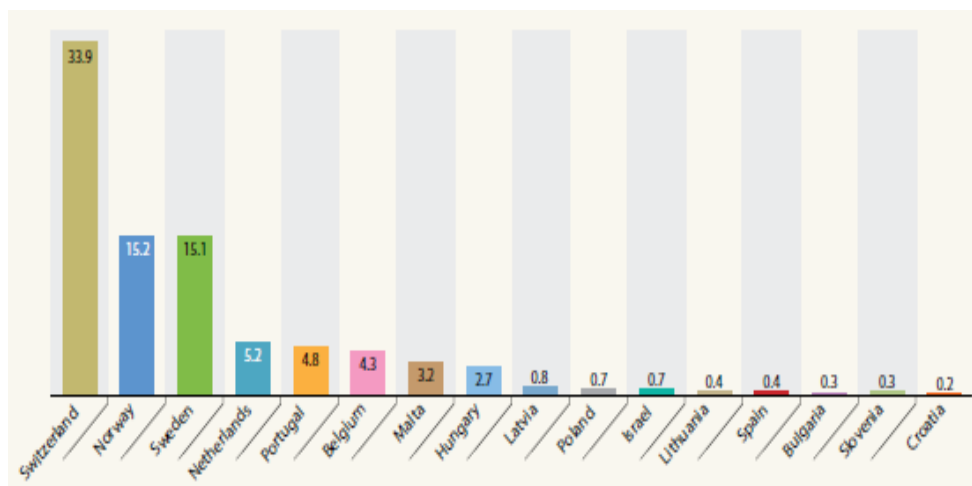
Source: UNESCO Institute for statistic / OECD /EUROSTAT

Neighbourhood countries and Russia benefitted from a budget of around EUR 670 million during the 2007-13 programming period for the Erasmus Mundus and Tempus programmes. As part of the EU's strengthened ENP and mobility policy, the financial allocation for the period 2011-2013 was almost doubled compared to preceding years, through a sizeable top-up that came following the 2011 review of the European Neighbourhood Policy. In total, 5,187 students (at the undergraduate, master, doctorate and post-doctorate level) and staff members from Neighbourhood East countries, and 6,221 from Neighbourhood South countries were able to benefit from scholarships in the framework of Erasmus Mundus Partnerships between 2007 and 2013. Within Erasmus Mundus Joint Programmes, 695 Eastern Partnership nationals benefited from mobility to follow a joint Erasmus Mundus master or doctorate (European Neighbourhood and Partnership Instrument, 2014). For example, in the frame of FP7-PEOPLE Marie Curie Actions (2007-2014) between Ukraine and the EU the international research staff exchange scheme is following:

Figure 3. Country fact sheet FP7 (2007-2014) – Staff sent by Ukrainian organisation, grouped by the country of destionation (top countries)
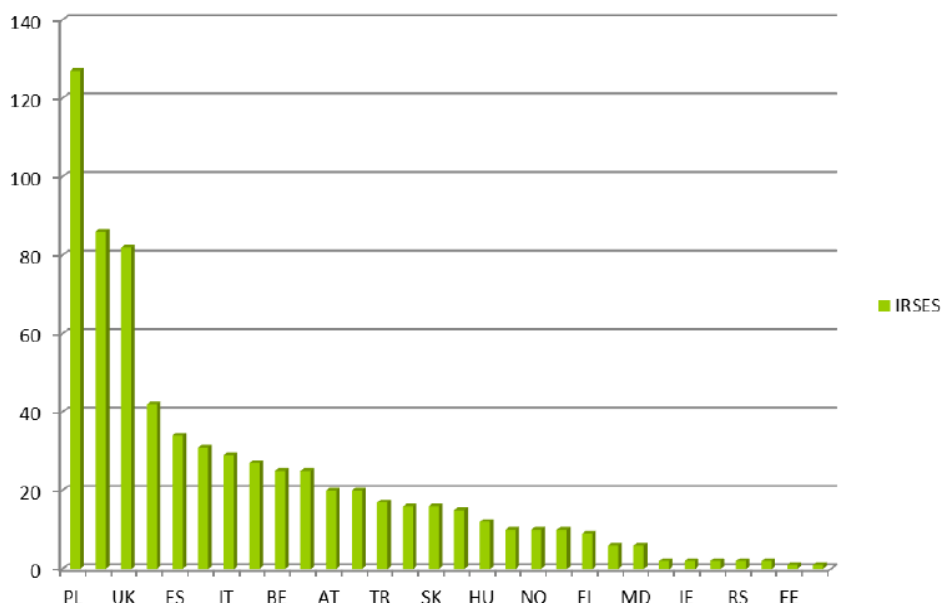
Source: UNESCO Institute for statistic / OECD /EUROSTAT

Country studies show that in the migration flows from Ukraine to the EU the education level of migrants (% with tertiary education) is about 13% overall (34% in the total employment) (GfK Ukraine Project). In comparison to other EaP

countries this is the average position, because for Armenia - 10-15%, 26% - Azerbaijan, 18% - Belarus, 33% - Georgia, 10% - Moldova. Main recipients of scientific mobility from Ukraine are the states-leaders in the scientific collaboration.

The paper will result in the production of the country study (for the Eastern Partnership country - Ukraine), and for the EU main destination. The country survey will be based on the logic, historical, statistical, and economic-mathematical analyses. The summative survey of the evidence on macroeconomic costs and benefits of the scientific migration specifically for the EaP state and the targeted EU countries will be produced.

We shall first collate and analyse the evidence on the costs and benefits of the scientific migration from Ukraine to the EU countries.

If to consider the choice of spillover effects of the scientific migration on the macroeconomic situation in the state-recipient and in the state-donor, we presume:

1) the effects of the extra income on household behaviour: overall, the extra income due to the migration and remittances reduces poverty in remittance-receiving households throughout the Eastern Partnership countries, leading to better nutrition, housing, and access to the education and health care (Cooray, 2012). During the 2000s, migrant remittances in the EaP countries rapidly grew along with the number of migrants, mirroring a world-wide trend stimulated by increased migratory flows and better technologies for transfers of small sums of money. For the whole EaP region, remittances rose from practically negligible amounts in 1995 to US$12.9 billion in 2008. After a sharp decline in 2009 due to the economic slump in Russia and other destination countries, they have consistently recovered, reaching a projected US$14.2 billion for 2012. Together with the rapid growth in nominal US$ terms, the macroeconomic importance of remittances has increased, albeit less impressively due to GDP in many Eastern Partnership countries also increased during the 2000s. Unsurprisingly, the smaller countries with higher levels of labour migration – Moldova, Armenia, and Georgia – are the most "dependent" on remittances (with the ratio of remittances to GDP, respectively, at 23, 13 and 11 percent in 2011), whereas in Azerbaijan, Belarus and Ukraine remittances are below 5 percent of GDP, but higher than FDI net inwards;

2) the effects on professional skills: the concern is that migrants may not be able to fully utilise their skills abroad. Any possible loss of skills must be more than compensated for by income gains or other benefits of migration like the experiences and human capital effects of working abroad. Supposed deskilling phenomenon (Artuç *et al*., 2014);

3) There is also evidence in some EaP countries (e.g. Moldova), but not all (e.g. Armenia), that the effect of remittances on the financial sector has been positive, contributing to financial deepening and the emergence of new financial products, which have helped to raise the general economic efficiency and the growth. The balance of the positive effects in this regard appears to be influenced by general policies with regard to the financial sector stability and the certainty of

property rights. Thus, remittances have a potential, particularly in the smaller countries, to contribute to stronger public finances through their effects on consumption and import, although in some cases there are indications that higher revenues may have weakened the fiscal discipline. Remittance inflows into the developing economies have increased tenfold from US$31,058 million to US$327,591 million over the 1990 to 2008 period, accounting for the second largest foreign exchange inflow next to foreign direct investment, and in some cases the largest (World Bank, 2012). Migrant remittances can promote financial development in the recipient countries by increasing the volume of deposits with financial institutions. In this respect, it is at the agenda to examine the impact of remittances on the financial sector' size and efficiency.

4) Offer the possibility to young people to frequent the upper levels of education both in their country and in other European universities. This last aspect can facilitate the cultural integration among the young European generations, and also a potential integration both in technological and economic systems.

Our research will be based on the empirical analysis. The study will use OLS methods to estimate the impact of scientific migration and accompanying migration spillovers on the economic development of the donor and the recipient (the case of EU-Ukraine). Here we acquire the following model as a base:

$$E_t = aSM_t + \beta M_{it} + \upsilon,$$

where E_{it} is the economic sustainability variable for the country in the period t; SM_t is the scientific mobility variable for the country in the period t. All our mobility-spillovering variables mentioned above are captured by the vector M_t. υ is a random error term that captures all other variables.

Though recognising all the difficulties involved in scientific migration flows forecasting (Chornous and Kharlamova, 2002), this study attempts to obtain a baseline series of estimates of potential flows using a macro data approach. While the propensity to emigrate increased sharply in some EaP countries during the first half of the 2000s, it has been relatively constant throughout the region and in Ukraine since then.

As well, having in mind the convergence approach in economics (also at times known as the catching-up effect), – the hypothesis that poorer economies' per capita incomes will tend to grow at faster rates than richer economies, – we consider to adapt it for the so called "scientific migration convergence". Therefore, we assume the reduction in the dispersion of levels of migration (mostly with tertiary education) determinants across economies. Thus, we consider "Beta-convergence" approach, on the other hand, stating that it occurs when the EaP mobility rate grows faster than the EU ones. As for σ-convergence, we define it as a reduction of future rates of variation (inequality, differentiation) in the levels of migration of regions (countries). Not only rates of variation can be used, but as well the variance or standard deviation. However, the most informative indicator is the rate of variation, for the reason that it does not depend on the dimension and scale of variables. Variance and standard deviation are impractical to use in the

presence of inflation (Young *et al*., 2008). We will check the existence of a scientific convergence phenomenon for the inherent dynamics of the EU and the EaP connected with scientific migration and its spillovers / determinants.

3. Results

The research takes the HDI as the main dependent variable. HDI measures the national achievements in human development based on three essential components of the human life: a long and healthy life, access to knowledge and a decent standard of living (UNDP).

In the same vein with change in HDI, we use GNI (formerly GNP) – the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad – as an alternative dependent variable to measure the impact of scientific mobility only on economic development. The data are compiled from a dataset based on WB World Factbook:

Factors			
Indicator	Variable	Description	Source
International migrant stock (% of population)	IMS	the number of people born in a country other than that in which they live, including refugees	World bank data
Emigration rate of tertiary educated (% of the total tertiary educated population)	ERTE	that shows the stock of emigrants ages 25 and older, residing in an OECD country other than that in which they were born, with at least one year of tertiary education as a percentage of the population age 25 and older with tertiary education. As stated above, there was a constantly increasing tendency to "smart" migration over the years	World bank data
Personal remittances, received (current US$)	PRR	that comprises personal transfers and a compensation of the employees. Personal transfers consist of all current transfers in cash or in kind made or received by resident households to or from non-resident households. Personal transfers, thus, include all current transfers between resident and non-resident individuals. Compensation of employees refers to the income	World Bank staff calculation based on data from IMF Balance of Payments Statistics database and data releases from central banks, national statistical agencies, and World Bank country desks

		of border, seasonal, and other short-term workers who are employed in an economy where they are not resident and of residents employed by non-resident entities. Data are the sum of two items defined in the sixth edition of the IMF's Balance of Payments Manual: personal transfers and compensation of employees. Data are in current U.S. dollars. As well, we consider personal remittances paid (PRP). Remittances as a share of GDP in 2014 (%) calculated 5,6%	
Research and development expenditure (% of GDP)	R&DE	that are current and capital expenditures (both public and private) on creative work undertook systematically to increase knowledge, including knowledge of humanity, culture, and society, and the use of knowledge for new applications. R&D covers basic research, applied research, and experimental development	World bank data
Grants, excluding technical cooperation (BoP, current US$)	GRANTS	that are defined as legally binding commitments that obligate a specific value of funds available for disbursement for which there is no repayment requirement. Data are in current U.S. dollars	World bank data
Technical cooperation grants (BoP, current US$)	TCG	that include freestanding technical cooperation grants, which are intended to finance the transfer of technical and managerial skills or of technology for the purpose of building up general national capacity without reference to any specific investment projects; and investment-related technical cooperation grants, which are provided to strengthen the capacity to execute specific	World bank data

		investment projects. Data are in current U.S. dollars.	
International collaboration	IC	an official indicator of international collaboration resulted in publication activity	SJR

The Granger approach (1969) to the question of whether X (independent variable) causes Y (dependent variable) is to make out how much of the current Y can be explained by past values of Y and then notice whether adding lagged values of X can enhance the explanation. This approach helps us to understand what is the main indicator and what factor can cause. Before the application Granger test, we clarified each of the time-series to determine their order of integration - involved ADF test. We received stationary results for all data set (Annex 1). Generally, for financial and economic processes the intergration higher than 1 is not peculiar, since in this case the process is "explosive." The occurrence of such processes is unlikely, since the financial and economic environment is quite inert, it does not allow to make an infinitely large value for small periods of time. Implementation of Granger causality test in EViews provided us with such resulting claims (at the appropriate level of F-stat) about link directions for considering data: we cannot reject the hypothesis that all performance indicators does not Granger cause Human development indicator of donor-state Ukraine (HDIUKR) and we do not reject the hypothesis that HDIUKR does not Granger cause the indicators (for all analysed indicators). Therefore, it appears that Granger causality runs two-ways for Human development indicator of donor-state Ukraine and most significant performance indicators of Ukrainian migration ("smart mobility") in the EU. This means that HDI is flexible to the internal situation in the country, and the positive effect of smart mobility and remittance inflows can be easily absorbed inside of the country (Annex 2). The same we observed for GNI of Ukraine. Note, Granger causality does not provide the answer what is the effect or the result.

If to consider correlation analyses, we received that the interconnection of HDIUKR and all analysed variables for the EU have a sound negative correlation, thus increasing these indicators' level in the EU would decrease the level of HDI in Ukraine. We could assume that the reason is in rapid increasing of migration to the EU looking for the improved situation. As well, we received that remittances are in exceptionally low correlation with resulted variables in Ukraine. Having T-statistic prove of significance for the results we as well received a control variable (international collaboration) tightly connected with IMS (directly), but still in low correlation with other analysed variables.

After the assessment of the indicated model: HDIUKR = f(R&DEEMU, R&DEUKR, PRREMU, PRRUKR, PRPUKR, GrantUKR, TCGUKR, PRRUSUKR, ICUKR; IMSUKR; ERTEUKR) for the period 1990 - 2014 (adj.R-sq = 0.79; significant as to F and t statistics), we received the following elasticity data, correspondently (%): 5,815362; 2,87858; -2,70639; 0,1486; 0,720562; 0,57939;

0,54147; 0,68389; 1,78562; 3,00123. Thus, the largest impact on the donor-development has the level of expenditures on the research in the recipient, that proves the hypothesis of Diaspora impact, science-centers attraction capacity and involving best practices during "smart" mobility. As to remittances, the impact of inflows in the EU is high, as in donor state, however quite obviously it is opposite. However, the elasticity mostly is not crucial as lower than 1. As to migration variables, we witness positive and high elasticity.

As to GNI, we received mostly same results.

As for convergence, considering the scientific migration, we can conclude that there is a quite convergence between the EU & EaP in this indicator in the years of the EaP initiation, but no results in the process of its fulfilment. Although, the asymmetry shows how much data is distributed asymmetrically with respect to the normal distribution: having A > 0 in the period we conclude that much of the data has a value greater than the average over the EaP+EU (Fig. 4).

Having in mind all spillover indicators of scientific migration between Ukraine and the EU we received that much of the data has a value greater than the average over the EaP+EU (Fig. 5). However, convergence seen in the EU in the first years of the Union, dramatically failed in the years of the EU enlargement in the aspect of analysed the scientific migration spillovers determinants latter mentioned, and the first EaP years had real potential to converge the region to the EU but failed in following years.
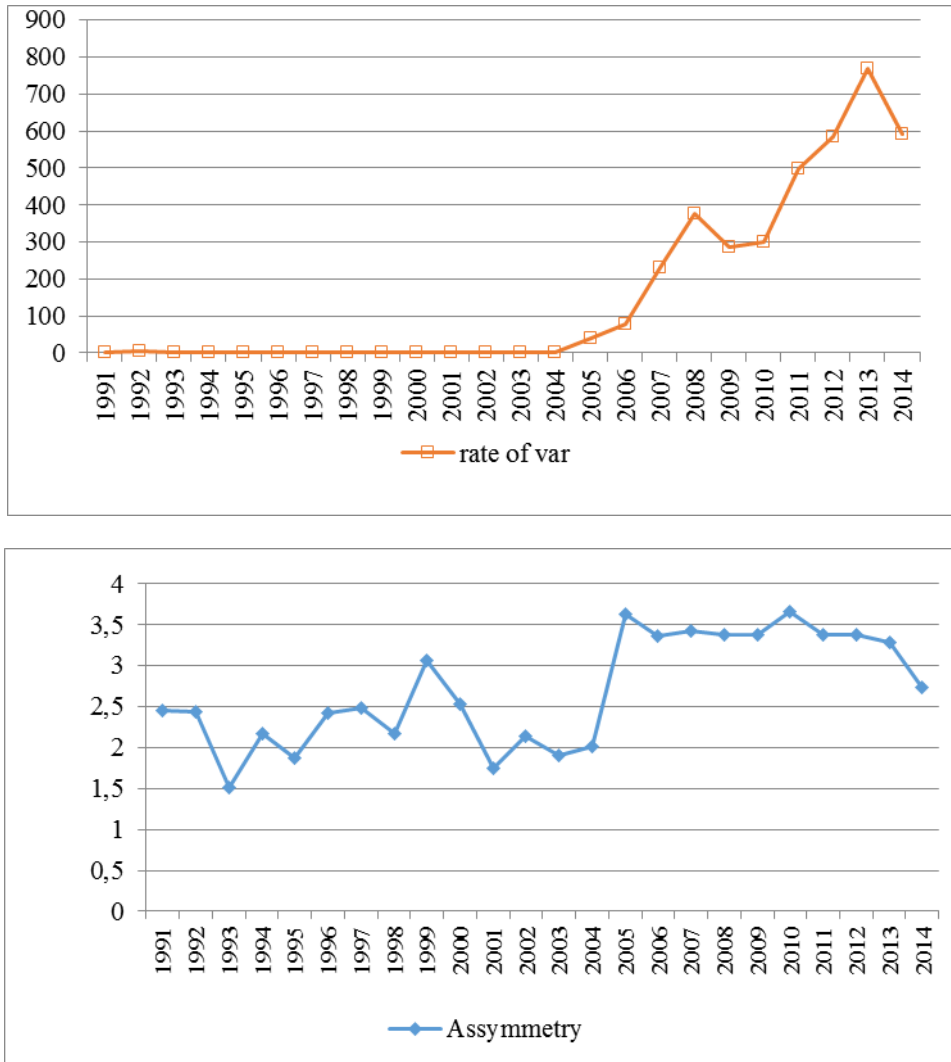
All results are significant at 0,1 level of significance.

Figure 4. Scientific migration in the EU-EaP: convergence effect
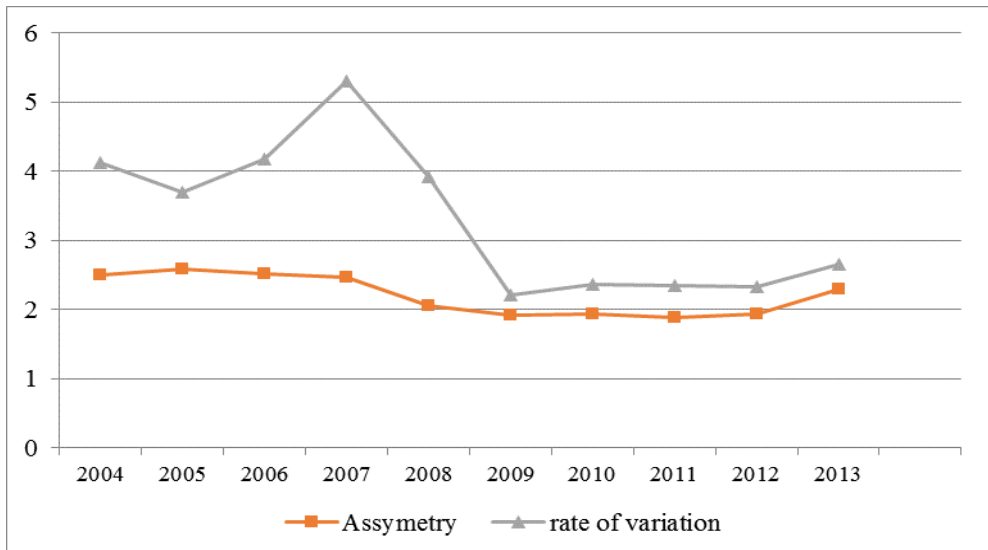
Source: Author's calculations

Figure 5. Scientific migration in the EU-EaP: convergence effect

Source: Author's calculations

Conclusions

The proposed research is an innovative one, as much as it sets out to generate new insights pertaining to the international scientific mobility that marks the relationship between the Eastern Partnership Countries (particularly, Ukraine) and the EU as a whole. The proposed assignment shall also develop strategies and game policies so as to turn the brain-power (i.e., scientists) into main stakeholders of the

economic and democratic development process in the state of the origin of these scientists as they bring into their economies also EU standards (Fig.6). The research done is targeted to support well-grounded policies for increased and mutually Beneficial Mobility between the EaP (particularly, Ukraine) and the EU. The impact of the international mobility on the economic characteristics of the scientific and educational systems is still poorly understood. The benefit to the donor country may consist of the development of contacts with the scientific Diaspora, and, in the case of the introduction of effective measures to promote cooperation, attracting those who left and the application of their knowledge in the country.

Figure 6. Scientific migrants as a bridge between the EU and the EaP
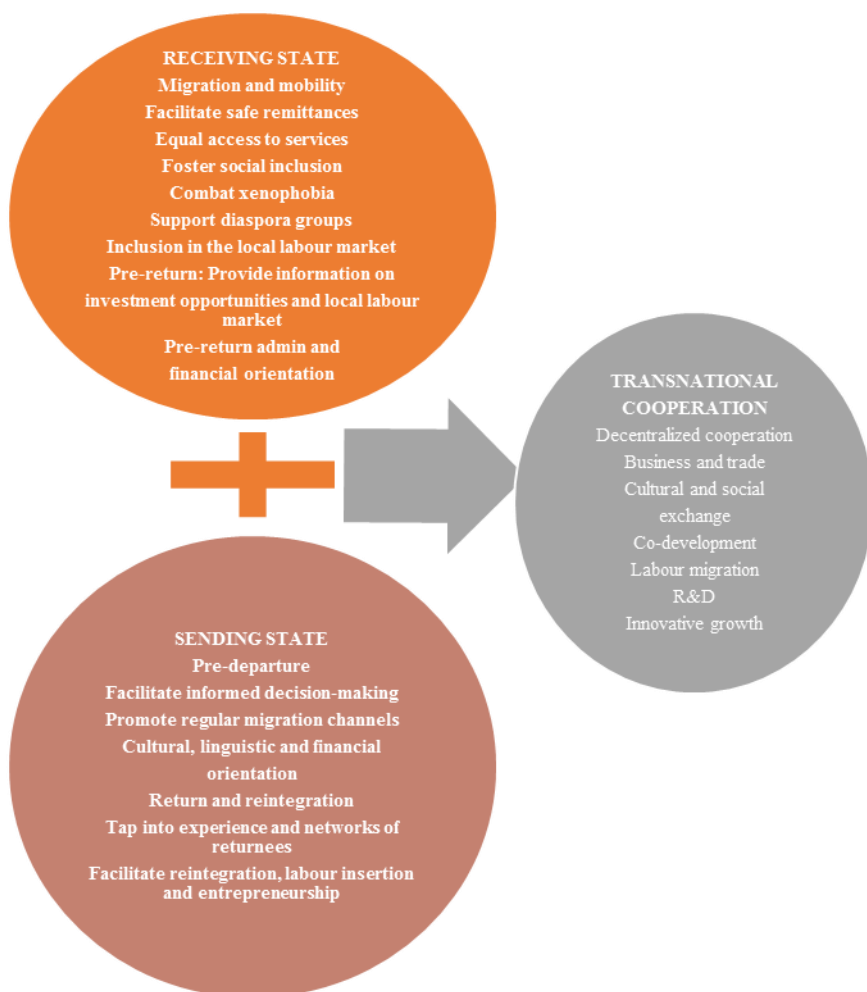
Source: Author's representation

The common EU attempts to analyse the question should result in particular studies for each EaP country, along with general survey reports of the scientific migration and exchange to the EU. The EU should examine the main reasons for "smart" migration and assess the resulting preference of various types of such migration in as much as it might influence on the economies. Migrants can support development back home through partnership/collaboration with countries of origin. Migrants can help promote development back home with their ideas, skills, labour, remittances and investments, as temporary foreign workers, permanent settlers as well as remitters and investors in the diaspora. Diaspora communities abroad also help create boomtowns in their countries of origin through remittances, investments and physical returns.

The European Union faces growing skill shortages in its labour markets, mainly as a consequence of adverse demographic trends in Europe. Developing measures to allow the enhancement of scientific cooperation and mobility of researchers so as to contribute to enhanced understanding between the EU and the BUM countries in the area of scientific and technological sustainable development should become the core of EU policies. This will also better regulate the participation of scientific migration community in the political process of their countries of origin.

For the targeted EaP country (Ukraine):
- The adoption of a scientific migration lens in all aspects of public policies that affect migration and its outcomes, through explicit incorporation of scientific migration issues in national macroeconomic and educational strategies as well as sectoral action plans (special banking projects, competition bursting, etc);
- Improved institutional coordination, the adoption of a strategic vision for labour migration (mostly educated migrants), and eventually the designation of a single national entity to coordinate and facilitate "brain" labour migration strategies and mobility of researchers. Support for macroeconomic development projects that aim at sustainable development and connection to EU policies and standards in Ukraine. To include scientific migration policy while developing national educational paradigm and legal issues.

For the EU and its Member States:
- The adoption of a visa-free travel regime for scientists/researchers/academia;
- A stepped-up engagement with the EaP countries through the EU-level, multilateral and bilateral mobility frameworks, work permit liberalisation and facilitation, programs for specific professions and sectors, as well as simplification and increased transparency of immigration procedures.
- Enhancement of complementary migrant integration policies, including skill transferability, scientific cooperation, recognition of social rights,

reduction of informational gaps, management of public opinion and involvement of relevant stakeholders;
- Despite the EU is the union, in reality, enlarged organisation, human capital issues, preferably to consider on the level of particular states;
- Development of special border policy in the aspect of involvement migrant remittances in cross-border regions.

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Annex. 1

Group unit root test: Summary				
Series: ERTEEMU, ERTEUKR, GNIPCUKR, GNIUKR, HDIUKR, GRANTUKR, ICUKR, IMSEMU, IMSUKR, PRPUKR, PRREMU, PRRUKR, PRRUSUKR, R_DEEMU, R_DEUKR, TCGUKR				
Sample: 1991 2014				
Exogenous variables: Individual effects				
Automatic selection of maximum lags				
Automatic lag length selection based on SIC: 0 to 4				
Newey-West automatic bandwidth selection and Bartlett kernel				
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	3.52845	0.9998	12	236
ADF - Fisher Chi-square	12.3284	0.9759	12	236
PP - Fisher Chi-square	14.7924	0.9267	12	242
** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.				

Annex. 2

Pairwise Granger Causality Tests
Sample: 1991 2014
Lags: 2

Null Hypothesis:		Prob.
GNIPCUKR does not Granger Cause ERTEEMU		0.0157
ERTEEMU does not Granger Cause GNIPCUKR		0.0440
GNIUKR does not Granger Cause ERTEEMU		0.0032
ERTEEMU does not Granger Cause GNIUKR		0.0077
HDIUKR does not Granger Cause ERTEEMU		0.0159
ERTEEMU does not Granger Cause HDIUKR		0.0288
GNIPCUKR does not Granger Cause ERTEUKR		0.0084
ERTEUKR does not Granger Cause GNIPCUKR		0.0419
GNIUKR does not Granger Cause ERTEUKR		0.0156
ERTEUKR does not Granger Cause GNIUKR		0.0556
HDIUKR does not Granger Cause ERTEUKR		0.0433
ERTEUKR does not Granger Cause HDIUKR		0.0405
GNIUKR does not Granger Cause GNIPCUKR		0.0047
GNIPCUKR does not Granger Cause GNIUKR		0.0079
GRANTUKR does not Granger Cause GNIPCUKR		0.0437

GNIPCUKR does not Granger Cause GRANTUKR	0.0211
HDIUKR does not Granger Cause GNIPCUKR	4.E-05
GNIPCUKR does not Granger Cause HDIUKR	0.0240
ICUKR does not Granger Cause GNIPCUKR	0.0084
GNIPCUKR does not Granger Cause ICUKR	0.0154
IMSEMU does not Granger Cause GNIPCUKR	0.0413
GNIPCUKR does not Granger Cause IMSEMU	0.0007
IMSUKR does not Granger Cause GNIPCUKR	0.0004
GNIPCUKR does not Granger Cause IMSUKR	0.0196
PRPUKR does not Granger Cause GNIPCUKR	0.0213
GNIPCUKR does not Granger Cause PRPUKR	0.0232
PRREMU does not Granger Cause GNIPCUKR	0.0378
GNIPCUKR does not Granger Cause PRREMU	0.0009
PRRUKR does not Granger Cause GNIPCUKR	0.0065
GNIPCUKR does not Granger Cause PRRUKR	0.0229
PRRUSUKR does not Granger Cause GNIPCUKR	0.0011
GNIPCUKR does not Granger Cause PRRUSUKR	0.0415
R_DEEMU does not Granger Cause GNIPCUKR	0.0354
GNIPCUKR does not Granger Cause R_DEEMU	0.0310
R_DEUKR does not Granger Cause GNIPCUKR	0.0331
GNIPCUKR does not Granger Cause R_DEUKR	0.0404
TCGUKR does not Granger Cause GNIPCUKR	0.0331
GNIPCUKR does not Granger Cause TCGUKR	0.0250
GRANTUKR does not Granger Cause GNIUKR	0.0281
GNIUKR does not Granger Cause GRANTUKR	0.0126
HDIUKR does not Granger Cause GNIUKR	0.0454
GNIUKR does not Granger Cause HDIUKR	0.0427
ICUKR does not Granger Cause GNIUKR	0.0414
GNIUKR does not Granger Cause ICUKR	0.0254
IMSEMU does not Granger Cause GNIUKR	0.0307
GNIUKR does not Granger Cause IMSEMU	0.0080
IMSUKR does not Granger Cause GNIUKR	0.0401
GNIUKR does not Granger Cause IMSUKR	0.0314
PRPUKR does not Granger Cause GNIUKR	0.0399
GNIUKR does not Granger Cause PRPUKR	0.0022
PRREMU does not Granger Cause GNIUKR	0.0273
GNIUKR does not Granger Cause PRREMU	0.0068
PRRUKR does not Granger Cause GNIUKR	0.0099

GNIUKR does not Granger Cause PRRUKR	0.0373
PRRUSUKR does not Granger Cause GNIUKR	0.0013
GNIUKR does not Granger Cause PRRUSUKR	0.0100
R_DEEMU does not Granger Cause GNIUKR	0.0637
GNIUKR does not Granger Cause R_DEEMU	0.0201
R_DEUKR does not Granger Cause GNIUKR	0.0421
GNIUKR does not Granger Cause R_DEUKR	0.0184
TCGUKR does not Granger Cause GNIUKR	0.0031
GNIUKR does not Granger Cause TCGUKR	0.0385
HDIUKR does not Granger Cause GRANTUKR	0.0155
GRANTUKR does not Granger Cause HDIUKR	0.0388
ICUKR does not Granger Cause HDIUKR	0.0077
HDIUKR does not Granger Cause ICUKR	0.0083
IMSEMU does not Granger Cause HDIUKR	0.0053
HDIUKR does not Granger Cause IMSEMU	0.0003
IMSUKR does not Granger Cause HDIUKR	0.0253
HDIUKR does not Granger Cause IMSUKR	0.0001
PRPUKR does not Granger Cause HDIUKR	0.0033
HDIUKR does not Granger Cause PRPUKR	0.0253
PRREMU does not Granger Cause HDIUKR	0.0000
HDIUKR does not Granger Cause PRREMU	0.0022
PRRUKR does not Granger Cause HDIUKR	0.0003
HDIUKR does not Granger Cause PRRUKR	0.0125
PRRUSUKR does not Granger Cause HDIUKR	0.0350
HDIUKR does not Granger Cause PRRUSUKR	0.0178
R_DEEMU does not Granger Cause HDIUKR	0.0188
HDIUKR does not Granger Cause R_DEEMU	0.0235
R_DEUKR does not Granger Cause HDIUKR	0.0456
HDIUKR does not Granger Cause R_DEUKR	0.0402
TCGUKR does not Granger Cause HDIUKR	0.0417
HDIUKR does not Granger Cause TCGUKR	0.0324