"The winner takes it all" or a story of the optimal allocation of the European Cohesion Fund.

Benoit DICHARRY* Phu NGUYEN-VAN † Thi Kim Cuong PHAM ‡
BETA, CNRS and Université de Strasbourg

Abstract

This paper aims to determine an optimal allocation of the European Cohesion Fund (ECF) and compares it with the observed ECF allocation. This optimal allocation is the solution of a donor optimization problem who intends to maximize recipient countries' GDP per capita to achieve economic convergence in the EU. It is shown that the observed ECF allocation of the period 2014-2020 is different from our optimal allocation. Besides, our solution identifies the recipient countries that can benefit from higher ECF transfers than the observed levels as those having low relative GDP per capita and good economic management. Poland and Romania are the 2 main winners of the optimal allocation and this result is robust to changes in the specification of the donor's utility function.

Keywords: European Union cohesion policy, foreign aid, economic convergence.

JEL classification: F35, H6, H11, I30, O47

Email: bdicharry@unistra.fr Address: 61 avenue de la Foret Noire, F-67085 Strasbourg, France. Corresponding author.

†*Email:* nguyen-van@unistra.fr. Address: 61 avenue de la Foret Noire, F-67085 Strasbourg, France.

‡*Email:* kim.pham@unistra.fr; Address: 61 avenue de la Foret Noire, F-67085 Strasbourg, France.

1 Introduction

One serious challenge of the European Union (EU) is the integration of the former socialist economies[1]. Economic convergence slowed down since the Great Recession. As it is indicated in Figure 1, some countries such as Greece and Portugal are relatively poorer in 2015 than in 2007 because these economies have been deeply affected by the Euro area sovereign debts' crisis. As well, some eastern European countries as Slovenia or Estonia are also concerned, their significant trade linkages with the Euro area made them exposed to the last European economic crisis.

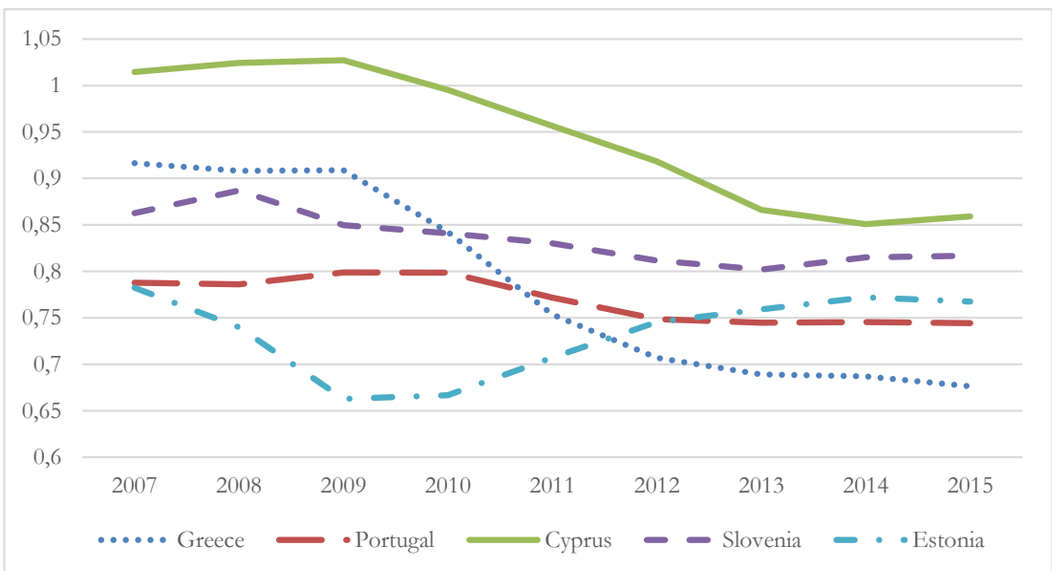

Figure 1: ECF recipient countries having lower relative GDP per capita in 2015 than in 2007.

To make the economic integration be successful, the EU launched the European Cohesion Fund (ECF) in 1994. This fund is targeted to countries having a GDP per capita lower than 90% of the EU's average, measured in purchase power parity (PPP). Those countries need to fund their economic transition but are not allowed to have high deficit and national debt levels because of the Stability and Growth Pact that does not allow the latter being higher

[1]This process started in June 1993 with the Copenhagen council and the announcement of the accession criteria: national budget deficit and national debt respectively lower than 3% and 60% of the GDP, inflation rate lower than the average of the three lowest ones of the EU area with a margin of 1.5 percentage points and the national average long run interest rates no higher than the average of the three countries having the lowest inflation rates.

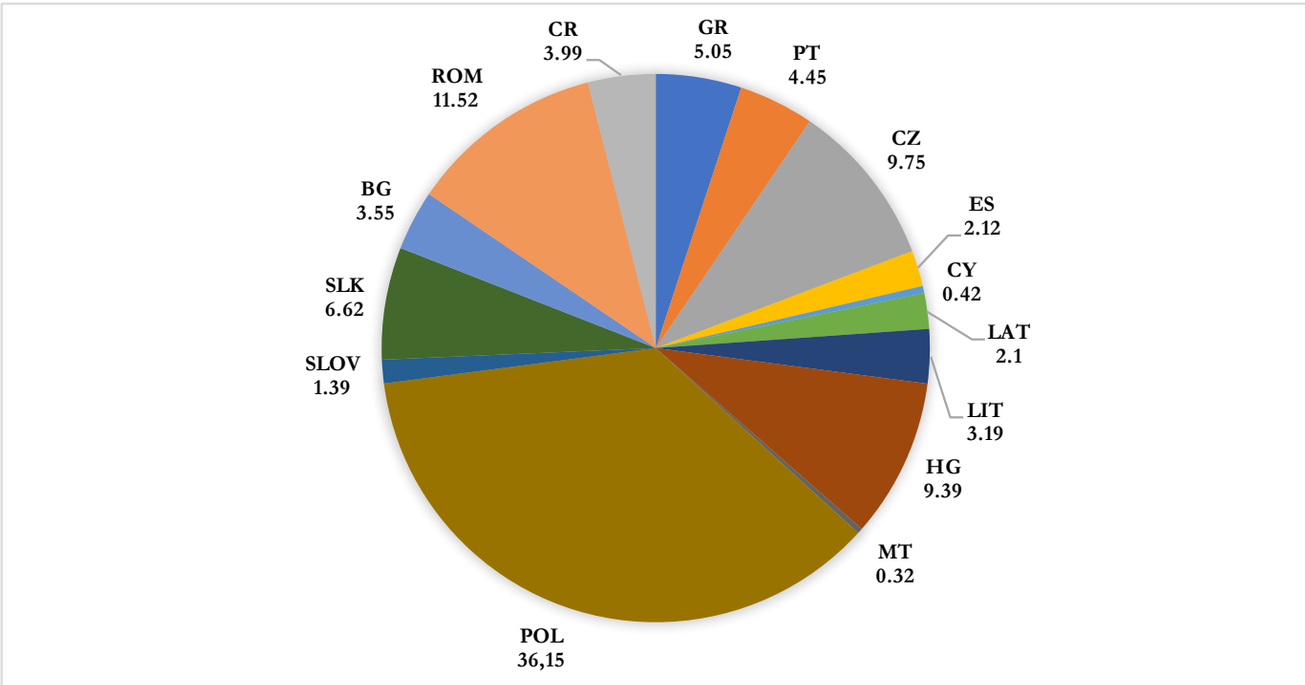

Figure 2: ECF observed allocation (period 2014-2020).

than 60% of their GDP, the boundary is set to 3% for national budget's deficit. The ECF has been implemented to make this trade-off disappear: this fund pushes public investments projects funding up to 85% of the total cost (additionality principle)[2]. ECF expenditures could be considered as productive public expenditures, they are even classified as "investment grants" under the European system of Accounts (ESA 1995 and 2000). In 2011 prices, the ECF is about $75 billions for the programming period 2014-2020. As it is displayed in Figure 2, Poland gets the lion's share with more than 36% of the total available amount. The two poorest countries of the EU, Romania and Bulgaria, get 16% of the total amount. Small and wealthy countries such as the Baltics, Slovenia and the Slovak Republic get significant shares though: they account for about 15% of the total allocation. Regarding the slowing down of the economic convergence process and the European governments' austerity pressures affecting the European budget, we wonder if the ECF could be allocated in a better way to help relaunching the economic convergence in the EU.

A consequent literature has criticized the way the European structural funds [3] are allocated between recipient countries, which affects the effectiveness of the European cohesion policy (see Ederveen et al. (2006), Bachtler & McMaster (2008), Becker et al. (2010), Becker (2012), Huliaras & Petropoulos (2016), Surubaru (2017)). Butkus & Matezuviciute (2016) recalled

[2]One half of the fund is allocated towards transport infrastructures to establish the Trans-European Transport Networks (TTN), which fastens physical capital's accumulation. The remaining 50% is concentrated on environmental infrastructures to preserve the stock of natural resources.

[3]There are five European structural funds that are the European regional development fund (ERDF), the European social fund (ESF), the European cohesion fund (ECF), the European agricultural fund for rural development (EAFRD), and the European maritime and fisheries fund (EMFF).

that the literature generally admits that European structural funds' efficiency, regarding their ability to promote economic growth, depends on factors such as commercial openness, the structure of the national economy and R&D intensity, the decentralization level of fiscal policy, the institutional environment, the lack of corruption and the stability of the macroeconomic environment. However, one caveat in this literature is that any of these studies suggests an allocation of the European structural funds able to maximize their impact on economic growth and promote the economic convergence of the EU.

Through a normative approach, that is precisely what we intend to do in this paper by figuring out an optimal allocation of the ECF and compare the latter with the actual one. To find out this optimal allocation, we first posit a theoretical problem similar to the one concerning the allocation of development aid as did Collier & Dollar (2002) where a purely altruistic donor maximizes recipient countries' global welfare. To obtain the solution of this problem, our analysis is realised in two steps:

We first should find out the link between the ECF and recipient countries' GDP per capita thanks to a growth equation. The latter is estimated using data covering the 17 ECF recipient countries for the period 1995-2015. Based on system-GMM estimators, we find that GDP per capita depends on recipient countries' macroeconomic management, institutional quality, human capital level and on the amount of ECF transfers provided. Moreover, we find that the marginal impact of the latter is lowered by the levels of national debt, inflation and human capital.

Secondly, thanks to the estimation results of the growth equation, we run a simulation of the optimal allocation of the ECF which is the solution of the donor's optimization problem. The latter indicates that the ECF should be concentrated on poor countries having good economic management and low human capital levels. Poland and Romania are the two main winner countries, they concentrate the great majority of the ECF optimal allocation. This result is robust to changes in the specification of the donor's utility function.

The remaining of the paper is structured as follows: Section 2 provides an analytical framework where the donor's theoretical problem and its solution are exposed. Section 3 describes the data of the growth equation's variables and the econometric specification we use. Estimation results are then displayed. Section 4 is related to the optimal allocation of the ECF and some policy implications of this result regarding the actual allocation of the fund. We finally conclude our study in Section 5 and provide some research perspectives.

2 A theoretical framework for the ECF optimal allocation

In this section, we construct a theoretical framework to determine an optimal allocation of the ECF. This European fund is a financial assistance designed to the EU's poorest countries and intends to increase their GDP per capita to take the challenge of the European economic convergence by reducing the gap between each recipient's GDP per capita and the EU's average GDP per capita.

We use an utilitarian approach where an altruistic donor maximizes the sum of recipient countries' utilities. Our approach refers to Collier & Dollar (2002) who figured out an optimal foreign aid allocation maximizing poverty reduction. In the case of the ECF, the donors are represented by the European Commission who decides how the ECF is allocated among recipient countries i.e countries having a GDP per capita lower than 90% of the EU average[4].

We assume that, for each recipient country i, its utility depends on the ratio between its GDP per capita y_i and 90% of the EU's average one noted as $0.9\overline{y}$. Therefore, a low ratio reflects recipient country's development lags relatively to the EU. We assume that y_i depends on the ECF transfers and other factors such as recipient country's national debt, its human capital level, unemployment rate, etc. Concerning the term $0.9\overline{y}$, we assume it is constant and exogenous as ECF recipient countries' GDP per capita may not have any impact on the European average. As well, we exclude the case of $y_i > 0.9\overline{y}$: otherwise, a recipient country would not be eligible anymore for the ECF.[5] We assume that the European Commission, through out the ECF, intends to maximise the ratio between recipient countries' GDP per capita under European average GDP per capita. For a sake of simplicity, we consider a CRRA utility as follows:

$$U\left(\frac{y_i}{0.9\overline{y}}\right) = \frac{\left(\frac{y_i}{0.9\overline{y}}\right)^{1-\sigma}}{1-\sigma} \tag{1}$$

where σ corresponds to the relative risk aversion of the donor with respect to the ratio between the recipient country i's GDP per capita and 90% of the average EU's one. As σ increases, the altruistic donor is more concerned with recipient countries having low relative GDP per capita. Utility function U is increasing and concave with y_i, $U_{y_i} > 0$ and $U_{y_i y_i} \leq 0$. We expect that GDP per capita y_i depends on the amount of ECF transfers per capita, A_i. Let us consider a donor optimization program where the ECF allocation is chosen by the

[4]It should be mentionned that the ECF is in fact mostly funded by western European countries. These countries are above the 90% threshold, which makes them be net contributors.

[5]For instance, Ireland and Spain have been excluded from the list of beneficiaries respectively in 2003 and 2013 because of their GDP per capita levels.

donor to maximize the sum of utilities of n recipient countries under constraints on the total amount of ECF and transfers' no-negativity:

$$\max_{A_i} \sum_{i=1}^{n} \alpha_i U \left(\frac{y_i(A_i)}{0.9\overline{Y}} \right)$$

$$s.t. \sum_{i=1}^{n} A_i N_i \leq \overline{A} \tag{2}$$

$$A_i \geq 0 \tag{3}$$

where the annual amount of ECF received by one country i is $A_i N_i$. α_i is a general parameter that weights each ECF recipient country in the utility function of the donor. In our analysis, we consider that α_i is the demographic weight of one ECF recipient country in the total population of all recipient countries, equation (2) represents the constraint of funds availability where $\overline{A}$ is the total available amount. The constraint on the positiveness of the ECF transfers is represented by equation (3).

The Lagrangian could therefore be written as the following:

$$L = \sum_{i=1}^{n} \alpha_i U \left(\frac{y_i(A_i)}{0.9\overline{Y}} \right) + \lambda \left(\overline{A} - \sum_{i=1}^{n} A_i N_i \right) + \sum_{i=1}^{n} \mu_i A_i \tag{4}$$

where and λ and μ_i are the Lagrange multipliers of constraints (2) and (3) respectively. A solution of the model $(\hat{A}_1, \hat{A}_2, ..., \hat{A}_n)$, $\hat{\lambda}$ and $\hat{\mu_i}$ must satisfy the following first order conditions (FOC) $\forall i = 1, ..., n$:

$$\frac{\partial L}{\partial A} = 0 \Leftrightarrow \hat{\lambda} N_i - \hat{\mu_i} = \alpha_i U_y y_A \tag{5}$$

$$\frac{\partial L}{\partial \lambda} = 0 \Leftrightarrow \textstyle\sum_{i=1}^{n} N_i \hat{A}_i = \overline{A} \tag{6}$$

$$\hat{\mu_i} \geq 0, \hat{A}_i \geq 0 \tag{7}$$

We note U_y the marginal utility of GDP per capita and y_A the marginal effect of the ECF on GDP per capita. Equation (7) is about the complementarity condition between $\hat{A}_i$ and $\hat{\mu_i}$ for a country i receiving a strictly positive ECF amount $\hat{A}_i > 0$, we have $\hat{\mu_i} = 0$. On the opposite, if $\hat{A}_j = 0$, we must have $\hat{\mu_j} > 0$.
If we consider the case of a country receiving a positive ECF amount, i.e. $\hat{A}_i > 0$ and $\hat{\mu_i} = 0$, equation (5) gives us the optimal value of λ:

$$\hat{\lambda} = \alpha_i \frac{U_y y_A}{N_i} \quad , \forall i \tag{8}$$

This expression gives the unique value for $\hat{\lambda}$ which equalizes the right hand side term in over

all the ECF recipient countries in equation (8) at the optimal solution of our optimization program. We observe that $\hat{\lambda}$ stands for the shadow value of the ECF. It represents the marginal benefit of one extra-unit of ECF expressed in utility units. This equality shows that, when the optimization problem is solved, the marginal cost of one extra-unit of ECF, $\hat{\lambda}$, is the same as its marginal benefit for every recipient countries. If we now consider only the case of a country j receiving no ECF transfer, i.e. $\hat{A_j} = 0$ and $\mu_j > 0$, we obtain the following conditions:

$$\hat{\mu_j} = \hat{\lambda} N_i - \alpha_j U_y y_A, \forall j \tag{9}$$

which give the value for $\hat{\mu_j}$ for countries receiving no ECF transfers i.e $\hat{A_j} = 0$. The results above can be summarized in the following proposition:

Proposition 1 *Considering the donor's optimization program in equations (2) and (3), the ECF optimal allocation $\hat{A_i}$ must respect the three following conditions:*

1. $\hat{A_i} > 0$ *if* $\hat{\lambda} = \alpha_i \dfrac{U_y y_A}{N_i}$ *and* $\hat{\mu} = 0$,
2. $\hat{A_j}$*=0 if* $\hat{\mu_j} = \hat{\lambda} N_j - \alpha_j U_y y_A$,
3. $\sum_{i=1}^{n} \hat{A_i} N_i = \overline{A}$.

where $\hat{\lambda}$ is the multiplier associated to the total amount of ECF, and $\hat{\mu}$ is the multiplier associated to the positiveness of recipient countries' ECF transfers.

The second derivative of U_i with respect to $\hat{A_i}$ is :

$$\frac{\partial^2 U(\hat{A_i})}{\partial \hat{A_i}^2} = U_{yy} y_A^2 + y_{AA} U_y \tag{10}$$

where U_{yy} is the second derivative of U_i with respect to y_i and y_{AA} is the second derivative of y_i with respect to A_i. As the budget constraint is linear with respect to A_i, this second derivative of U_i must be non positive to ensure the existence of a finite solution. Thus, the following condition should be satisfied:

$$\frac{y_{AA}}{y_A^2} \leq -\frac{U_{yy}}{U_y} \tag{11}$$

The right-hand side term of equation (11) is the donor's absolute risk aversion coefficient: it is always positive because of an increasing and concave utility function with respect to GDP per capita. However, we do not know the sign of the left-hand side term of equation (11). An empirical estimation of the growth equation will allow us to ensure the existence of a finite solution, this will be the object of the following section. More precisely, we estimate the

GDP per capita of recipient countries by considering the role of ECF and other factors being likely to affect their GDP per capita such as economic management or recipient countries' institutionnal quality. The estimation results of this growth equation will then be employed to make a simulation of the ECF's optimal allocation, the latter being the solution of the donor's optimization program.

3 Estimation of the growth equation

3.1 Determinants of economic growth

This subsection describes the set of explanatory variables we have selected to build the growth equation. The latter will allow us to estimate the ECF and its squared term in order to check the existence of a finite solution to our optimization problem i.e y_A and y_{AA} in equation (11).

We first consider some non-economic variables able to determine the current GDP per capita level of the ECF recipient countries. We focus on recipient country's geographical localization and on having known a socialist experience after World War Two.

Concerning the geographical localization of a country, Menil (2003) underlines the importance of being close to a EU-15 country to explain the satisfying economic performances of Poland, Hungary and the Czech Republic during the 1990s. Menil (2003) argues that is because these countries have been able to implement more market oriented structural reforms thanks to a lowered political cost. Indeed, citizens were directly confronted to western European high standard livings, which provided them more incentives to accept those structural reforms. As well, Bevan & Estrin (2004) stressed the role of location on foreign direct investment inflows (FDI) for Poland and the Czech Republic. These countries have greatly benefited from the European integration by becoming part of the German supply chain (Hinterland). Bevan & Estrin (2004) supported that being a neighbour of Germany increased their FDI inflows thanks to reduced transactions costs[6].

The second non-economic variable relevant to ECF recipient countries is the length of a socialist experience after World War Two, or market memory as it is called by De Melo et al. (2001). This variable captures the lack of familiarity with market institutions: if a country has been under central planning for many decades, it will be less willing to implement a quick and deep process of structural reforms towards market economy, which may damage its current economic performances. De Melo et al. (2001) finds that the initial degree of macroeconomic distortions caused by central planning has a negative impact on current economic performance levels.

[6]The mentionned transaction costs are transports and communication costs, costs of dealing with a different language, informational costs and those related to sending personnel abroad.

One other determinant of current economic performance is the level of economic freedom (Goldsmith (1995), Dawson (2003)). It has been observed that the former socialist countries that joined the EU as soon as 2004 are those which implemented the most market oriented structural policies in the 1990s, or a shock therapy[7]. The rationale behind these reforms has been to increase the national economic freedom levels. [8] As well, Pitek et al. (2013) finds that moderate government spending level, monetary and investment freedoms have been significant determinants of economic growth between 1990 and 2008 in transition countries. Dell'Anno & Villa (2013) analyzed the impact of the speed of these reforms on economic growth. In line with De Melo et al. (2001), they found that the contemporaneous speed of transition lowers current economic growth but the impact becomes positive in the medium-long run[9]. In other words, the speed of transition has a J-curve effect on economic growth. Therefore, we could expect that countries having high economic freedom would have higher GDP per capita levels.

We finally take into account the variables mentioned by the literature able to explain European structural funds' performance regarding economic growth.

Authors as Ederveen et al. (2006) consider that the quality of institutions determines the ability of European structural funds to drive economic growth. They use commercial openness to proxy institutional quality because the more a country is open, the more it is under trade competition, which increases the pressure to efficiently use structural funds. They study the ability of the European Regional Development Fund (ERDF) in promoting economic growth and find that the interaction of ERDF with institutional quality affects economic growth. They suggest that this fund should be more targeted towards northern EU members because of their aid-conducive institutions.[10].

Secondly, macroeconomic management matters to explain European structural funds' growth stimulating performances. In the case of the ECF, the EU explicitely mentions that recipient countries should respect the Stability and Growth Pact's criteria to be eligible for this financial support. Otherwise, the ECF transfers could be suspended following an excessive deficit procedure launched by the European Commission. The rationale behind this rule is that high deficit and public debt levels could be harmful to ECF's economic performance because of the additionality principle. Indeed, ECF recipient countries' managing authorities must pro-

[7]We are refering to Poland, the Czech and Slovak republics, the Baltics, Hungary and Slovenia.

[8]Economic freedom is based on the security of property rights, the ability to trade with any domestic or foreign entity and the extent of property confiscation through the taxation and inflation levels.

[9]Aghion & Blanchard (1994) estimate that the past level of reforms leads to higher economic growth and this effect reaches its greatest value with a lag of 3 years.

[10]As well, institutional quality can be proxied by administrative capacity (ADM)Mendez et al. (2013) defined the latter as the capacity of national and regional institutions to design robust strategies, allocate resources and administer EU funding efficiently. ADM is made of three criteria that are the centralization degree of bureaucracy in EU funds management, the adequacy and quality of human resources and the administrative adaptability i.e the processing time of bureaucracy and alignment of national procedures with the European standards.

vide, at least, the remaining 15% of a project's cost. If it does so with the implementation of distortionary taxes, the initial positive effects on growth could be offset. This crowding-out could even be stronger if the ECF recipient country has already important national debt or budget deficit levels. Hulten & Schwab (1997) found an adverse effect through the leverage of tax competition among areas into the EU: if a higher level of government funding must be co-financed at the national level, a tax increase could depress the area's relative competitive edge, which is harmful to economic growth.

Finally, Becker (2012) and Butkus & Matezuviciute (2016) found that if European structural funds are invested in regions having high R&D intensity levels and a large industrial sector, economic convergence is boosted in the long run. These regions are characterised by high human capital levels where the labor supply is sufficiently skilled to perform in these activities.

In a nutshell, according to this literature, our growth equation will comprise non-economic variables such as having a common border with a EU-15 country and the number of years under a socialist governement after World War Two.Then, we deal with ECF recipient country's human capital level, its institutional quality proxied by commercial openness, and variables related to its economic management as national debt, national budget deficit, inflation and unemployment. As well, recipient country's initial conditions such as its initial GDP per capita and human capital levels are also considered. Finally, the conditional effect of the ECF on GDP per capita is studied with the inclusion of interaction terms in the growth equation.

3.2 Econometric specification

Our growth equation is estimated by using a panel data framework (Islam (1995), Caselli et al. (1996)) with an unbalanced panel data covering 17 countries and the period 1995-2015. To avoid business cycles effects, we use 5-years average data for all variables excepted GDP per capita and its lagged value. As in Caselli et al. (1996), we use the current GDP per capita and its lagged values from observations of a 5 years interval i.e. 1995, 2000, 2005, 2010 and 2015. Concerning explanatory variables, we use their average values over the following 5 years periods: 1996-2000, 2001-2005, 2006-2010 and 2011-2015. The resulting data covering 4 waves of 5 years intervals.

Our dependent variable is the log real GDP per capita in international prices PPP 2011 ($y_{i,t}$). We assume that the latter depends on two initial conditions that are GDP per capita lagged value $y_{i,t-1}$ and ECF recipient country's human capital level $H_{i,t}$. GDP per capita of country i in period t also depends on the amount of ECF per capita $A_{i,t}$ expressed in international prices PPP 2011 \$, and on and its squared term $A^2_{i,t}$. We also consider two non-economic variables related to geographical location $G_{i,t}$ and having experienced a socialist period $C_{i,t}$.

$G_{i,t}$ is a dummy variable having the value "1" if a ECF recipient country has a common border with a UE-15 country or if it itself part of the EU. $C_{i,t}$ is the number of years a ECF recipient country has been under socialism after the World War Two. As well, we assume that ECF recipient country's GDP per capita depends on its economic management: the level of economic freedom $E_{i,t}$, inflation $I_{i,t}$, national budget balance $S_{i,t}$, national debt $D_{i,t}$, unemployment level $U_{i,t}$ are taken into account. In order to capture a non linear effect of national debt on growth, we also consider its squared term $D^2_{i,t}$. Finally, we consider the commercial openess rate $O_{i,t}$ as a proxy for the ECF recipient country's institutionnal quality.

Our basic specification (Specification 1), without any interaction term between the ECF and other explanatory variables, is such as the following:

$$y_{i,t} = \rho y_{i,t-1} + \beta_S S_{i,t} + \beta_D D_{i,t} + \beta_{DD} D^2_{i,t} + \beta_I I_{i,t} + \beta_U U_{i,t} + \beta_E E_{i,t} + \beta_O O_{i,t} + \beta_G G_{i,t} + \beta_C C_i + \beta_H H_{i,t} + \beta_A A_{i,t} + \beta_{AA} A^2_{i,t} + u_i + v_t + \epsilon_{i,t}$$

The term u_i represents the country fixed effect while v_t stands for the time effect.

Refering to the literature on the foreign aid effectiveness which underlines a conditional effect of aid on growth[11], our second specification (Specification 2) includes interaction terms between the ECF and national debt, budget balance and inflation. We also analyse the interaction between the ECF and recipient countries' initial conditions, i.e human capital as (Guillaumont et al. 2015), to find out if they affect the efficiency of the ECF. This second specification can be expressed as the following:

$$y_{i,t} = \rho y_{i,t-1} + \beta_S S_{i,t} + \beta_D D_{i,t} + \beta_{DD} D^2_{i,t} + \beta_I I_{i,t} + \beta_U U_{i,t} + \beta_E E_{i,t} + \beta_O O_{i,t} + \beta_G G_{i,t} + \beta_C C_i + \beta_H H_{i,t} + \beta_A A_{i,t} + \beta_{AA} A^2_{i,t} + u_i + v_t + \beta_{SA} S_{i,t} A_{i,t} + \beta_{DA} D_{i,t} A_{i,t} + \beta_{IA} I_{i,t} A_{i,t} + \beta_{HA} H_{i,t} A_{i,t} + u_i + v_t + \epsilon_{i,t}$$

We finally run a third specification adding two interaction terms: the first one deals with ECF and commercial openness while the second one interacts the ECF with the unemployment level.

One issue is the violation of the exogeneity hypothesis regarding the lagged dependent variable term as an explanatory variable[12]. We first define which regressors are exogenous, predetermined and endogenous. We assume that time dummies and non-economic variables are strictly exogenous i.e $E(\epsilon_{i,t}, x_{i,s}) = 0, \forall t, s$. Some variables are predetermined i.e $E(\epsilon_{i,t}, x_{i,s}) = 0$, for $t \geq s$. In other words, current and lagged explanatory variables are not affected by present shocks. However, we assume that a shock happening now will affect fu-

[11] We refer to the pioneer works of (Collier & Dollar 2002) who state that foreign aid is more efficient in countries exhibiting high institutionnal quality.

[12] We find a high correlation between GDP per capita and its lagged value.

ture values of the variable i.e $E(\epsilon_{i,t}, x_{i,s}) \neq 0$. For instance, with the predetermined variables assumption, we could say that a shock affecting an explanatory variable $X_{i,t}$ in the future will impact the error term $\epsilon_{i,t}$ and therefore affect $y_{i,t}$. Our predetermined variables are the following ones: national budget balance, national debt, unemployment, inflation, economic openness, ECF and lagged GDP per capita.

3.3 Data and variables

Table 1: Data.

Variable name	Explanation	Unit	Source
GDP/capita ($y_{i,t}$)	Dependent variable	PPP 2011$ per capita	World Bank
Lagged GDP/capita ($y_{i,t-1}$)	Initial condition	PPP 2011$ per capita	World Bank
Human capital ($H_{i,t}$)	Initial condition	% of working labour force having achieved tertiary education	World Bank
Geographical location ($G_{i,}$)	Non-economic variable	Dummy variable	
Communism (C_i)	Non-economic variable	Number of years under communism after WW2	
Commercial openness ($O_{i,t}$)	Institutional quality	% of recipient country's GDP	World Bank
Economic freedom ($E_{i,t}$)	Economic management	Score between 0 and 100	Heritage Foundation
Unemployment ($U_{i,t}$)	Economic management	% of recipient country's labour force.	World Bank
Inflation ($I_{i,t}$)	Economic management	% of recipient country's consumer price index.	World Bank
National debt ($D_{i,t}$)	Economic management	% of recipient country's GDP	Eurostat
National budget balance ($B_{i,t}$)	Economic management	% of recipient country's GDP	Eurostat
ECF ($A_{i,t}$)	European transfer	PPP 2011$ per capita	European Commission

Table 1 summarizes all variables we use in the estimation of our growth equation: data about the ECF are available at country level in current prices for a given programming period[13]. To get annual values of ECF transfers for a given recipient country, we take the 6 years average and consider this value as an annual observation.

As well, concerning the index of economic freedom (IEF), published by the Heritage Foundation, it is based on a country's performance on Rule of Law, government size, regulatory efficiency, and performance on market's openness (financial freedom, investment and trade freedoms). Each of these 4 components has the same weight, the IEF is the arithmetic mean of these 4 components and take a value between 0 and 100, with 100 representing the best score. Descriptive statistics of the growth equation's explanatory variables are given in Table 2.

3.4 Estimation results

Our analysis shows that Arrellano-Bond tests in the regressions residuals, AR(1) and AR(2), are verified. As well, we check the validity of the instruments. To do so, we run the overidentification Hansen test. The null hypothesis of the Hansen test is "instruments are valid so the error term of the regression is not correlated with the instruments". The estimation results indicate that this null hypothesis is not rejected. Our dynamic panel data is unbalanced with an individual dimension relatively higher than the time dimension (T=4 and N=17).

[13]The European budget is programmed for a period of 7 years. The current programming period is 2014-2020.

Table 2: Descriptive statistics.

Variable name	Observations	Mean	Standard deviation	Minimum	Maximum
GDP/capita (log)	85	9.97	0.4	9.02	11.02
Lagged GDP/capita (log)	68	9.91	0.404	9.02	10.8
Geographical location	68	0.53	0.5	0	1
Communism	68	0.29	0.5	0	1
Human capital	68	0.247	0.126	0.075	0.718
Economic freedom	68	64.62	7.1	47.57	82.16
Commercial openness	68	1.133	0.53	0.437	3.02
Unemployment	68	0.104	0.042	0.0437	0.2426
Inflation	68	0.082	0.264	0.0014	2.122
National debt	67	0.491	0.319	0.051	1.732
National debt squared	67	0.34	0.471	0.0026	3
National budget balance	68	-0.033	0.03	-0.1	0.046
ECF	68	0.7	0.71	0	3.41
ECF squared	68	0.983	1.72	0	11.66
Time dummy 2001-2005	85	0.2	0.4	0	1
Time dummy 2006-2010	85	0.2	0.4	0	1
Time dummy 2011-2015	85	0.2	0.4	0	1

Following Roodman (2009), it is therefore preferable to use the system GMM method of Blundell & Bond (1998) in a large N and small T panel. This specification is based on the application of Arellano & Bond (1991)'s estimators.

Results obtained with system-GMM estimators for 3 specifications are given in Table 3. Dealing with initial conditions i.e. human capital and lagged GDP per capita, our results show that the latter has a positive and significant effect at the 1% significance level in all the specifications. Moreover, we find that human capital, proxied by the share of the working population having achieved tertiary education is associated with an increased GDP per capita in specifications 2 and 3.

Non-economic variables do not seem to play a major role because having experienced socialism or being located close to a EU-15 country is not significant to explain GDP per capita levels. Our results are against the gravity model theories and the findings of De Melo et al. (2001). As well, the quality of institutions proxied by the commercial openness rate is mostly insignificant, excepted in specification 2, where the 10% significance level is reached. This result goes against (Ederveen et al. 2006).

Dealing with economic management variables, 4 remarks are in order: First, the amount of structural reforms achieved by a ECF recipient country is not relevant to explain its current GDP per capita level because economic freedom is not significant in all of our specifications. Secondly, we find that national budget balance has a positive effect on GDP per capita in all of our specifications. Second, national debt is strongly significant and has a non-linear effect as Reinhart & Rogoff (2010). According to the second specification's results, we find that the debt overhang comes for levels higher than 196% of GDP. This result shows that

Table 3: Growth equation estimation results.

	Specification 1		Specification 2		Specification 3	
Variable	Coefficient	Std. Err.	Coefficient	Std. Err.	Coefficient	Std.Err.
Lagged GDP/capita	0.613***	0.087	0.645***	0.125	0.607***	0.144
Location	0.084*	0.0466	0.084	0.064	0.116	0.076
Communism	-0.0003	0.002	0	0.002	0	0.002
Human capital	0.162	0.103	0.573**	0.271	0.725**	0.274
Economic freedom	0.006	0.004	0	0	0	0.004
Commercial openness	0.15	0.097	0.155*	0.0075	0.144	0.92
Unemployment	-0.382	0.462	-0.45	0.496	-1.077	0.922
Inflation	-0.16***	0.027	-0.205***	0.0342	-0.218***	0.34
National debt	0.375	0.225	0.671***	0.214	0.812***	0.25
National debt squared	-0.15*	0.075	-0.171**	0.08	-0.229**	0.093
Budget balance	1.45***	0.484	1.6*	0.842	2**	0.887
ECF	0.113	0.069	0.513***	0.141	0.343	0.3
ECF squared	-0.054	0.038	-0.04	-0.037	-0.039	0.051
Inflation*ECF			-3.08***	1.018	-2.566	1.613
National budget balance*ECF			-0.085	1.81	0.0235	2.259
National debt*ECF			-0.444*	-0.21	-0.521**	0.21
Human capital*ECF			-0.473*	0.261	-0.6*	0.3
Unemployment*ECF					1.5	1.69
Commercial openness*ECF					0.047	0.065
2001-2005	0.117	0.809	0.23	0.112	0.214	0.128
2006-2010	0.125**	0.059	0.2**	0.008	0.182**	0.104
2011-2015	0.033	0.045	0.103	0.064	0.102	0.071
Intercept	3.236***	0.928	2.88**	1.44	3.327**	1.61
Number of observations	67		67		67	
Number of countries	17		17		17	
AR(1)	-2.65***		-2.17**		-1.22	
AR(2)	1.38		-0.76		0.36	
Hansen test of overidentification	0***		0***		0***	

Notes: This table displays the estimation results of the growth equation. Dependent variable: GDP/capita. Results obtained with system GMM method of Blundell and Bond (1998). *, ** and *** denote 10%, 5% and 1% significance levels. Strictly exogenous regressors include time dummies, Geography and Communism. Predetermined regressors are national budget balance, national debt, unemployment, inflation, economic openness, ECF and lagged GDP per capita.

ECF recipient countries have incentives to go beyond the 60% limit. It might be explained by the common capital market, established in the EU since the end of the 1980s, that helped financial integration: European countries could borrow at low interest rates, which postpones the effects of crowding out. Last, our results also suggest that keeping inflation on track is beneficial to GDP per capita as the coefficent associated with inflation is negative and significant at the 1% level in the three specifications.

Then, we find that an increase of the ECF is associated with a direct rise of current GDP per capita in specification 2 only. We find that the ECF does not have any decreasing returns because the squared term is not significant. This result concerning the squared term implies that condition (11) is always fulfilled. This confirms the existence of a finite solution to our optimization problem. Therefore, the estimation results of specification 2 will be taken into account to find out the ECF optimal allocation.

As well, the estimation results of specification 2 and specification 3 show that the effects of ECF on GDP per capita are conditionnal on different factors such as inflation, national debt or human capital. However, the estimation results in specification 3 indicate that both institutional quality proxied by commercial openness and unemployment are not relevant to explain the marginal effect of the ECF.
From specification 2, the conditionnal effect of the ECF on GDP per capita can be expressed as:

$$\frac{\partial y_{i,t}}{\partial A_{i,t}} = 0.513 - 0.473H_{i,t} - 3.08I_{i,t} - 0.444D_{i,t} \tag{12}$$

Our results suggest that the marginal effect of ECF on GDP per capita is lowered by the recipient countries' human capital level. This result goes against Becker et al. (2010) who stated that structural funds are more efficient in regions having high human capital levels. As well, we find that the marginal effect of ECF on GDP is lowered by inflation and national debt levels. The latter lowers the marginal effect of the ECF. One reason of this adverse effect could be the additionality principle i.e national governments must fund at least 15% of an investment project's cost. To avoid any further increase of public debt in virtue of the SCP, one recipient country would need to rise its tax level, which is detrimental to economic growth. This effect is amplified with large national debt levels because they may lead to high current or future tax level, which increases the crowding-out effect.
It should be noticed that the impact of national debt on GDP per capita changes as we take into account the ECF. To figure this out, let us consider the estimation results of the marginal effect of national debt on GDP per capita (from specification 2):

$$\frac{\partial y_{i,t}}{\partial D_{i,t}} = 0.671 - 0.342D_{i,t} - 0.44A_{i,t} \tag{13}$$

If $A_{i,t}$ is set to its average value, 70 PPP 2011 $ per capita, the national debt ratio that maximizes GDP per capita $D^*_{i,t}$ can be expressed as the following:

$$\frac{\partial y_{i,t}}{\partial D_{i,t}} = 0 \iff D^*_{i,t} = 105.3\%$$

The optimal debt ratio which maximizes tGDP per capita is about 45 percentage points higher than the SGP's boundary. Indeed, we see that the marginal effect of national debt on GDP per capita remains positive until the 105.3% threshold is reached. There are therefore incentives for ECF recipient countries to go over the 60 % limit, which may be harmful for the efficiency of the ECF. As well, we find that the more the ECF per capita is high, the less recipient countries have incentives to rise their national debt. Indeed, the national debt optimal ratio increases as the average amount of ECF per capita decreases. If the latter is

risen by 10% to 77 PPP 2011 $ per capita, the maximizing national debt ratio $D_{i,tmax}$ falls to 96.2%. On the contrary, if ECF per capita is reduced by 10% to 63 PPP 2011 $ per capita, $D_{i,tmax}$ is 115.1%. These results are represented in figure 3[14].

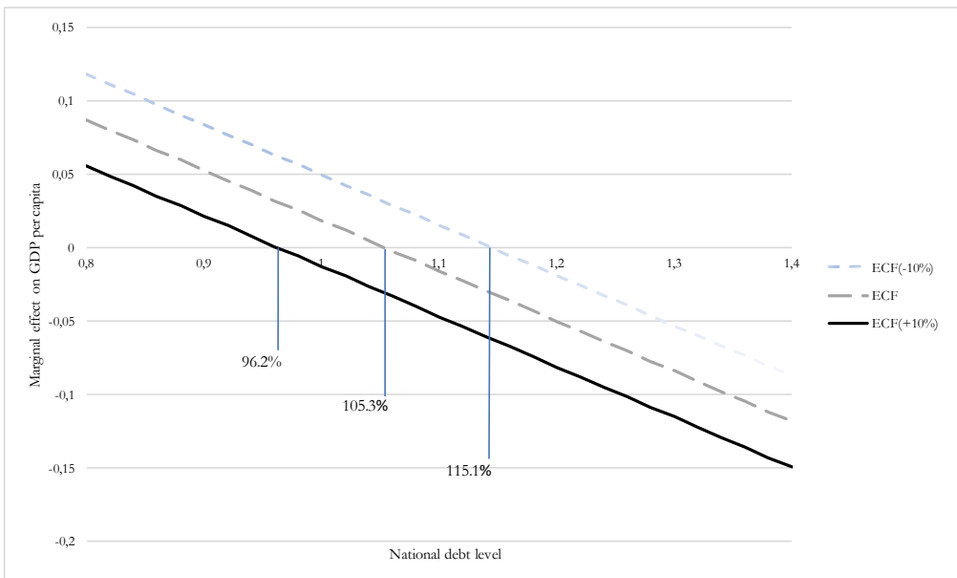

Figure 3: Marginal impact of national debt on GDP per capita

Table 4 indicates the observed and optimal debt ratios for each ECF current countries[15]. The Czech republic, Estonia, Hungary, Latvia, Lithuania, Poland and the Slovak republic should not have any debt to maximize their GDP per capita because of their very high ECF transfers. As a result, ECF and national debt can be interpreted as substitutes for increasing GDP per capita. Because these countries are major ECF receivers, they do not need to use indebtment to increase their GDP per capita. Excepted Hungary, table 4 shows that all of them respect the 60% threshold imposed by the SGP. On the contrary, countries receiving less support such as Croatia, Greece, Portugal or Cyprus exhibit the highest debt ratios. Because of less transfers, these countries use public debt to rise their GDP per capita. Consequently, more ECF transfers towards them may provide an incentive to make them respect the SGP.

To sum up, our analysis shows a conditionnal effectiveness of the ECF: this fund is more efficient in countries having low national debt, inflation land human capital levels, which justifies the European rules behind the ECF. Our results also suggest that low human capital levels increase the efficiency of the ECF. As well, we have highlighted that recipient countries have incentives to go over the 60% debt threshold fixed by the SGP.

[14]The estimation results of specification 3 indicate similar conclusions even if the optimal debt ratios are about 7 percentage points lower.

[15]Observed ECF per capita levels have been considered to compute the optimal national debt ratios.

Table 4: Optimal and observed national debt ratios in 2015 (%).

Country	Optimal debt ratio	Observed debt ratio
Bulgaria	63.22	20.14
Croatia	117.46	78.30
Czech republic	0.00	42.30
Estonia	0.00	9.40
Greece	126.94	173.20
Hungary	0.00	77.20
Latvia	0.00	40.00
Lithuania	0.00	39.80
Malta	43.28	67.40
Poland	0.00	53.00
Portugal	128.90	125.00
Romania	56.07	37.30
Slovenia	57.39	67.10
Slovak republic	0.00	51.30
Cyprus	136.37	92.3

Notes: The observed national debt ratios for the year 2015 and those maximizing GDP/capita are expressed in % of GDP.

4 Simulation of the optimal allocation of ECF

4.1 Observed allocation and optimal allocation

In this section, estimation results of specification 2 are employed to simulate the optimal solution of the donor's optimization problem. We can then compare this optimal allocation to the observed one. As it has been shown in the first order conditions of our optimization problem, an optimal allocation of the ECF leads to the same $\hat{\lambda}$ for every recipient countries. The optimal allocation sets $\hat{A}_i$ such as:

$$\hat{\lambda} = \frac{1}{0.9\overline{y}}(\frac{y_i}{0.9\overline{y}})^{-\sigma}(y_A\hat{A}_i) \tag{14}$$

The optimal ECF allocation is estimated for the year 2015 because the current programming period has started in 2014 and ends up in 2020. We recall that the 2015 value is the mean value of the 2014-2020 period. A total of 15 countries have been receiving the ECF during this period.

The growth equation's estimation results give the empirical values of $y_a(A_i)$. Then, the value of σ is set to 0.7 as in (Guillaumont et al. 2015). This parameter indicates to what extent the donor is adverse to low recipient countries's GDP per capita: as σ increases, the weight of poor recipient countries in the donor's utility is increased.

Empirical simulations of optimal ECF allocations are provided in Table 5. The first simulation is computed by taking into account the demographic weight of each recipient country

in the donor's utility function i.e $\alpha_i \neq 1$ while the second one considers $\alpha_i = 1$. Our results show that both ECF optimal allocations are similar.

Table 5: Observed and optimal ECF allocations with $\alpha_i = 1$ and $\alpha_i \neq 1$.

Country	Observed ECF/cap	% total	Optimal, $\alpha_i = 1$ ECF/cap	% total	Optimal, $\alpha_i \neq 1$ ECF/cap	% total
Bulgaria	53.32	3.55	48.22	3.21	18.15	1.21
Croatia	102.38	3.99	0.24	0.01	0.00	0.00
Czech republic	99.70	9.75	38.56	3.77	26.04	2.55
Estonia	173.95	2.12	0.05	0.00	0.00	0.00
Greece	50.33	5.05	0.26	0.03	73.43	7.36
Hungary	102.90	9.39	74.87	6.83	82.40	7.52
Latvia	114.68	2.10	49.38	0.90	33.21	0.61
Lithuania	118.56	3.19	75.42	2.03	51.74	1.39
Malta	79.88	0.32	5.62	0.02	16.11	0.06
Poland	102.67	36.15	159.24	56.07	165.50	58.27
Portugal	46.34	4.45	17.75	1.70	43.53	4.18
Romania	62.72	11.52	115.52	21.22	77.83	14.29
Slovenia	72.71	1.39	41.21	0.79	24.41	0.47
Slovak republic	131.71	6.62	67.85	3.41	41.49	2.09
Cyprus	38.99	0.42	0.71	0.01	0.00	0.00

Notes: The table provides both the observed and optimal ECF transfers per capita expressed in PPP $ 2011 prices. Then, the share allocated to each ECF recipient country expressed in % is indicated.

Poland beneficiates from large increases of its ECF transfers and becomes the main ECF recipient country with nearly 60% of the total optimal allocations, or about 20 to 22 percentage points more than the observed one. As well, Romania is better off in each optimal allocation: this country stands for more than 21% of the total allocation when $\alpha_i = 1$, 14% when $\alpha_i \neq 1$ while this figure is currently about 12%. In the two cases, both these countries concentrate the great majority of the ECF allocation.

Greece and Portugal see their transfers being sharply reduced when the demographic weight of recipient countries is not taken into account i.e $\alpha_i = 1$, they respectively lose more than 91% and 99% of their transfers. However, this result is not robust to a change in$\alpha_i \neq 1$, Greece even becomes a large beneficiary of the optimal allocation with an increase by 46% of its transfers, Portuguese transfers become close their observed level. As well, we observe a similar phenomenon for different values of σ, the estimations results are available in table 9 in the appendix.

The 11 remaining recipient countries see their ECF transfers be reduced. Some countries such as Cyprus, Estonia, Malta and Croatia even lose more than 90% of their funds in both optimal allocations. The decreases are however lower for Hungary, Lithuania, Bulgaria and Slovenia. How could be these results be interpreted? There are at least two arguments which may explain the optimal ECF allocation, and in particular why Poland and Romania take it all:

First, both are countries where the ECF has a strong marginal impact on GDP per capita,

Romania is second and Poland is seventh in our sample[16]. Indeed, in Poland, an increase by 1$ of the ECF transfers generates a rise of GDP/capita by 0.09$, this figure is about 0.18$ in Romania while the average value of the sample is around 0.03$.

On the contrary, in countries where an ECF increase reduces GDP per capita such as in Greece, Portugal or Cyprus, ECF transfers are sharply reduced. Those countries exhibit the worst ECF economic performances of our sample because of their high national debt levels: Greece has a skyrocking national debt representing nearly 180% of its GDP, Portugal is above the 120% threshold. However both these countries beneficiate more of $\alpha_i \neq 1$ because of their large demographic weights thanks to their 10 millions inhabitants, which is not the case of Cyprus. The increase may be stronger for Greece because σ is relatively high and Greece is poorer than Portugal: the Greek GDP per capita is about 68% of the EU's average one, the Portuguese one is close to 82%.

Then, GDP per capita is the second relevant argument to explain our results: Romania has the fourteenth GDP per capita of the sample, Poland is ninth. We recall that the donor's utility depends positively on recipient countries' GDP per capita. That is why the losers of our optimal allocation are among the wealthiest countries. For instance, despite one of the highest ECF economic efficiency, the Czech Republic loses about 60% to 70% of its funds because this country has the third GDP per capita of our sample. As well, the two wealthiest countries that are Cyprus and Malta see their transfers reduced by more than 99%.

Table 9 shows that the optimal allocation exhibits a low sensibility to a change in σ. Both cases of a donor very averse ($\sigma = 0.99$) and indifferent ($\sigma = 0.01$) to low GDP per capita levels are considered but the picture of the ECF optimal allocation changes marginally:

Poland keeps the lion's share with at least 50.4% of the total allocation when $\sigma = 0.01$ and $\alpha_i = 1$. In all the simulated optimal allocations, Romania is the second recipient country with a share estimated from 14.8% up to 18.9%, Hungary comes third with 6.7% to 13.4% of the total funds. These countries concentrate the great majority of the ECF funds, they stand for around 80% of the ECF optimal allocations.

For $\sigma = 0.01$ and $\sigma = 0.99$, both Greece and Portugal see their shares in the ECF optimal allocation increasing significantly when the demographic weight in the donor's utility function is itaken into account ($\alpha_i \neq 1$).

As the donor's aversion for recipient country's GDP/capita increases (σ risen from 0.01 to 0.99), most of wealthy countries such as the Czech Republic, the Slovak Republic and Slovenia see their share in the ECF optimal allocation being reduced. The two wealthiest ones that are Malta and Cyprus receive nearly no funds in both cases. On the contrary, poor countries such as Bulgaria and Romania see theirs increasing.

We recall that the aim of our optimal allocation is to increase the ECF's economic efficiency

[16]Data about ECF economic performance and relative GDP of recipient countries per capita is provided in Table 8 in the appendix.

in order to help the EU achieving economic convergence. The next subsection will compare the economic performances of both the observed and optimal allocations.

4.2 Effectiveness of the observed and optimal allocations

We compare the economic performances in terms of economic growth between the ECF observed allocation and the simulated optimal allocations with different values of σ and α_i. Table 6 indicates that GDP per capita increases more when $\alpha_i = 1$:

Table 6: GDP per capita changes expressed in $ with the observed and optimal ECF allocations.

			$\alpha_i \neq 1$			$\alpha_i = 1$	
Country	Observed	$\sigma = 0.01$	$\sigma = 0.7$	$\sigma = 0.99$	$\sigma = 0.01$	$\sigma = 0.7$	$\sigma = 0.99$
Bulgaria	14.47	8.05	13.09	13.97	4.18	4.93	3.30
Croatia	1.34	0.00	0.00	0.00	0.00	0.00	0.00
Czech republic	17.88	11.47	6.91	5.82	11.50	4.67	5.13
Estonia	8.87	0.02	0.00	0.01	0.02	0.00	0.00
Greece	-22.12	-0.14	-0.11	0.00	-28.19	-32.26	-25.75
Hungary	-1.73	-2.46	-1.26	-1.23	-1.35	-1.38	-1.33
Latvia	16.20	12.55	6.98	8.54	4.84	4.69	5.03
Lithuania	12.88	7.44	8.19	9.15	5.01	5.62	5.35
Malta	4.08	0.00	0.29	0.06	1.09	0.82	0.85
Poland	9.54	13.29	14.79	15.35	15.64	15.37	15.87
Portugal	-8.42	-0.15	-0.32	-3.67	-0.73	-0.79	-0.57
Romania	11.38	14.61	20.97	18.69	15.13	14.13	15.40
Slovenia	2.68	1.66	1.52	0.78	0.82	0.90	0.58
Slovak republic	17.78	21.63	9.16	10.45	6.26	5.60	5.92
Cyprus	-4.88	-0.19	-0.09	0.00	-0.03	0.00	-0.05
Average	6.34	8.83	9.66	9.26	6.20	5.02	5.93

Notes: The table provides the observed and optimal ECF allocation's GDP per capita changes expressed in PPP $ 2011 prices. Then, the ECF recipient countries' average change is computed in order to compare the economic performances of each allocation.

First and foremost, the increases of the Polish and Romanian GDPs per capita drive the ECF recipient countries' average one thanks to their high ECF efficiency and their important demographic weight[17]. On the contrary, Greece and Portugal drag the overall economic performance of the ECF recipient countries down due to the fact that the ECF has a negative impact on these countries' GDP per capita.

Consequently, the optimal allocations where the demographic weight of ECF recipient countries is introduced in the donor's utility function exhibit a lower economic performance: the optimal allocation with $\alpha_i \neq 1$ increases the average GDP per capita from 2% (when $\sigma = 0.99$) to 21% less (when $\sigma = 0.7$) than the observed allocation does. On the contrary, the optimal allocation where $\alpha_i = 1$ exhibits a much higher economic efficiency than the observed allocation: the average GDP/capita of ECF recipient countries is increased from 38% (when $\sigma = 0.01$) up to 50% more (when $\sigma = 0.7$). Reduced ECF transfers towards

[17]Poland and Romania respectively stand for 30.1% and 15.7% of the ECF recipient countries population.

countries having low economic performances such as Greece and Portugal mainly explains this result.

4.3 Discussion

Poland and Romania are the winners of our optimal allocations because they exhibit high ECF efficiency and relatively low GDP per capita. In the same time, economic efficiency is rewarded and economic fairness is not forgotten:
First, about the ECF's economic efficiency, it depends mostly negatively on public debt because of the homogeneity of inflation and human capital levels across ECF recipient countries. Both Poland and Romania respect the SGP criteria regarding public debt, the latter being at a level of 51.1% in Poland and 37.6% in Romania in 2015.
Secondly, about economic fairness, Poland and Romania are relatively poor regarding the EU and the remaining ECF recipient countries, their GDP per capita being respectively at 78% and 53% at the EU's average one. The wealthiest countries of our sample are the main losers of our optimal allocations: Malta and Cyprus see their transfers being nearly totally removed.
Third, some countries only have high ECF economic efficiency or low GDP per capita: Hungary exhibits a relatively low ECF economic efficiency and a relatively low GDP per capita. As a result, this country is the third ECF recipient country and keeps about 80% of its ECF transfers regarding the observed allocation. On the other hand, some countries like the Czech and Slovak republics are close to the 90% boundary regarding GDP per capita but both these countries are places where the ECF is efficient: this allows them to keep at least one third of their observed transfers in every simulated ECF optimal allocation.
Last, the weighting based on each recipient country's population should be discussed because of its negative impact on the economic performance of the ECF optimal allocation: when $\alpha_i \neq 1$ is taken into account, big countries such as Greece, Portugal and Hungary receive more ECF transfers. Because of their low ECF economic performances (see table 7 in the Appendix), the optimal ECF allocation exhibits a lower economic performance than the observed one. This feature does not appear when every recipient country has the same weight in the donor's utility function.

5 Conclusion

The European Cohesion Fund is an additional tool used by the EU to promote economic convergence between its member states. The ECF is targeted to the countries having a relative GDP per capita lower than 90% of the EU's average.
This study has dealt with the issue of the allocation of the ECF between recipient countries.

We have adopted a normative approach where an optimal allocation of the ECF is computed and compared to the observed allocation of the ECF during the period 2014-2020. To obtain this optimal allocation, we have solved an optimization problem where a purely altruistic donor has maximized the global welfare of ECF recipient countries, the latter depending on their GDP per capita. The optimal solution of this theoretical problem has been then empirically simulated thanks to the estimation results of a GDP per capita equation based on system GMM estimators using a database covering 17 countries for the period 1995-2015. We find that GDP per capita is positively affected by its own lagged value, the human capital level of economy, the amount of ECF received and by national debt with a non-linear pattern *à la Reihnart et Rogoff*. On the contrary, inflation, has an adverse effect on GDP per capita. Our results also confirmed that the ability of the ECF to stimulate GDP per capita is conditional to national debt, inflation and human capital. Recipient countries with low national debt levels are those where the ECF is the most efficient. The optimal ECF allocation gives more funds to Poland and Romania thanks to their high ECF efficiency and low GDP per capita levels. This result is robust to a change in the donor's aversion to recipient countries low GDP per capita σ and to the introduction of a ponderation based on each ECF recipient country's demographic weight in the donor's utility function. Poland and Romania stands for at least 65% of the total funds while this figure is about 48% with the observed ECF allocation.

About the economic efficiency of the ECF optimal allocation, results are mixed: when each country is treated equally in the donor's utility function, the ECF increases recipient countries' GDP per capita from 38% to 50% more than the observed allocation. However, when recipient countries are weighted in the donor's utility function regarding their population size, the economic performance of the ECF optimal allocation is about 2% to 21% lower than the observed one's.

Further extensions could be added to this study and particularly a new weightening in the donor's utility function. It is generally admitted that trade liberalization is achieved in the EU since the end of the 1980s. As a result, significant growth interdependencies have emerged as those between Germany and its Hinterland. Adopting a criterion able to integrate those trade linkages would have rewarded countries able to fasten the economic transition of their neighbours instead of countries having large population sizes.

References

Aghion, P. & Blanchard, O. J. (1994), 'On the speed of transition in central europe', *NBER Macroeconomics Annual* **9**, 283–320.

Arellano, M. & Bond, S. (1991), 'Some tests of specification for panel data: Monte carlo

evidence and an application to employment equations', *Review of Economic Studies* **58**(2), 277–297.

Bachtler, J. & McMaster, I. (2008), 'Eu cohesion policy and the role of the regions: Investigating the influence of structural funds in the new member states', *Environment and Planning C: Government and Policy* **26**(2), 398–427.

Barrios, S., Görg, H. & Strobl, E. (2005), 'Foreign direct investment, competition and industrial development in the host country', *European Economic Review* **49**(7), 1761–1784.

Becker, S. O. (2012), *EU Structural Funds: Do They Generate More Growth?*, The CAGE-Chatham House Series.

Becker, S. O., Egger, P. H. & Von Ehrlich, M. (2010), 'Going nuts: The effect of eu structural funds on regional performance', *Journal of Public Economics* **94**(9), 578–590.

Bevan, A. A. & Estrin, S. (2004), 'The determinants of foreign direct investment into european transition economies', *Journal of comparative economics* **32**(4), 775–787.

Blundell, R. & Bond, S. (1998), 'Initial conditions and moment restrictions in dynamic panel data models', *Journal of Econometrics* **87**(1), 115–143.

Burnside, C. & Dollar, D. (2004), 'Aid, policies, and growth: reply', *American Economic Review* **94**(3), 781–784.

Butkus, M. & Matezuviciute, K. (2016), 'Evaluation of eu cohesion policy impact on regional convergence. do culture differences matter?', *Economics and Culture* **13**(1).

Caselli, F., Esquivel, G. & Lefort, F. (1996), 'Reopening the convergence debate: a new look at cross-country growth empirics', *Journal of Economic Growth* **1**(3), 363–389.

Collier, P. & Dollar, D. (2002), 'Aid allocation and poverty reduction', *European Economic Review* **46**(8), 1475–1500.

Dawson, J. W. (2003), 'Causality in the freedom–growth relationship', *European Journal of Political Economy* **19**(3), 479–495.

De Melo, M., Denizer, C., Gelb, A. & Tenev, S. (2001), 'Circumstance and choice: The role of initial conditions and policies in transition economies', *World Bank Economic Review* **15**(1), 1–31.

Dell'Anno, R. & Villa, S. (2013), 'Growth in transition countries', *Economics of Transition* **21**(3), 381–417.

Ederveen, S., Groot, H. L. & Nahuis, R. (2006), 'Fertile soil for structural funds? a panel data analysis of the conditional effectiveness of european cohesion policy', *Kyklos* **59**(1), 17–42.

Goldsmith, A. A. (1995), 'Democracy, property rights and economic growth', *Journal of Development Studies* **32**(2), 157–174.

Guillaumont, P., Nguyen-Van, P., Pham, T. K. C. & Wagner, L. (2015), An efficient and fair allocation of aid.

Huliaras, A. & Petropoulos, S. (2016), 'European money in greece: In search of the real impact of eu structural funds', *Journal of Common Market Studies* **54**(6), 1332–1349.

Hulten, C. R. & Schwab, R. M. (1997), 'A fiscal federalism approach to infrastructure policy', *Regional Science and Urban Economics* **27**(2), 139–159.

Islam, N. (1995), 'Growth empirics: a panel data approach', *Quarterly Journal of Economics* **110**(4), 1127–1170.

McGillivray, M. & Pham, T. K. C. (2017), 'Reforming performance-based aid allocation practice', *World Development* **90**, 1–5.

Mendez, C., Bachtler, J. & Granqvist, K. (2013), 'European commission perspectives on the 2014-2020 partnership agreements and programmes: A comparative review of the commission's position papers', *European Policy Research Paper* (84), 1–9.

Menil, G. d. (2003), 'History, policy and performance in two transition countries–poland and romania,[w:] rodrik d', *Search of Prosperity. Analytic Narratives on Economic Growth, Princeton University Press, Princeton* .

Pitek, D., Szarzec, K. & Pilc, M. (2013), 'Economic freedom, democracy and economic growth: a causal investigation in transition countries', *Post-Communist Economies* **25(3)**, 267–288.

Reinhart, C. M. & Rogoff, K. S. (2010), Growth in a time of debt, Technical report, National Bureau of Economic Research.

Roodman, D. (2009), 'How to do xtabond2: An introduction to difference and system gmm in stata. stata journal, 9 (1), 86-136', *FOR ONLINE PUBLICATION* .

Surubaru, N.-C. (2017), 'Administrative capacity or quality of political governance? eu cohesion policy in the new europe, 2007–13', *Regional Studies* **51**(6), 844–856.

Tomova, M., Rezessy, A., Lenkowski, A., Maincent, E. et al. (2013), Eu governance and eu funds-testing the effectiveness of eu funds in a sound macroeconomic framework, Technical report, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

6 Appendix

Table 7: Estimated ECF recipient countries' economic performance and relative GDP per capita.

	GDP per capita change ($)	Relative GDP per capita to the EU's average (%)
Bulgaria	0.2714	53
Croatia	0.0131	64.5
Czech republic	0.1793	94.8
Estonia	0.051	85.3
Greece	-0.4394	75.2
Hungary	-0.0168	77.5
Latvia	0.1413	72
Lithuania	0.1086	83.6
Malta	0.0511	102.1
Poland	0.0929	79
Portugal	-0.1816	82.7
Romania	0.1815	63.9
Slovenia	0.0368	90.8
Slovak republic	0.135	88.1
Cyprus	-0.1251	95.5

Notes: The first column provides the GDP per capita's change expressed in PPP $ 2011 prices following the increase by 1$ of the ECF transfers' increase. The second one indicates each ECF recipient country's relative GDP per capita regarding the EU's average one.

Table 8: Optimal allocations of the ECF with changes in σ and α_i (%).

				σ=0.01				σ=0.99		
	Observed		α_i=1		$\alpha_i \neq 1$		$\alpha_i = 1$		$\alpha_i \neq 1$	
Country	ECF/cap	%	ECF/cap	%	ECF/cap	%	ECF/cap	%	ECF/cap	%
Bulgaria	53.32	3.55	29.66	1.97	15.39	1.02	51.47	3.42	12.16	0.81
Croatia	102.38	3.99	0.00	0.00	0.16	0.01	0.01	0.00	0.08	0.01
Czech republic	99.70	9.75	63.99	6.26	64.16	6.27	32.47	3.17	28.59	2.8
Estonia	173.95	2.12	0.42	0.01	0.36	0.01	0.16	0.00	0.00	0.00
Greece	50.33	5.05	0.31	0.03	64.16	6.44	0.00	0.00	58.59	5.88
Hungary	102.9	9.39	146.57	13.37	80.26	7.32	73.30	6.69	79.23	7.23
Latvia	114.68	2.10	88.83	1.63	34.29	0.63	60.4	1.11	35.58	0.65
Lithuania	118.56	3.19	68.52	1.84	46.17	1.24	84.22	2.27	49.29	1.33
Malta	79.88	0.32	0.03	0.00	21.30	0.09	1.24	0.01	16.63	0.07
Poland	102.67	36.15	143.09	50.38	168.39	59.29	165.23	58.18	170.87	60.16
Portugal	46.34	4.45	8.18	0.79	39.95	3.84	20.23	1.94	31.18	2.99
Romania	62.72	11.52	80.50	14.77	83.33	15.31	103.00	18.92	84.85	15.58
Slovenia	72.71	1.39	45.19	0.86	22.41	0.43	21.15	0.40	15.66	0.3
Slovak republic	131.71	6.62	160.21	8.05	46.37	2.33	77.38	3.89	43.85	2.2
Cyprus	38.99	0.42	1.51	0.02	0.27	0.01	0.00	0.00	0.41	0.01

Notes: The table provides the share expressed in % of each recipient country in every optimal ECF allocation for different values of σ.